

Proceedings of

# **THE 2nd INTERNATIONAL CONFERENCE OF HYOJEONG ACADEMY 2023**

DATE: 31(Thu), Aug - 2(Sat), Sep 2023  
VENUE: Sun Moon University, Korea



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The hyojeong academic foundation cordially invites you to the

# 2<sup>nd</sup> ICHJA & 20<sup>st</sup> ICUMS

Towards the World of Co-Existence Co-Prosperity and Co-Righteousness

## About the Event:

The joint conference of 2nd International Conference of Hyojeong Academy and 20<sup>th</sup> International Conference for Unification Medical Science aims to serve as a global platform where researchers and scholars of various disciplines can contribute ideas for our sustainable global community of Co-existence, Co-prosperity, and Co-righteousness. This conference will not only be avenue for exchange of ideas and collaboration among scholars of today but also one to foster the next generation of scholars concerned with our global community. At this academic conference, we will have both oral and poster presentations dealing with religion, science and technology, unification medicine, the environment, and more. This joint International Conference is scheduled for August-September 2023 (see the tentative schedule below).

## Date and Venue:

- DATE: Aug 29(Thu) - Sep 2(Sat),2023
- Venue: Sun Moon University in Asan & HJ Magnolia Hospital in Cheongpyung (A hybrid conference)

## Organized By:

- Hyojeong Academic Foundation
- Unification Thought Institute International

## Co-Organized by:

- Future automobile research group
- Unification Theology research group
- Unification movement as a social movement
- Restoration mechanism research group
- East Africa research group
- African diaspora research group
- Bio big data smart clean research group
- Unification Medical Science Center

Detail Schedule will be posted in [www.ichja.org](http://www.ichja.org)

DAY 1 - 31 (Thu) Aug	DAY2 - 1 (Fri) Sep	DAY 3 - 2 (Sat) Sep
<ul style="list-style-type: none"><li>- Registration &lt;Asan&gt;</li><li>- Opening (10:00 AM)</li><li>- Unification Thought Ceremony</li></ul>	<ul style="list-style-type: none"><li>- Session 3-5</li><li>- Workshop: how to write a good academic paper?</li><li>- Plenary Talks</li></ul>	Closing& Unification Medical Science Workshop  <Asan & Cheongpyung>
<ul style="list-style-type: none"><li>- Poster session</li><li>- Keynote 1,2</li><li>- Session1-2</li></ul>	<ul style="list-style-type: none"><li>- Poster session</li><li>- Session 6-10 &lt;Asan&gt;</li></ul>	

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## Hosted by

- Cheongshim Academy • Sun Moon University • Sunhak Academy • SunHak Universal Peace Graduate University
- UPF(IAAP) • Professors World Peace Academy • Hyojeong Magnolia Medical Foundation • Hyojeong Academic Foundation



Conference Chairs: T. Hiroi(Brown), CH Han(UTRI), K. Aoki(TMDU), Y. Watanabe (Isshin), J. H. Kim (HJM Medical center)





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# Welcome Address

Distinguished scholars and scientists, honored guests, ladies and gentlemen!

It gives me distinct pleasure to greet you here today in our second year after the inauguration of the new Journal of Hyojeong Academia. The first Academy was founded by Plato some 2,400 years ago, setting the tone for the first true philosophy. No other allegory has influenced intellectual history like Plato's Allegory of the Cave, in which we find in concise terms the overall process of epistemological realization, namely cognition, so important in science.

We may state that "science" and "scholarship" have undergone a great circle during these two-and-a-half millennia, to now finally return to the original spirit, purpose, and methodology of the Founder. Socrates and Plato stood up to the Sophists of the time, who neglected universal truth, favoring instead practical, convenient, popular relative truths. In a similar way, nowadays, if we posit Absolute Values in science today, we are confronted by pervasive moral relativity.

Where does truth come from? Is it to be discerned by observing objects and events in the transient world of phenomena? That approach is what we call empirical science, in which the laws governing physical objects and their relations are derived by inductive methods.

Plato is famous for his "Allegory of the Cave", with the "ascending path" whereby the confined prisoner escapes the dark cave with shadow images, comparable to our ubiquitous computer screens that depict reality conveniently for our entertainment and education. The process of ascent to the truth is the inductive process from particular things to universals and from universals to the highest universals. As he emerges, the enlightened captive first notices the world of brilliant colors and animated creatures he had never imagined. This new realm corresponds to the spiritual world or realm of universals. Finally he looks up and sees the sun for the first time. The sun symbolizes the highest universal, the Idea of the Good, the Ultimate Reality, namely God.

In the process of induction, the path of ascent, we observe and experience sensory reality in the phenomenal world, then assemble it into universal concepts in the World of Idea. Then the third stage is realizing the existence of the ultimate universal, the Idea of the Good. Realizing this great truth, our prisoner returns to inform his fellow inmates of a dreamlike world they never suspected. This descent to the truth is called deduction, proceeding from the highest universals to the general universals to individual or particular things. This Allegory of the Cave has remained a teaching tool for more than two thousand years.

Unification Thought unites the sciences and disciplines by applying unification methodology. We acknowledge the unique methodological characteristics of each branch of science and philosophy, aiming at uniting and synthesizing these, while enhancing mutual understanding among the various methodologies. Empiricism emphasizes inductive logic while rationalism applies deductive logic—but unification methodology balances these two in harmony. Unification Thought sees God as the Original Image, the Idea of the Good, or the ultimate Universal. The Structure of the Original Image is reflected in

all entities, creatures, and human beings. Through the created nature we can come to know the ultimate reality and character of the Creator.

The Theory of Original Image in Unification Thought is a hypothetical-deductive system and is at the heart of Hyojeong Academia. Hypothetical postulates need to be verified through experiential facts in order to stand as the truth. By balancing and harmonizing the conflicting views, Hyojeong Academia stands in a position to mediate opposing parties in various scholarly fields and elevate the dialogue to a higher level of understanding for the good of all. Our world is indeed sorely in need of a new vision. This may be seen as the task of Hyojeong Academia and the great journal you are undertaking.

Congratulations! I wish you success on your endeavor! Thank you.

A handwritten signature in black ink, reading "Jin Sung Bae" in a cursive style, followed by a long horizontal flourish.

Dr. Jin Sung-Bae,  
Chair of Hyojeong Academic Foundation



# Greetings

Distinguished Scholars, Scientists, Ladies and Gentlemen:

On behalf of Sunhak Educational Foundation, I am very pleased to welcome you to the 2nd International Conference of Hyojeong Academy and the 20th International Conference for the Unification Medical Science.

As I understand, this is the first joint International Conference between two organizations, and the common underlying theme of God-centered perspectives, unification of religion and sciences, Co-existence, Co-Prosperity, and Co-righteousness reminds me of the International Conference on the Unity of the Sciences (ICUS), which the Reverend Dr. Sun Myung Moon and Dr. Hak Ja Moon founded almost 50 years ago.

I hope that you will honor the monumental tradition of ICUS and that the outcome of this joint Conference become a proud addition to the ICUS series.

I believe that, in this troubled world, we have to strive for Co-existence, Co-Prosperity, and Co-righteousness more than ever before, and I am hopeful that the participants in this conference together will make meaningful contributions toward such goals.

Finally, I wish that all of you have inspiring and productive meeting for the next three days. May God bless you and your families!

Thank you.

A handwritten signature in black ink, reading "Yeon Ah Moon" followed by a stylized flourish.

Dr. Yeon Ah Moon  
Chair of Sunhak Educational Foundation



# The Needs for Religion to be Scientific and for Science to be Free from Politics

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**Abstract:** Religions have traditionally been free from proving their credibility based on evidences and logics employed in science. However, as today's science has highly developed to deal with mysterious existences such as dark energy along with technological development allowing artificial intelligence and cloning, religions cannot ignore their discoveries and capabilities that may infiltrate the religious territory. Religions can be interpreted as the pursuit of the spiritual truth that includes the purpose of life and the cosmos. In this respect, religions are expected to base on facts and utilize scientific methods. Examples of scientific revolutions and how religions interfered with them can be good guidance for humanity to pursue such reformation of religions, which can allow unity between science and religion. On the other hand, today's science often tend to be influenced by politics in pursuit of funding from governments supported by tax payers who can be influenced by biased media. For science to perform its role, it has to stand firmly on scientific methods with no human bias. While Unificationism has been attempting to unify science and religion, its teaching materials may need to be updated according to today's scientific and historical facts and also be free from any internal politics.

**Keywords:** religion, science, politics, Unificationism, history, environment

## 1. Introduction

Major religions such as Christianity have experienced reformations in the past in order to satisfy their people's desire to understand the spirit world and God's creation as the whole. However, religions are still not totally based on scientific methods employing facts and logics to which people are familiar today. Instead, religions still demand people to believe their teachings coming from top down. On the other hand, today's science and technology have so highly developed that traditional teachings and methods of religions are challenged more to make peace with those new findings such as dark energy and dark matter and capabilities such as quantum computing, artificial intelligence, genetic engineering, and cloning. Religions which are based on old facts and traditional teachings may have to update them and employ scientific methods in order to guide people of today. Science itself may be often influenced by politics through biased people or media. Today's environmental issues are a good example to examine how science and politics are influencing each other. In this paper, the need for religion to be scientific and the need for science to be free from politics are described with examples of Christianity, Unificationism, and environmental science.

## 2. Scientific Method

Science is widely trusted by people mainly because of its methodology. Science collects facts through observations and experiments to discover hidden laws which can explain them. Scientists hit on certain hypotheses partially employing their intuition which may explain those facts, test the hypotheses through more observations and experiments, modify the hypotheses if the test results are not satisfactory, and repeat the process until they reach the ultimate, self-consistent answer. In that process, scientists need to follow a set of rules in order to reach the correct answer. Some of them are listed in this section.

### 2.1. Objectiveness and Repeatability

Any observations or experiments involving a human being can be biased by the person whether intended or not. Scientists should try to be as objective and unbiased as possible so that others can repeat the same observations or experiments to obtain the same facts. Only based on such reliable facts, true cause or law behind them can be

discovered. In that respect, scientific papers must contain sufficient information in order to allow others to reproduce the same process. There are retracted papers even in the top-level scientific journals after other scientists failed to reproduce the same results.

## 2.2. Occam's Razor

There are cases where more than one set of laws can explain the same facts. In that case, science prefers to adopt the simplest explanation or laws among them. This is according to a problem-solving principle called "Occam's razor" which recommends searching for explanations constructed with the smallest possible set of elements [1]. It advocates that when presented with competing hypotheses about the same prediction, one should prefer the one that requires the fewest assumptions.

## 3. Examples of Religion or Ideology Interfering with Science

History records some major cases where religion or ideology blocked the advancement of science by persecuting scientists or people who are open to scientific approach. Shed light in this paper are two such cases in astronomy and biology.

### 3.1. Geocentrism vs. Heliocentrism

Claudius Ptolemy (100-170 AD) summarized the Greek geocentrism [2] into a model of celestial bodies and had been popularly accepted in the Islamic and Catholic worlds until the Renaissance scientific revolution. Although the opposing heliocentrism had already been proposed by Philolaus of Croton in as early as the 4th century BC [3], it did not become popular until a mathematical model was proposed by Nicolaus Copernicus in 1543, elliptical orbits were introduced by Johannes Kepler, and observational evidences were presented by Galileo Galilei [3].

In spite of its simpler and beautiful modeling of the orbits of celestial bodies than the geocentrism, the heliocentrism was not readily accepted by the Roman Catholic Church based on its doctrine, even condemning Galileo in 1633 [4]. The church authority probably could not fathom the secrets of God's creation beyond their literal interpretation of the biblical teachings.

### 3.2. Darwinism vs. Theory of Intelligent Design

Darwinism is a theory of biological evolution developed by the English naturalist Charles Darwin (1809–1882) and others, stating that all species of organisms arise and develop through the natural selection of small, inherited variations that increase the individual's ability to compete, survive, and reproduce [5]. As no one has succeeded to observe or reproduce an evolution from one species to another, Darwinian view of evolution has been merely a speculation without any scientific proof that such chance events really allowed primitive single-cell lifeforms to evolve to complex lifeforms such as humankind.

On the other hand, the theory of intelligent design [6] assumes a preexisting design that allowed evolution to occur without chance effects. It is a simple explanation for the observed phenomena of evolution of species without relying on the low probability of mutations to occur in a limited direction to allow life to evolve. However, the theory of intelligent design is often opposed or regarded as pseudoscience because of its religious nature suggesting the Creator.

This is a case where an atheistic belief (Darwinism) is preventing a healthy scientific view (intelligent design theory) from being introduced to science. This is no different from the case where the Catholic authorities who are blind of deeper meanings of their teachings condemned the heliocentrism because the Darwinists who are blind of the invisible world are condemning the intelligent design theory.

## 4. Examples of Politics Interfering with Science

Because science is performed by scientists who often need financial support from governments, science could be biased by politics. Listed as such examples are science and technology of climate change due to biased government funding, Covid-19 vaccines biased for profiting pharmaceutical companies, and statistical proof of the 2020 US general election frauds sanctioned by biased media and government. A representative example, science of climate change, is described below.

### 4.1. What is Wrong with Higher Temperature and CO<sub>2</sub> Level?



Climate change of the Earth is mainly based on planetary phenomena such as solar activities, Sun-Earth orbital configuration, Earth's spin axis orientation, internal heat generation and distribution, atmospheric composition, etc. As a result, over the last 50 million years of the Earth history, both the atmospheric CO<sub>2</sub> level and temperature kept decreasing until about 20 thousand years ago when mankind likely emerged as shown in Figure 1 [7,8]. Partially thanks to CO<sub>2</sub> emission by mankind burning wood, coal, and oil, CO<sub>2</sub> level and temperature increased, but they are nowhere close to the past peak levels 50-500 million years ago.

For animals on Earth to survive and prosper, plants are indispensable as food supply. Because plants cannot efficiently perform photosynthesis at lower CO<sub>2</sub> level or temperature, plants and thus animals die if the past trend until 20 thousand years ago had continued. In fact, when those levels were at the highest during the Cambrian Period 500 million years ago, many species of life evolved and flourished [9]. Therefore, higher temperature and CO<sub>2</sub> level are not the problem.

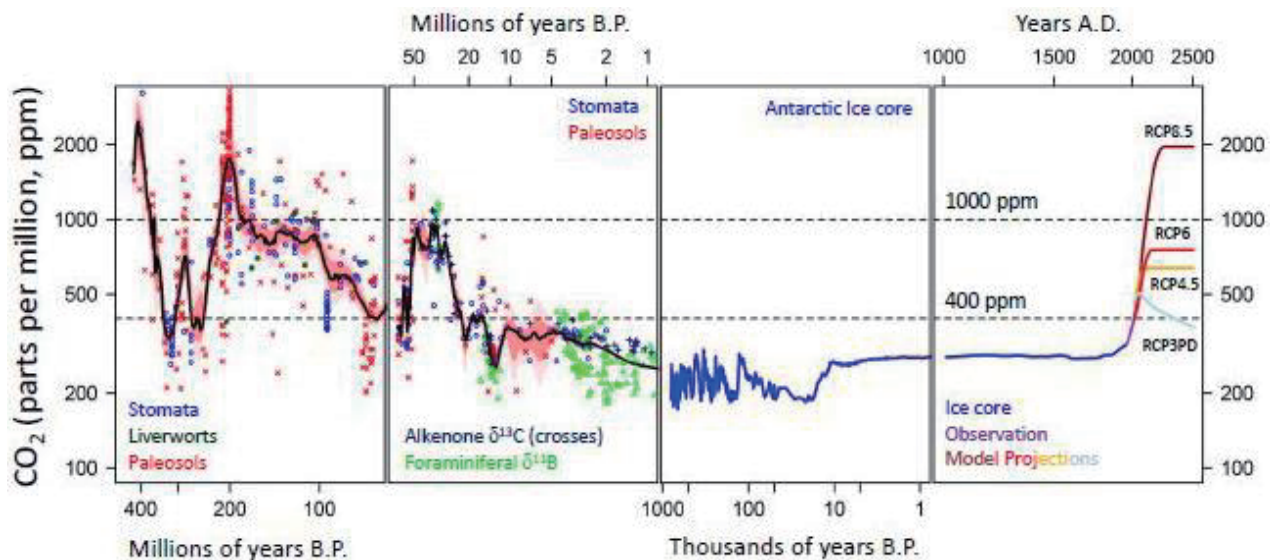


Figure 1. Past and future CO<sub>2</sub> [7].

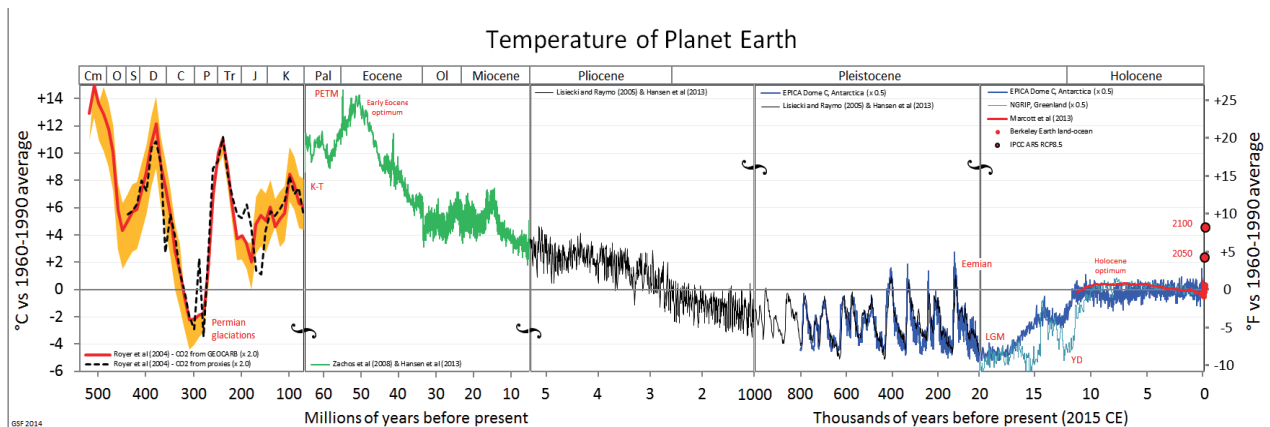
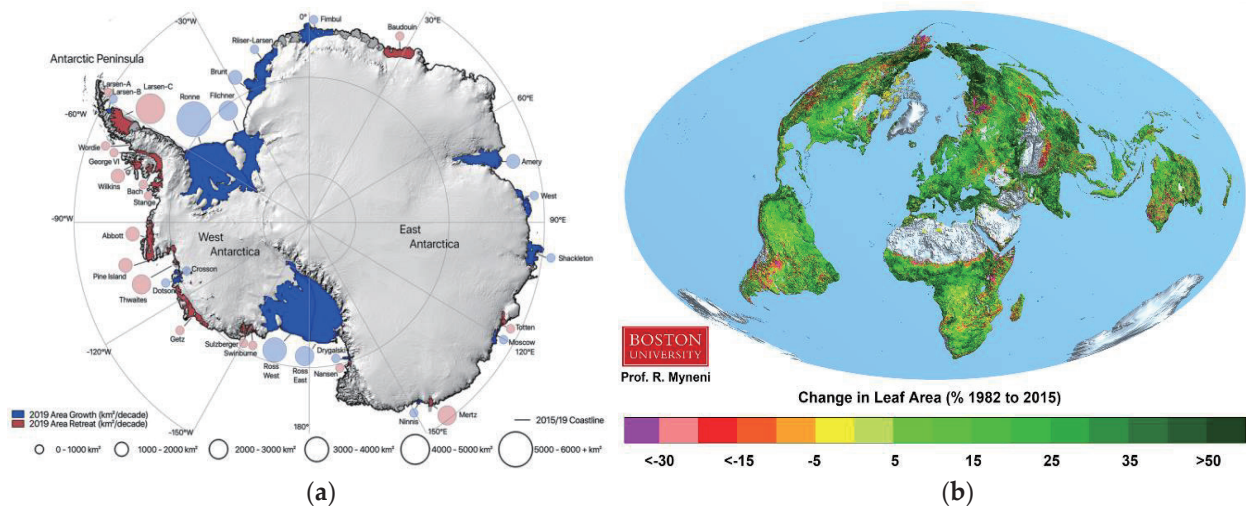


Figure 2. Global average temperature estimates for the last 540 million years [8].

#### 4.2. Increasing Antarctic Ice and Global Vegetation Rate

Although biased media often show melting ice and worsening environment, as shown in Figure 3, Antarctic ice has increased over the last ten years [10], and the global vegetation rate increased over the last decades [11]. Most of the surface area of Antarctica is at blow freezing temperature, when temperature rises, water vapor increases, and thus snow and ice precipitation onto Antarctica increases. Antarctica is functioning as a natural ice reservoir in this manner. The global vegetation (leaf area) naturally increased according to the increases in CO<sub>2</sub> level and temperature as explained earlier.



**Figure 3.** (a) Antarctic map of ice shelf area change from 2009 to 2019 [10], (b) the change in leaf area across the globe from 1982-2015 [11].

## 5. Summary and Discussion

Science can be the most trustable method to pursue the truth in both physical and spiritual worlds and beyond. Religions today need to be more scientific to attract people and answer to their demands. In addition, both religion and science should be free from politics which can usually bias their pure pursuit. Unificationism [12] claims to unify science and religions in a higher level with the new truth. For that purpose, the Unification movement itself needs to update its teachings [13] with the current knowledge of scientific and historical facts and become free from its internal politics.

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**Conflicts of Interest:** The authors declare no conflict of interest.

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# Spiritual laws we can learn studying physical Universe

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**Abstract:** Several most obvious physical principles are regarded in this paper as a textbook to learn about spiritual reality. Three of these laws which are respectively the most fundamental, the most important and the most needed now to my understanding are addressed and 3 spiritual principles: Giving is prior to receiving, Life for higher purpose and Keeping purity (chastity before marriage and fidelity in marriage) are introduced to be natural expressions of well-known physical laws.

**Keywords:** spiritual and physical laws, one Creator

## 1. Introduction

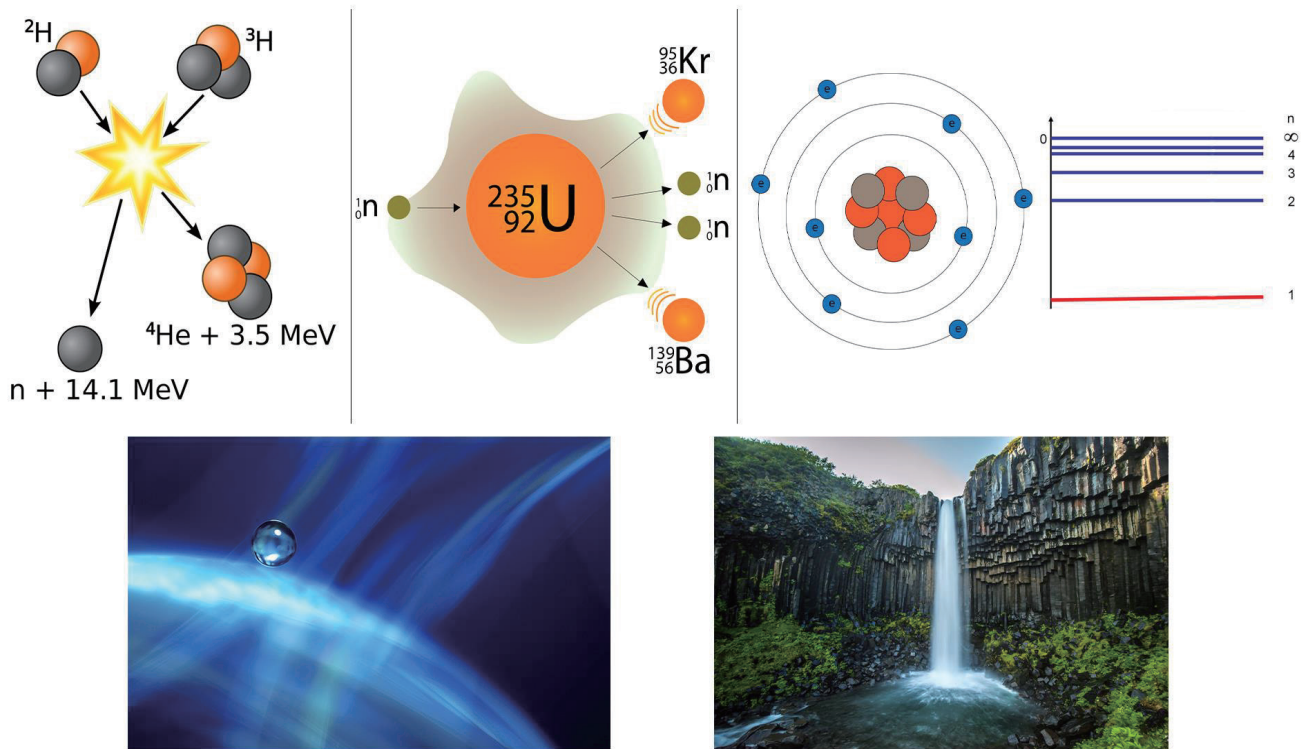
One of the most important questions, that bothers human mind throughout the whole history, concerns spiritual reality. Are there spiritual laws, and if so, what are they? What is the way we can figure it out. So called scientific method which we use to explore physical Universe does not apply here for we don't have any means to directly quantitatively interact with the object of the research - the spiritual reality, which is essential for this method. All we see is success and failures in human lives, being ignorant of true reasons for it. So, ages pass but the question still remains.

One way to resolve this question lies under assumption that both physical and spiritual realities were created by the same Creator which sounds quite logical based on the Occam's razor principle. In this case both of the realities reflect nature of the same Creator. Studying the physical Universe, we come to understand that it is not chaotic and even if it seems like this in some areas, now we know that its every part is following some strict laws which we just might not completely understand yet. This shows us that physical reality can be understood, so our scientific efforts are not in vain. But it also allows us to assume that spiritual reality should be based on strict laws as well and its main laws should have a lot in common with main physical laws, allowing us to understand spiritual laws based on the analysis of physical ones.

Historically it happened so that it were religious people who were studying spiritual reality, so, it might seem, that the best way to understand spiritual laws is through religions. It may be true but only to some extent. All the main religions started with the appearance of a special person – it's founder, who had a special spiritual path, reviled and practiced some spiritual laws and passed it on to his disciples through his example and scriptures. Usually, first disciples, who witnessed the founder and practiced these laws with him, inherit them well, but, as religion develops and its organizational structure grows, its priests and believers become more and more intellectual understanders then heartistic practitioners of its truth. In other words, reviled and understood to some extent by founders these laws get refracted through the imperfect human nature of the followers and twisted by interpretations thus becoming quite different from the origin. Some very colorful examples are Christian countries enslaving African people and selfishly colonizing other countries, terrorism done by people calling themselves devoted Muslims, homosexual Christian priests or marriages of humans and animals, plants, themselves and even things like Eiffel Tower in Christian countries.

On the other hand, our physical Universe suffers neither of these effects and its laws are as original as possible. So, if we assume, that both physical and spiritual realities are created by the same Creator and so they both reflect one and same nature [1], we can learn something about this nature through physical reality and extend this understanding to the spiritual one. To my understanding there is a main law to both realities which reflects the main nature of the Creator and governs all the other laws and in this paper I discuss it together with as I think the most important for today's humanity consequent law.

## 2. Methods



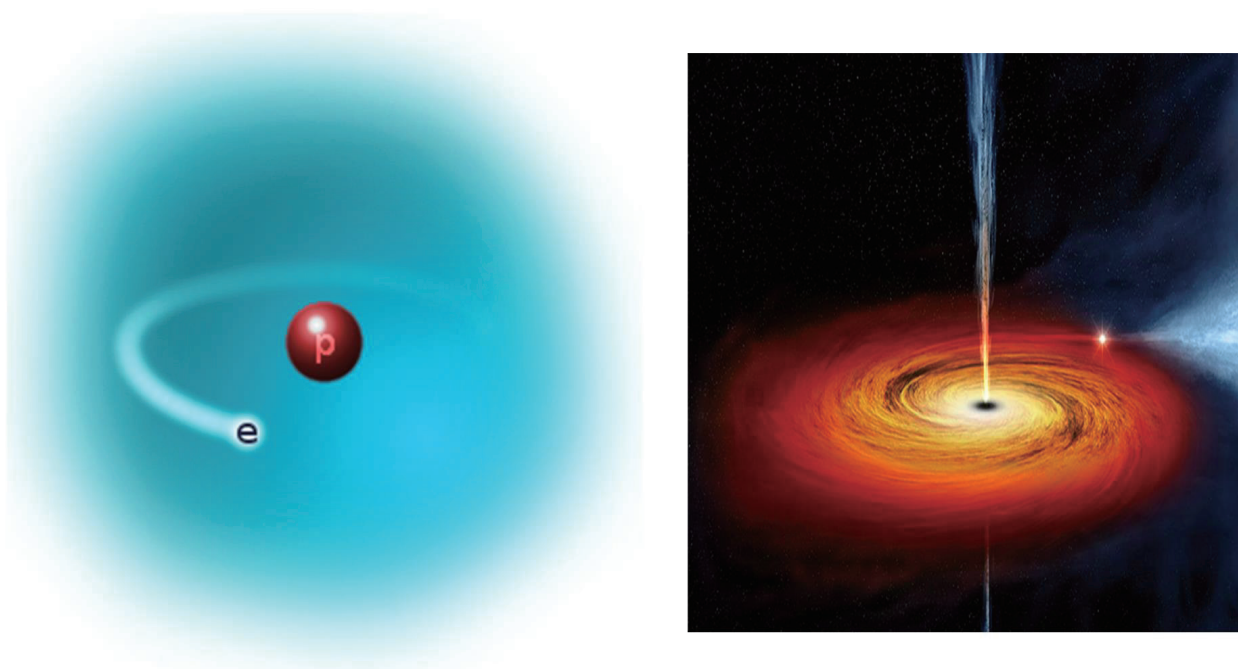
**Figure 1.** Every entity in the Universe tends to occupy a lowest energy state possible.

It is important to mention here, that most of the knowledge we have about our Universe is acquired through the so-called scientific method. In other words, we do not know what is Universe and how it is organized so we make models, test it through experiments, correct it accordingly and once the model satisfactorily describes the reality put our faith into it and say: "That's how the things work!". And many times, it happened that in a few decades a new researcher would come up with a new better model, that included the previous one as a particular case. Obviously, this model-based description of the

Universe is not complete and so we cannot blindly state that all our physical laws truly reflect the reality. Moreover, some of the laws are not universal because they are based on particular features of the physical world. For example, a well-known energy conservation law is nothing but a straight consequence of time homogeneity, impetus conservation law is due to space homogeneity, angular momentum conservation law is due to space isotropy [2] etc. So, these laws are based on the existence of space and time, which only exist due to matter being an integral part of physical world. In other words, all the mentioned and many other laws are particular cases for physical world and cannot be regarded as universal.

And here we recall an interdisciplinary lowest energy principle - all entities in the Universe including Universe itself tend to occupy a lowest possible energy state (Fig. 1). For example, all the low mass elements tend to join together and all the high mass ones tend to decay to become Fe, for it has a highest binding energy possible corresponding to the minimum energy state. All the electrons in atom tend to occupy lowest energy levels. Being fermions, they cannot occupy one same level, so they fill all the lowest levels possible - this corresponding to the atom ground state. All the nuclear and chemical spontaneous reactions proceed in the direction of the system occupying a lower energy state. A volume of water tends to take a spherical shape once in weightlessness - all because such a shape corresponds to a lower energy in comparison with other shapes. A drop of water during the rain will not stop until it reaches the lowest available deepening. Gravitation forces gas particles, dust grains, stars and galaxies to get rid of extra angular momentum and join together to occupy a lower energy state. All the Universe was born, evolved and breathes based on this universal principle.





**Figure 2.** To occupy a lower energy state any simple particle will bind itself with others to create a higher complexity entity.

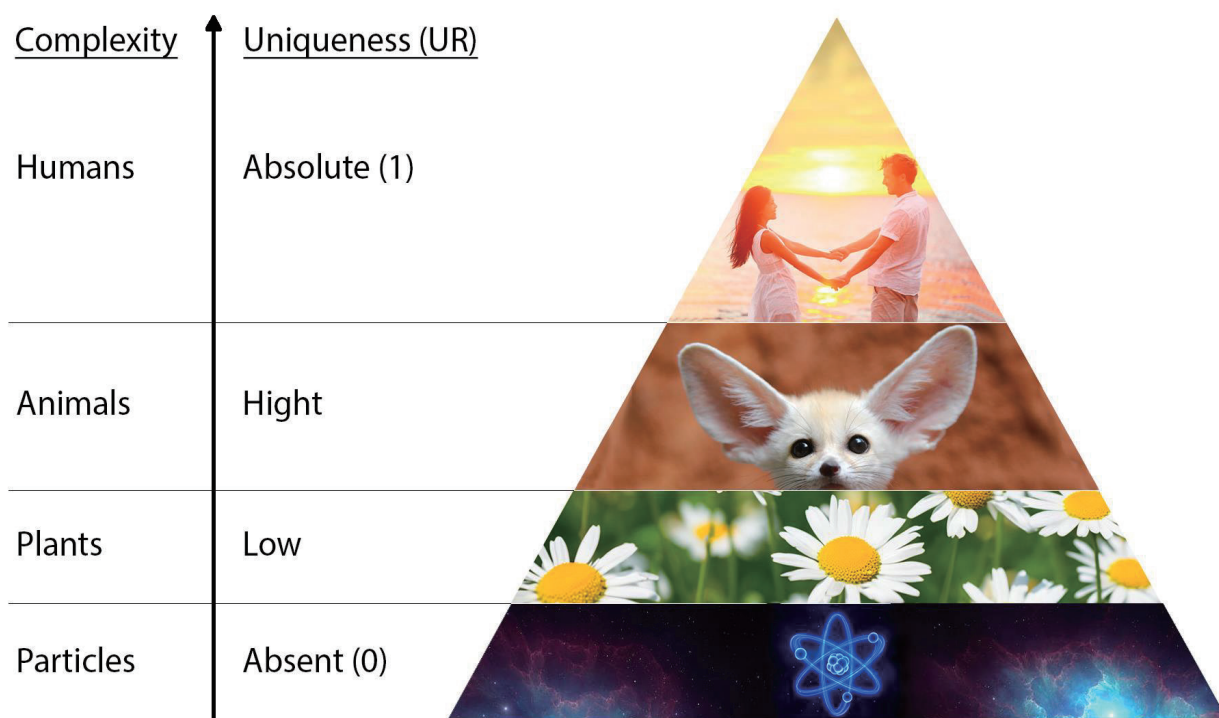
### 3. Results

So, what can we learn from this universal principle? Everything is seeking to occupy a lower energy level, but how does it have to act then to do so? Give its energy away, of course! So, particles don't hunt to receive energy rather wise versa they strive to give it away! And Universe goes on to teach us how it is possible - simple particles join together to form something greater, something more complicated to do so (Fig. 2). Of course, all things act this way not based on its motivation, they simply follow laws, but, if we regard Universe as a textbook to learn from, how could this be read? It's simple, the living paradigm behind the Universe is: "I want to become a part of something greater than I am and for this I'm giving out my energy". Does not it sound familiar? Do not all the religions inspire us to give to others and live for the greater good? These are, as I think, the most fundamental and following from it the most important principles behind our Universe.

One cannot construct a harmonious system based on units that prior receiving over giving. If something consumes more then it produces it has no way to form a system capable of development. Anything that puts its own sake over the whole is doomed to parish. If we take an example of a living sell, we can see it clearly. A sell has its own built-in "desires" - eat, grow and multiply. As a part of an organism, it has public goal - follow the guidance of the brain on what to do, when to eat and to multiply. Once the sell gets sick it stops receiving commands from the brain and starts acting based on it' own goals, ignoring the public sake. So, it starts to eat and multiply continuously. We call such sells cancer. It kills the organism so destroying itself. This simple example is very illustrative. It seems like behind all disharmonies we see in different systems lays violation of this simple principle. And again, behind all the harmony of living and non-living Universe lays the ability to put public goal priority higher than the personal one. In deed this seems to be the main law of the Universe. So, all the other laws reflect and extend it.

In this paper I would like to draw your attention to one of such laws, which is, to my understanding, is most needed now a days for our society. One could call it the "Law of Uniqueness". Let us consider a quantity we will call Uniqueness in Relationships (URE[0;1]) and let us qualitatively follow its value through several discrete levels of complexity of entities in our Universe from simple to most complex ones (Fig. 3).

If we regard particles like protons and electrons, we can easily see, that the value of the UR parameter is practically zero for them. Any proton will interact with any electron nearby to form an H atom if possible. If it would "want" to interact only with that electron on the other side of the Galaxy, atom would never be formed, it



**Figure 3.** Illustration of the “Uniqueness in Relationships” law.

would never become a part of a molecule and so on - nothing greater and more complex could have been born. So, due to the law of living for the sake of greater good, particles have to “sacrifice their desire and freedom” of unique relationships completely. Indeed, nature is put together the way that determines such relationships - all the particles of the same type are completely same with no uniqueness at all. Moreover, any electrically charged particle will interact electromagnetically with any other electrically charged particle regardless of its type or even sets of particles such as charged bodies.

Let’s go a couple steps higher in the complexness hierarchy of entities and look at plants. Here we clearly see that UR is growing as a function of complexity. Indeed, any given chamomile will pollinate any other nearby. It cannot say “I will only pollinate that one on the other continent”, because it means that no new chamomiles will ever appear and bees and other insects and animals that feed on it and use it as shelter will suffer, which is so prohibited by the more fundamental principle - law of living for the greater good. Moreover, it is possible to cross different spices like apple and birch trees but plants of different genera already cannot be crossed and of course you cannot cross a flower and a stone, or a tree and an animal. So, we see that on this level of complexity fruitful relationships require higher level of UR.

If we go a step higher to the animal kingdom, UR grows even more. All horses from a given herd may have fruitful offsprings with each other or even horses from other herd but the same spices and it is due to the necessity of many horses for their eco-system including wolves, bears etc. But if you mix a horse and, say, such an alike spices from the same genera as zebra, you get a zebroid incapable of reproducing. All the more impossible is inter-genera crossing, which is prohibited for the sake of stability of greater eco-system that may be destroyed by genetically defective results.

The most complex entity we know in the Universe is a human being. How high does the principle of living for a greater good leads the UR parameter at this level? I state that it is unity. In other words, the uniqueness of relationships between man and woman is absolute. Why so? Let us see. Physically it is possible for us to act like animals and have relationships and children with many other people, although people only in our case - only same species. And at first glance it looks normal. But let us look deeper. What is the biggest desire of any human being? Our bodies seek food, sex and comfort, yet we are ready to sacrifice all of this for the sake of one thing - we all want to be happy [1]. And the way to it is simple - we all want to get love in any of its flavors. If you ask anyone of how much love does he or she want, the answer would be - limitless! Love is not a physical quantity so it’s not possible to apply mathematics for quantitative analysis - it’s a particular feature of spiritual reality. We



want as much love as there exists, monopolize it if possible! We are never tired of it and want to get more and more of it. And, unlike food, we can digest any amount of love! Some people strive to get money or power, but, unless it is used for the sake of someone it brings only temporal joy. Happiness and love imply relationships with other people.

We know of 4 types of relationships: with children, with friends and siblings, with spouse and with parents [1]. I cannot occupy all the 100% of love with my child simply because my wife owns a half of it. I cannot occupy 100% of love of my siblings and friends because they have other friends and it is really not a healthy way to limit my friends' relationships only to myself, friendship does not work this way. Neither can I occupy 100% of love from my parents: no matter how strong their love to me is, they love their other children too. So, the only relationship available to satisfy my dream to occupy 100% of love is conjugal. When during the wedding night I look at eyes of my wife and see her story behind it: "I had a long way here. There were many men who wanted to be part of my life but I knew that I will meet you someday so I kept myself whole for you. And now I give to you and you only my past, my present and my future, my heart, whole myself for eternity!" - that moment I see the whole special women Universe inside my wife in her eyes and feel that all this Universe belongs to me, I occupied 100% of love of this Universe and that is forever. Of course, she will be a daughter, a friend a mother to someone but wife only to me! This is the moment when my deepest desire to monopolize 100% of love is fulfilled!

Why is this so important to fulfill this desire? Because only then my love tank gets filled and I refocus my life from searching for love and reflecting it to generating it together with my spouse. This is the only way to unstuck the flow of the main law - living for the greater good - to the levels beyond human being. Only then we can become harmonious parents for our children and build an even more complex entity - the family. Creation and development of a family may not be achieved by separate man and women no matter how good they are as personalities, how smart they are or how hard they try, it requires abilities that appear only when the two become one. In the begging it was mentioned that in order to create a more complex entity two must become one giving out their energy and freedom. In the case of human beings, the new higher-level unity is created when we give out a part of our freedom - we keep purity before marriage and fidelity in marriage. This sphere is crystal. Any mistake in it will break it - difference between 100% and 99.999...% purity is infinite! Without it my spouse will never get her intimate desire of monopolizing 100% of love fulfilled. She may then act like a wife or mother but will never be able to fulfill all her potential. This is why the main law of the Universe - living for the sake of greater good - forces human beings to have absolutely unique relationships of man and woman.

#### 4. Discussion

Absolute uniqueness of man and woman relationships cannot be proved scientifically, because, unlike other parts of the Universe, human beings are not physical only but have a spiritual aspect, so it implies regarding spiritual reality which we don't have a mathematical apparatus to describe. From purely physical point of view, it seems unnecessary and we see a human history of people not following this principle and yet creating families and raising up children. But for some reason the process never went further - we failed to create a society of harmony we dreamed about all the way. It looks like a broken pipe. Main law of the Universe provides harmony on all the levels prior to human beings but is stuck at us. In this paper I propose that pipe brakes because we fail to follow this law. When we regard marriage and family as something only profitable to us - it fails. Once we are not ready to give our power and freedom to prepare for and nurture or family - it fails. More over if the family is incapsulated in itself and does not follow the main law of the Universe - does not live for the sake of some greater good - it fails. It is really smart to follow this law as a family - live for the sake of society, because only then we start to uncover and realize all the hidden values and features behind our family, our family problems get solved more easily, our children grow and mature more naturally and qualitatively. It really feels like a natural flow of the Universe - once we unstuck it on our level, the blood will fill the veins and go further up enabling our healthy families to become good sells for society and even lead our society to live for the sake of greater good - the Universe and finally the Creator.

The same way we can apply this law to clearly see the doom of homosexual families. Such relationships are incapable of natural multiplication, so it blocks the flow of the main law of the Universe. If you break a Universal law the Universe repels you. For example, the natural law tells us that humans need to eat and then defecate. If one gets a problem with digestion the food is stuck and the natural flow is blocked. The person gets sick and may even die. This way Universe spews entities defying its laws.

Although this approach gives a broader view of our Universe then just its scientifically studied physical part, it will mostly be useful to those people who internally agree with up mentioned laws and are searching for more logic explanation of them. I do not suppose that this perspective alone will change minds of its opposers because

our main problem is not that we do not understand all the right things in the world, but that we don't practice even those things we are sure to be right. But understanding may serve as a first step for practicing and then realizing.

## 5. Conclusions

In this paper I propose an approach to spiritual reality through studying the laws and principles of physical reality. Based on this approach I regard only 3 laws: Giving is prior to receiving, Life for higher purpose and Keeping purity, which I regard as main ones, but definitely they are not the only ones. So, with this paper I would like to inspire researchers to put this approach to practice and dig into the modern science with this prospective.

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# Implications of the joint meeting between ICHJA and ICUMS - Interdisciplinary Research on Mind and Body Relationship -

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**Abstract:** The current vision of the Science Council of Japan's Committee on Dentistry as its mid-to-long-term strategy is "Extending 'healthy life expectancy' and 'happy life expectancy' in a super-smart society. A vision for the future, envisioned by Japan's top research organization, aims not only at physical health but also mental health and mental well-being. The times are changing. Although Western medicine, as well as the field of dentistry to which I belong, has made great progress in diagnosing diseases through segmented analysis, treating mental illness is still a conflicting field of work, and it isn't easy to provide a good strategy in modern medicine. In addition, there are too few researchers to discuss how mental states such as anxiety and stress affect allergic diseases and malignant tumors or how these cognitive factors affect treatment outcomes. The group of scientists seeking to enrich the mind is still seeking to establish a unified medicine by integrating Eastern and Western medicine. The establishment of unified medicine will start with the accumulation of evidence in daily medical practice, such as how the mind affects the body or how improvements in the body affect the mind. With the support of the Japan Science and Technology Agency (JST), I am clarifying some aspects of the mind-body relationship based on a comprehensive analysis of saliva metabolites and a well-being survey. As various interdisciplinary pieces of research are encouraged, I would like to realize the extension of the life span of happiness for the permanent peace of humankind through further development of research on the relationship between the human mind and body by an interdisciplinary organization that includes researchers in the humanities and social sciences as well as the biological science and engineering fields of work. This proposal will provide implications of our joint meeting between ICHJA and ICUMS from the interdisciplinary research point of view.

**Keywords:** drug development, placebo effects, mind and body relationship, interdisciplinary research

## 1. From Elucidation of Physiological Mechanisms of Bone to Drug Discovery

Bone is an important organ that supports the body. Bones are constantly remodeled to maintain their elasticity and rigidity [1]. This refresh system is called remodeling, in which old bone is resorbed by osteoclasts, bone-eating cells, followed by bone formation by osteoblasts, which form bone. This yin and yang balance maintains healthy bones. However, we still need to learn more about how this switch from bone resorption to bone formation occurs. In 2018, we discovered a substance that bridged the gap from bone resorption to bone formation and published it in Nature [2]. This important discovery has led to many interdisciplinary collaborations, especially with professors in science and engineering, to discover a novel bone anabolic drug that could change the treatment in both the dental and orthopedic fields of work.

## 2. Why Drugs Do Not Work for Everyone

By the way, drugs do not work for all patients. Even the analgesics do not work for about 20-50% of patients [3]. It is generally believed that drugs do not work for everyone because each person has a different genetic background [4]. It is also thought to be due to differences in mRNA modifications, known as epigenetics, such as variations in the rate of drug degradation and target enzymes [4]. One possible reason for the ineffectiveness of drugs could be the effect on the mind. This psychological effect is a so-called placebo effect, a well-known fact, and evidence that the mind affects the body [5]. However, because this mind cannot be quantified and cannot be shown, Oriental medicine, which deals with the invisible flow of ki, invisible energy, or sense, has not been able to enter the arena of modern science and has been treated as rather unscientific. Although the number of researchers specializing in Oriental medicine is increasing, the number of researchers is still a small portion compared to Western medicine research.

### 3. Cultivation of New Research Fields

In FY2021, with funding from the Japan Science and Technology Agency (JST), we analyzed the relationship between the level of happiness and cancer markers in saliva. The results suggested that cancer markers and the diversity of oral microflora in saliva change depending on the level of happiness. I am confirming whether a low level of happiness increases the risk of cancer, even after removing the influence of many confounding factors. As shown earlier, the development of bone anabolic drugs requires collaboration with science and engineering researchers. We must conduct fusion research with cutting-edge brain science and the humanities to quantify the invisible sense and put the human mind on the scientific stage. In the JST project, a happiness survey has been conducted through discussions with prominent psychologists and experts in happiness study.

### 4. The significance of the joint ICHJA and ICUMS meeting

The breakthroughs in science in the future will be research results that bring the science of the invisible sense to the forefront of research. ICUMS, which aims to unify Oriental and Western medicine, reaches its 20th anniversary this year. It is necessary to unravel the scientific basis of Oriental medical treatment through the techniques of Western medicine, which excels in analysis and quantification. It is also essential to collaborate with scholars who study the natural sciences and with scholars in the humanities and social sciences. At a time when attempts are being made to visualize the invisible sense using analytical techniques based on cutting-edge physical concepts, this joint conference of the ICHJA and ICUMS will be a venue for creating the most advanced in the world. Let us, people with different specialties, come closer to each other and promote the project to clarify the relationship between the mind and the body, which will lead to the construction of a world of permanent peace for humankind and the extension of the life span of happiness.

**Conflicts of Interest:** The authors declare no conflict of interest.

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# **Bio/ Environmental/ Social Sciences**



# Comparative genomic study of polar bacteria having tolerance to abiotic stress and potential for environmental and agricultural implementation

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**Abstract:** The polar regions are home to a variety of microorganisms. These microorganisms have been reported to have developed adaptive methods for survival in extreme conditions and resist varieties of abiotic stress such as heavy metals (HMs). Despite this, very limited studies have been done in bacteria from polar regions than bacteria from non-polar regions. The main aim of this study is to explore microorganisms from polar regions that could tolerate abiotic stress of HMs. In this study, microorganisms from polar areas have been isolated and various bioinformatics tools were used for understanding the genomic features, comparison, and analysis. The wet-lab experiments were performed for the validation where the isolated bacteria were exposed to the abiotic stress of HMs. The genome analysis of all the isolated bacteria showed presence of heavy metal resistance genes. Furthermore, the three isolated bacterial strains showed some ability to tolerate HM at 15°C. This study is very helpful to explore diversity of abiotic stress resistant microorganisms, to monitor environmental health, and to utilize these potential microorganisms for betterment of the environment, agriculture, and ultimately humankind.

**Keywords:** Heavy metal, *Mesorhizobium* sp., Polar region, *Sphingomonas* sp.

## 1. Introduction

The *Sphingomonas* genus was defined by Yabuuchi et al., in 1990 is a member of the family *Sphingomonadales*, phylum *Pseudomonadota* and class Alphaproteobacteria [1]. They have been reported to be isolated from the soil, water, air, and marine environment [2–5]. Similarly, the *Mesorhizobium* genus was identified by Jarvis et al., in 1997 [6] is a member of the family *Phyllobacteriaceae*, phylum *Pseudomonadota*, and class Alphaproteobacteria [7,8], and have been reported to be isolated from the seawater, wastewater treatment system, and groundwater [9–11]. The characteristic features of *Sphingomonas* and *Mesorhizobium* are that they are both gram-negative, aerobic. Furthermore, *Sphingomonas* are rod shaped chemoheterotrophic bacteria having a characteristic compound called sphingolipids, whereas *Mesorhizobium* are non-spore forming bacteria.

Polar regions, being an isolated environment and having an extremely harsh climate has been reported to be affected by increased human activities including climate change and global warming. Furthermore, abiotic stress of HMs has been reported in the polar areas. The microorganisms living in these areas have reported to have developed adaptive strategies to survive in extreme conditions and resist varieties of abiotic stresses [12]. The development of these strategies in polar microorganisms is a fascinating area of research. Despite the fact, very limited studies have been done in bacteria from the polar areas of distant location and harsh climate. In addition to that, the information regarding the diversity of such microorganisms is very limited.

The main objective of this study was to isolate such types of bacteria from various polar areas, perform genomic analysis and wet-lab experiments. In this study, we have isolated three different bacteria from the polar region two bacteria of the same genus but different species and one bacteria of a different genus. Genomic analysis was done by using various bioinformatics tools to understand all the genomic features and wet-lab experiments were performed. All the isolated bacteria might have potential to be utilized in the future for the betterment of the environment, agriculture and ultimately humankind.

## 2. Materials and Methods



### 2.1. Isolation and genomic DNA extraction

*Sphingomonas* sp. (1) and *Sphingomonas* sp. (2) were isolated from a rock of an arctic lichen *Umbilicaria* sp. and an arctic lichen *Cetraria* sp. respectively whereas, the strain *Mesorhizobium* sp. was isolated from soil samples from Uganda. The bacterial strains were cultured at 15°C on R2A agar for 10 days. Genomic DNA from all the bacteria was extracted using the QIAamp DNA Mini Kit, and its quantity and purity were assessed using a spectrophotometer. The extracted DNA was further evaluated for quality using agarose gel electrophoresis and stored at -20°C.

### 2.2. Genome sequencing and assembly process

The genome sequencing for *Mesorhizobium* sp. was carried out using the PacBio RS II single-molecule real-time (SMRT) sequencing technology from Pacific Biosciences (Menlo Park, CA, USA). SMRTbell library inserts of 20 kb were prepared and sequenced using SMRT cells. The raw sequencing data were generated and subjected to de novo assembly utilizing the hierarchical genome assembly process (HGAP) protocol [13] and RS HGAP4 Assembly in SMRT analysis software (ver. 2.3; Pacific Biosciences, SMRT Link 4.0.0) protocols. The annotation of the genome was performed using the NCBI Prokaryotic Genome Annotation Pipeline (PGAP). Furthermore, coding DNA sequences (CDSs) were predicted and annotated using the Rapid Annotation using Subsystem Technology (RAST) server [14].

The genome sequencing of *Sphingomonas* sp. (1) and *Sphingomonas* sp. (2) was analyzed by using a combined approach with the 454 GS FLX Titanium system (Roche Diagnostics, Brandford, CT) with an 8-kb paired-end library and the illumina GAIIX system (San diego, CA) with a 500-bp paired-end library. The detailed about these strains were mentioned by Jungeun Lee et al., 2012 [15] and Hyoungeok Lee et al., 2012 [16].

### 2.3. Functional annotation and comparative genomics analysis

Annotation tools such as RAST server was used, predicted gene sequences were translated and subjected to the National Center for Biotechnology Information (NCBI) non-redundant database, UniProtKB/Swiss-Prot, and Protein Data Bank proteins (PDB). The comprehensive annotation approach allowed us to gather a thorough understanding of the genomic features of all the strain (*Sphingomonas* sp. (1), *Sphingomonas* sp. (2), and *Mesorhizobium* sp.

### 2.4. Bacterial isolation and growth

The *Sphingomonas* sp. (1), *Sphingomonas* sp. (2), and *Mesorhizobium* sp. was isolated using 0.1 x R2A agar (MB cell Ltd., Seoul, Korea). The environmental temperature during the isolation of the strain was 15°C.

### 2.5. Bacterial tolerance test to heavy metals

The tolerance of all three bacterial strains towards the heavy metals was measured at 15°C by using salts of heavy metals such as copper sulphate pentahydrate ( $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ), cobalt chloride hexahydrate ( $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ ), 2 mM, 1 mM, 0.5 mM, 0.25 mM, 0.1 mM, 0.05 mM, and 0.01 mM. Spectrophotometer was used for the measurement of bacterial OD<sub>600</sub>. All the experiments were performed in triplicates.

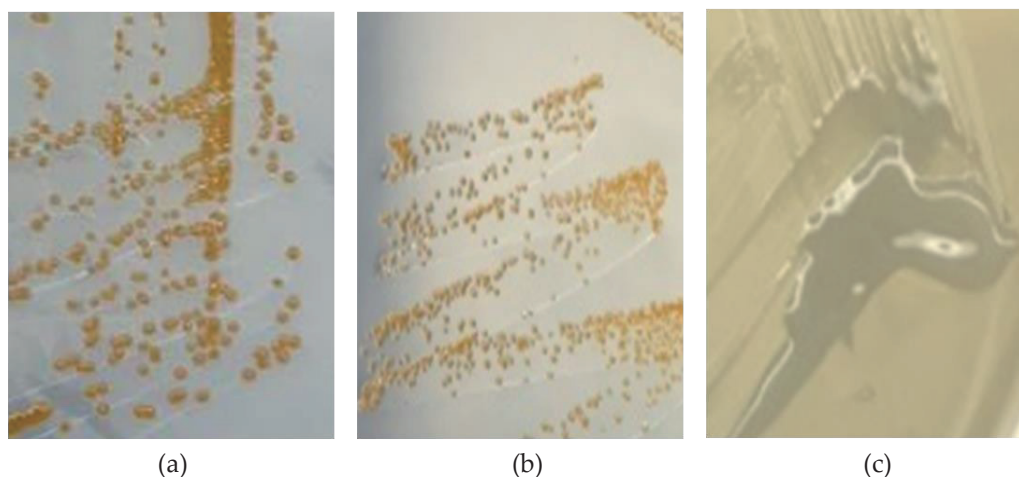
## 3. Results

### 3.1. Genomic features and genome analysis

*Sphingomonas* sp. (1) and *Sphingomonas* sp. (2) are draft genome and *Mesorhizobium* sp. is a complete genome. The genome analysis of *Sphingomonas* sp. (1) showed the presence of copper resistance protein and cobalt-zinc-cadmium resistance protein, and *Sphingomonas* sp. (2) showed the presence of copper resistance protein (CopB, CopC, and CopD) and cobalt-zinc-cadmium resistance protein (CzcA and CzcD). And *Mesorhizobium* sp. showed the presence of copper resistance protein (CopC and CopD) and cobalt-zinc-cadmium resistant protein (CzcD).

### 3.2. Growth of the bacteria

All bacteria, *Sphingomonas* sp. (1), *Sphingomonas* sp.(2), and *Mesorhizobium* sp. was cultured in R2A agar plates at 15°C (Fig. 1).



**Figure 1.** (a) *Sphingomonas* sp.; (b) *Sphingomonas* sp.; (c) *Mesorhizobium* sp.

**Table 1.** Table showing HMs toxicity tolerance by *Sphingomonas* sp. (1), *Sphingomonas* sp. (2), and *Mesorhizobium* sp.

	<i>Sphingomonas</i> sp. (1)		<i>Sphingomonas</i> sp. (2)		<i>Mesorhizobium</i> sp.	
(Used concentration of HMs)	CuSO <sub>4</sub> ·5H <sub>2</sub> O	CoCl <sub>2</sub> ·6H <sub>2</sub> O	CuSO <sub>4</sub> ·5H <sub>2</sub> O	CoCl <sub>2</sub> ·6H <sub>2</sub> O	CuSO <sub>4</sub> ·5H <sub>2</sub> O	CoCl <sub>2</sub> ·6H <sub>2</sub> O
2 mM	-	-	-	-	-	+
1 mM	-	-	-	-	+	+
0.5 mM	-	-	-	-	+	+
0.25 mM	-	+	-	-	+	+
0.1 mM	+	+	+	+	+	+
0.05 mM	+	+	+	+	+	+
0.01 mM	+	+	+	+	+	+

### 3.3. Tolerance of bacteria to different heavy metals

*Sphingomonas* sp. (1) showed tolerance to 0.1 mM of CuSO<sub>4</sub>·5H<sub>2</sub>O and 0.25 mM of CoCl<sub>2</sub>·6H<sub>2</sub>O, *Sphingomonas* sp. (2) showed tolerance to 0.1 mM of CuSO<sub>4</sub>·5H<sub>2</sub>O and CoCl<sub>2</sub>·6H<sub>2</sub>O, and *Mesorhizobium* sp. showed tolerance to 1 mM of CuSO<sub>4</sub>·5H<sub>2</sub>O and 2 mM of CoCl<sub>2</sub>·6H<sub>2</sub>O respectively at 15°C. Overall, these results indicate that the three bacterial strains have varying degrees of tolerance to the tested heavy metals at the given temperature.

## 4. Discussion

HMs pollution had become an urgent issue worldwide which need rapid solution for future sustainability. Moreover, HMs pollution affected the polar regions too and the community of microbes living there. Microorganisms living there have been reported to have developed adaptive strategies. Furthermore, Microbes were reported to confer various types of resistance mechanism in response to HMs [17]. The comparative study of genome analysis of *Sphingomonas* sp. (1) and *Sphingomonas* sp. (2) showed the presence of copper resistance protein (CopC and CopD) and cobalt-zinc-cadmium resistance protein (CzcA and CzcD) in both the strain, besides that, *Sphingomonas* sp. (2) showed the presence of copper resistance protein (CopB). The comparison between *Sphingomonas* sp. (1) and *Sphingomonas* sp. (2) in terms of HMs, the former strain showed tolerance of 0.25 mM of CoCl<sub>2</sub>·6H<sub>2</sub>O and the latter strain showed tolerance of 0.1 mM of CoCl<sub>2</sub>·6H<sub>2</sub>O. In the case of CuSO<sub>4</sub>·5H<sub>2</sub>O, both strains showed tolerance to 0.1 mM of CuSO<sub>4</sub>·5H<sub>2</sub>O at 15°C. *Mesorhizobium* sp. were able to tolerate up to 1 mM CuSO<sub>4</sub>·5H<sub>2</sub>O and 2 mM of CoCl<sub>2</sub>·6H<sub>2</sub>O at 15 °C. Even though our isolated strain did not showed very high tolerance but some tolerance to HMs than the other microorganism from polluted areas, the fact that the polar areas are not exposed to high pollution and considered as pristine [18] should be noted.

## 5. Conclusions

The polar regions are home to many different microorganisms even being isolated environment with extreme climate. Information regarding the diversity of such microorganisms is valuable. Besides that, these microorganisms have developed various strategies to cope with extreme environment and tolerance to stresses like HMs. In this study, we compare three bacteria isolated from the polar region (*Sphingomonas* sp. (1), *Sphingomonas* sp. (2), and *Mesorhizobium* sp.) in terms of their genomic features. Furthermore, the strain showed HMs tolerance at low temp. Those isolated strains might have potential for bioremediation in future. This study is very helpful to find diversity of abiotic stress (HMs) resistant microorganisms, to monitor environmental health, and to utilize these potential microorganisms in future for betterment of the environment, agriculture, and ultimately humankind.

**Author Contributions:** T.-J.O. designed and supervised the project. A.K. performed the experiments; A.K., S.-R.H., H.L., and T.-J.O. wrote the manuscript. All authors discussed the results, commented on the manuscript, and approved the manuscript.

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# Phytochemistry and Pharmacology of *Catharanthus Roseus*: Literature Review

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**Abstract:** This study aims to examine the chemical composition, medicinal properties, and pharmacological activities of *Catharanthus roseus*. The medicinal properties of *Catharanthus roseus* are attributed to diverse bioactive compounds, including alkaloids, flavonoids, and glycosides, each exhibiting unique pharmacological activities. This article presents a comprehensive analysis of the chemical composition, medicinal applications, and pharmacological effects of *Catharanthus roseus*, with a primary focus on its potential in combating cancer and diabetes. Furthermore, considerations regarding the plant's toxicity and safe usage will be addressed. *Catharanthus roseus* contains several alkaloids with anticancer properties, including vinblastine, vincristine, ajmalicine, and reserpine, which contribute to its effectiveness in cancer treatment. Vinblastine and vincristine, chemotherapy drugs derived from the plant, have shown efficacy against lymphoma and leukemia. Conversely, ajmalicine and reserpine are utilized for hypertension management. Additionally, *Catharanthus roseus* contains a range of flavonoids like quercetin, kaempferol, and rutin, known for their antioxidant and anti-inflammatory properties. These flavonoids possess anti-cancer and anti-cardiovascular disease properties. Furthermore, *Catharanthus roseus* is rich in various glycosides such as oleandrin and digitoxin, which exhibit cardiac glycoside activity and are employed in treating heart failure and arrhythmias. The presence of alkaloids in the plant can result in adverse effects like nausea, vomiting, diarrhea, and convulsions. Additionally, some individuals may experience allergic reactions upon contact with the plant. However, caution should be exercised to avoid excessive consumption, which may lead to toxicity.

**Keywords:** Catharanthus roseus, Phytochemistry, Medicinal plants, Pharmacological activities, Cancer treatment, Diabetes management

## 1. Introduction

*Catharanthus roseus* has been extensively utilized in traditional medicine. This plant has attracted considerable interest due to its potential to treat a variety of diseases, including cancer and diabetes. Its medicinal efficacy is attributable to a wide variety of bioactive compounds, including alkaloids, flavonoids, and glycosides, each of which possesses unique pharmacological activities. Understanding the phytochemistry, medicinal applications, and pharmacological effects of *Catharanthus roseus* is essential for realizing its therapeutic potential and ensuring its safe application.

*Catharanthus roseus* has been the subject of extensive research in recent years to determine its chemical composition and pharmacological benefits. The study aims to provide a comprehensive analysis of the phytochemical constituents, medicinal applications, and pharmacological activities of *Catharanthus roseus*, with a particular emphasis on its effectiveness in combating cancer and managing diabetes by synthesizing existing knowledge.

Cancer continues to be one of the most widespread and debilitating diseases in the world, necessitating the investigation of novel therapeutic options. Due to the presence of alkaloids such as vinblastine and vincristine, *Catharanthus roseus* has gained considerable attention for its significant anticancer potential. These alkaloids have shown promising efficacy against lymphoma and leukemia, offering cancer patients a glimmer of hope. In addition, the plant's bioactive compounds, such as flavonoids such as quercetin, and glycosides such as digitoxin, have antioxidant and anti-inflammatory properties, which contribute to their anti-cancer effects. In addition to



its anticancer properties, *Catharanthus roseus* has the potential to treat diabetes, an additional global health concern. The plant's bioactive compounds have shown promise for ameliorating diabetic complications and enhancing glycemic control.

Despite its therapeutic potential, it is essential to consider *Catharanthus roseus*'s safety. Due to the alkaloid content of the plant, excessive consumption may result in toxicity, manifesting as nausea, vomiting, diarrhea, and convulsions. Additionally, some individuals have reported allergic reactions upon contact with the plant. To maximize the benefits of *Catharanthus roseus* while minimizing risks, it is essential to comprehend the plant's potential toxicity and adhere to the correct usage guidelines.

## 2. Phytochemistry of *Catharanthus roseus*

### 2.1. Overview of the bioactive compounds present in *Catharanthus roseus*

*Catharanthus roseus* is widely recognized for its rich reservoir of bioactive compounds, which contribute significantly to its therapeutic properties. These compounds encompass alkaloids, flavonoids, and glycosides, each possessing distinctive pharmacological activities. Gaining a comprehensive understanding of the bioactive constituents of *Catharanthus roseus* is crucial for unraveling its therapeutic potential and uncovering its diverse applications in healthcare.

This plant harbors several noteworthy alkaloids, including vinblastine, vincristine, ajmalicine, and reserpine. These alkaloids have gained prominence for their potent pharmacological effects, particularly in the treatment of cancer. Vinblastine and vincristine, derived from *Catharanthus roseus*, have demonstrated remarkable efficacy against lymphoma and leukemia, among other cancers. They exert their anticancer activity by inhibiting the formation of mitotic spindles, impeding cell division, and inducing apoptosis. Conversely, ajmalicine and reserpine find application in treating hypertension due to their vasodilatory and hypotensive effects.

*Catharanthus roseus* boasts an array of flavonoids, such as quercetin, kaempferol, and rutin. The antioxidant and anti-inflammatory properties of flavonoids, which contribute to their therapeutic effects, are well-established. These compounds exhibit potential anticancer activity by inhibiting tumor growth, reducing inflammation, and modulating cellular signaling pathways. Moreover, *Catharanthus roseus* flavonoids have been implicated in the prevention and management of cardiovascular diseases, attributed to their ability to enhance endothelial function, reduce oxidative stress, and regulate lipid metabolism.

Another vital class of bioactive compounds found in *Catharanthus roseus* is glycosides. The plant houses notable glycosides, including oleandrin and digitoxin. These substances possess cardiac glycoside activity and have traditionally been employed in the treatment of heart failure and arrhythmias. Their effects are mediated by the inhibition of the sodium-potassium pump, resulting in heightened cardiac contractility and output. However, due to their narrow therapeutic index and potential toxicity if not administered properly, caution should be exercised in their usage.

The medicinal value of *Catharanthus roseus* and its potential as a source of novel therapeutic agents are underscored by the presence of these bioactive compounds. The diverse array of alkaloids, flavonoids, and glycosides offers numerous avenues for research and drug development. Further exploration of the mechanisms of action and synergistic effects of these compounds holds the promise of discovering new treatment strategies for a range of diseases, including cancer, diabetes, and cardiovascular disorders.

### 2.1. Detailed analysis of alkaloids, flavonoids, and glycosides

*Catharanthus roseus* is well-known for its abundance of bioactive compounds, including alkaloids, flavonoids, and glycosides. Due to their potential therapeutic applications, these compounds have garnered significant interest in the scientific community.

#### 2.1.1. Alkaloids

The alkaloids vinblastine, vincristine, ajmalicine, and reserpine are notable examples. Vinblastine and vincristine inhibit cell division by preventing the formation of mitotic spindles and binding to tubulin, a protein involved in cell division. This induces apoptosis, which is a form of programmed cell death. Vinblastine and vincristine are used in combination with other chemotherapeutic agents to improve their efficacy, and it has been demonstrated that they produce a high rate of complete remission in certain types of cancer. Additionally, ajmalicine and reserpine have garnered interest for their potential therapeutic applications. Hypertension has been treated with ajmalicine, whereas schizophrenia and hypertension have been treated with reserpine. Ajmalicine exerts its

effects by causing vasodilation and lowering blood pressure, whereas reserpine reduces blood pressure by inhibiting the reuptake of neurotransmitters such as dopamine and norepinephrine.

### 2.1.2. Flavonoids

*Catharanthus roseus* contains a variety of flavonoids, such as quercetin, kaempferol, and rutin. Flavonoids are polyphenolic compounds with anti-inflammatory and antioxidant properties. It has been demonstrated that they exert a vast array of pharmacological effects, including anticancer, anti-inflammatory, and cardioprotective properties. By inhibiting tumor growth and inducing apoptosis, quercetin, kaempferol, and rutin have shown potential anticancer activity. In addition, flavonoids have been linked to the prevention and treatment of cardiovascular disease due to their ability to improve endothelial function, reduce oxidative stress, and regulate lipid metabolism.

### 2.1.3. Glycosides

*Catharanthus roseus* contains an additional important class of bioactive compounds called glycosides. Among the plant's notable glycosides are oleandrin and digitoxin. These compounds have cardiac glycoside activity and have been used historically to treat heart failure and arrhythmias. Oleandrin and digitoxin inhibit the sodium-potassium pump, causing an increase in intracellular sodium and calcium levels. This results in improved cardiac contractility and output, which can be advantageous for the treatment of heart failure. However, these compounds have a limited therapeutic index and, if administered improperly, can be toxic. Therefore, they should be utilized with caution.

## 2.2. Chemical structures and characteristics of key compounds

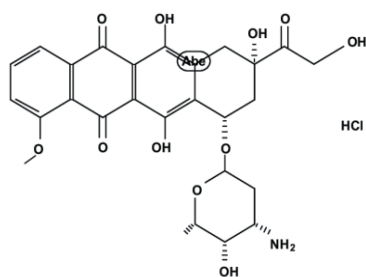


Figure 1. Adriamycin

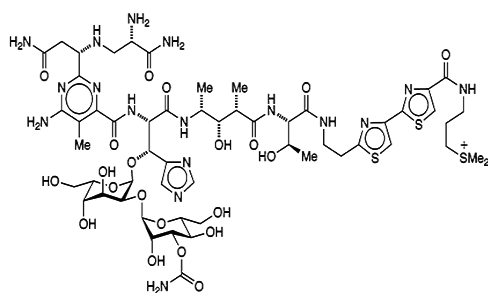


Figure 2. Bleomycin



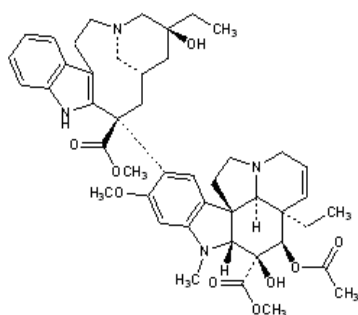


Figure 3. Vinblastine

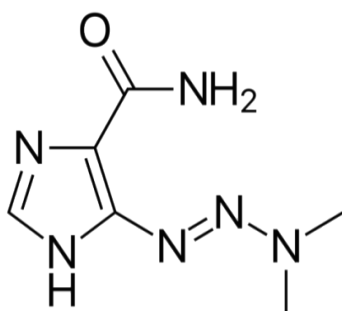


Figure 4. Dacarbazine

### 3. Medicinal Applications of *Catharanthus roseus*

#### 3.1. Traditional uses of *Catharanthus roseus* in different cultures

The historical usage of *Catharanthus roseus* spans diverse cultures worldwide, showcasing its traditional value. Passed down through generations, this plant's medicinal attributes and therapeutic potential have been recognized. Within the realm of ancient Ayurvedic medicine in India, *Catharanthus roseus*, known as "Sadabahar" or "Nithya Kalyani," holds a significant position. Its usage in various preparations, such as decoctions, infusions, and poultices, has persisted for centuries to address ailments like diabetes, hypertension, coughs, skin infections, and digestive disorders. The plant is believed to possess beneficial properties that aid in the effective management of these health issues.

Similarly, in traditional Chinese medicine, *Catharanthus roseus* also referred to as "Xiao Ao Ying Fang," has been valued for its medicinal properties. Emphasizing the balance of the body's energy, this ancient practice utilizes *Catharanthus roseus* to enhance blood flow, reduce inflammation, and alleviate pain. It is commonly prescribed for conditions such as irregular menstruation, dysmenorrhea, and rheumatic disorders.

Indigenous remedies in the Pacific Islands incorporate *Catharanthus roseus*, where the plant's leaves and flowers are typically crushed or boiled to create topical treatments for wounds, cuts, and skin infections. These remedies are believed to possess antimicrobial properties that aid in healing and prevent infection.

Numerous African cultures deeply integrate *Catharanthus roseus* into their traditional healing practices. The plant's roots, leaves, and flowers are utilized to prepare internal and external infusions, decoctions, and poultices, effectively addressing conditions such as diabetes, malaria, hypertension, and gastrointestinal disorders. The inclusion of *Catharanthus roseus* in the traditional knowledge of these cultures underscores its significance as a valuable medicinal plant.

Moreover, *Catharanthus roseus* has found a place in indigenous healing practices in the Caribbean and Central American regions. It is employed to treat ailments including diabetes, hypertension, fever, menstrual disorders, and skin conditions. Typically, oral administration or topical application of infusions and decoctions derived from the plant's leaves and flowers are utilized to harness its potential medicinal properties.

#### 3.1. Therapeutic potential of *Catharanthus roseus* in cancer treatment

##### 3.1.1. Anticancer alkaloids and their mechanisms of action

The discovery of alkaloids with potent anticancer activity is one of the most significant contributions of this plant to contemporary medicine. Vinblastine and vincristine, two alkaloids found in *Catharanthus roseus*, are well-known for their antitumor activity. These alkaloids, which are members of the vinca alkaloids family, inhibit microtubule assembly during cell division. In addition to their antitumor activity, vinblastine and vincristine also suppress the immune system. It is believed that these effects result from the inhibition of the production of cytokines, which are crucial immune response mediators.

Other alkaloids found in *Catharanthus roseus*, such as ajmalicine, serpentine, and reserpine, have demonstrated anticancer activity in addition to vinblastine and vincristine. These alkaloids exert their effects via multiple mechanisms, including inhibition of DNA synthesis.

### 3.1.2. Efficacy against specific types of cancer

*Catharanthus roseus* has demonstrated efficacy against certain types of cancer. Extensive research has been conducted on these phytochemicals, which have shown promising results in preclinical and clinical studies. *Catharanthus roseus*-derived vinblastine and vincristine are particularly effective against lymphomas, leukemias, and certain solid tumors. These alkaloids inhibit the formation of microtubules and result in cell cycle arrest and apoptosis. Their effectiveness in treating these cancers has been thoroughly demonstrated. Vinorelbine, like other vinca alkaloids, disrupts microtubule dynamics, resulting in cell cycle arrest and apoptosis. In clinical trials for these specific types of cancer, its use has demonstrated positive results.

Ajmalicine, a phytochemical discovered in *Catharanthus roseus*, has demonstrated anti-leukemia potential. Although additional research is necessary, preliminary studies indicate its effectiveness in targeting leukemia cells. Reserpine, which is also found in *Catharanthus roseus*, has been studied for its anticancer properties against leukemia, breast cancer, and lung cancer. It has cytotoxic effects on cancer cells, resulting in cell cycle arrest and apoptosis. Its potential as an anticancer agent requires further study, but preliminary research indicates that it possesses promising properties.

### 3.2.. Role of *Catharanthus roseus* in diabetes management

1. Effects on glycemic control and insulin sensitivity
2. Potential prevention of diabetic complications

## 4. Pharmacological Effects of *Catharanthus roseus*

- A. Antioxidant and anti-inflammatory properties of bioactive compounds
- B. Mechanisms underlying the anticancer effects
- C. Impact on cardiovascular health and management of hypertension
- D. Other pharmacological activities and potential therapeutic applications

## 5. Safety Considerations and Toxicity

- A. Potential adverse effects of *Catharanthus roseus* consumption
- B. Alkaloid-induced toxicity and its manifestations
- C. Allergic reactions and precautions for individuals with sensitivities

## 6.. Research Findings and Clinical Evidence

### 6.1. Overview of key studies and clinical trials investigating the effects of *Catharanthus roseus*

#### 6.1.1. For revealing antimicrobial activity,

When examined using GCMS, the leaf extracts made in ethanol and methanol unrevealed the presence of any notable chemicals. However, 3, 10-dinitrodifalton, and desmethylnomifensine were present in the acetone-prepared extract. Likewise, the same extract's MALDI-TOF MS study (with a cinnamic acid matrix) revealed the presence of catharanthine, perivine, and aparicine molecules. The data above show that the leaf extract had a high concentration of indole alkaloids and a small number of phenolic chemicals. The antibacterial effects of the phenolic compounds are well established [1].

In reality, indole alkaloids directly fight bacteria; rather, they enhance the immune system, and it is the immune system that fights off pathogens. Similar to this, a powerful immune system handles also many of the early stages of some types of oncogeneses. However, for these chemicals to exhibit significant antibacterial activity, other medications will need to be administered in addition to them if the immune system is too frail or the organism is too virulent.

They were used for the in vitro testing of antibacterial activity employing the agar disc diffusion method, to determine the zone of inhibition. After being treated with 1% ethyl methane sulphonate, the dwarf variations were separated from the M1 population and established as mutants, breeding successfully in the following generations. In comparison to control plants, the dwarf mutant showed reduced plant height, corolla tube length, internodal length, leaf breadth, and petal length and breadth, giving plants a distinctive phenotype. Both aqueous and alcohol-based leaf extracts from mutant and control leaves were found to suppress the formation of bacterial colonies, but the impact was stronger with mutant leaf extracts.

The growth of bacterial colonies was observed to be inhibited by leaf extracts from mutant and control leaves in both aqueous and alcohol. This effect was stronger with the mutant leaf extracts. Additionally, alcohol extracts had a stronger impact on bacterial proliferation. According to a report, the polarity of antibacterial chemicals plays a key role in their effectiveness, and ethanol-prepared extracts were more effective against different bacterial species [2].

## 6.2. Evaluation of the strength of evidence and limitations

In the antidiarrheal effect study, Wistar rats were used as test subjects to look at the in vivo antidiarrheal effect. Castor oil was used to cause experimental diarrhea in rats that had previously received extracts delivered. In the two tests, common medications like loperamide and atropine sulphate were employed. Alkaloids, tannins, triterpenes, flavonoids, and saponins were all found in the extract after the preliminary phytochemical screening. The outcomes showed that the *C. roseus* ethanol extract possesses a substantial effect. These findings support the use of this herbal medication as a general treatment for diarrhea within folk medicine [3].

*Catharanthus roseus* has wound healing activity [4-6]. According to the current study, *C. roseus* has antioxidant activity that may be measured by DPPH assays at various concentrations (200µgrams), (400µgrams), (600µgrams), (800µgrams), and 91000 µgrams). 800 microgram displays the highest level of antioxidant activity (81.70%) among the five different concentrations examined. Medicinal plants are of enormous interest to the global medicinal and cosmetic business, making mixtures of them an attractive target for patent claims. There are numerous plants known for their antioxidant capacities.

Most cell types can partially withstand oxidative stress thanks to two main mechanisms: ROS-scavenging enzymes like superoxide dismutase (SOD), catalase, and different peroxidases, as well as tiny antioxidant compounds like ascorbate, polyunsaturated fatty acids, or sugars, primarily mannitol. Free radical reactions' part in biological processes is becoming a hotly debated topic [7].

This plant has anti-oxidative properties [8, 9] and is also used as an anti-arthritis agent. In a study, the substantial soft tissue swelling and joint space constriction was observed in Freund's adjuvant-induced arthritic rats is indicative of bone damage in the arthritic condition. This bone deterioration is unprecedented in those treated with the conventional medication methotrexate (0.75 milligrams/kilogram), and there is also only a little joint swelling. Similarly, as compared to Complete Freund's adjuvant, histological tests on *Catharanthus roseus* extracts showed considerable prophylaxis against bone damage by revealing less soft tissue swelling and narrowing of joint gaps after 40 days of treatment (negative control group) [10].

It has hypotensive and hypolipidemic efficacy. The commercial beta-blocker medication atenolol and *Catharanthus roseus* leaf extract were given for a week, through the intraperitoneal (i.p.) method. The effects of *Catharanthus roseus*' leaf extract on hypotension and lipidemia were examined. A crossover strategy was used to compare the effects of atenolol with those of adrenaline-induced hypertensive rats [11].

Four groups were formed by randomly dividing the animals. To compare the pharmacological activities, groups I and II were assigned control rats given normal saline, groups II and III were made up of rats treated with *Catharanthus roseus* leaves extract, and group IV was made up of rats treated with atenolol after being given adrenaline to induce hypertension. A week of intraperitoneal (i.p.) administration of *Catharanthus roseus* leaf extract and the commercial medication atenolol at the appropriate doses every morning till the experiment was completed. Before and after the treatment, the group I and group II rats' body weights, blood glucose levels, serum triglyceride levels, serum cholesterol levels, and heart weights were all measured [12].

*Catharanthus roseus* acts as a memory booster by improving the brain's capacity to use glucose and oxygen, stimulating brain activity. Not the Madagascar species, but the aerial portion of the garden periwinkle is used to improve memory. Vincamine and its chemically modified derivative Vinpocetine are the primary chemical components in charge of the activity. Vincamine, an alkaloid derived majorly from *Vinca minor*, is believed to improve cerebral blood flow and oxygen utilization in the brain. Vincamine is a component of the pharmaceuticals Aethroma, Centracetam, and Dipervina (Figure 5).

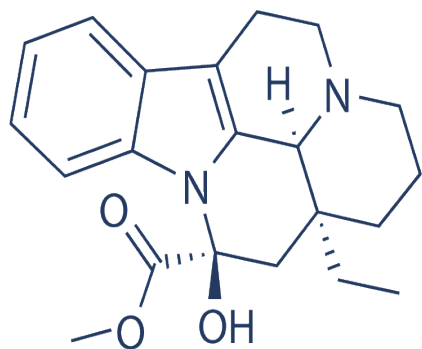


Figure 5. Vincamine

Vinpocetine often referred to as cavinton or ethyl apovincamate, is a chemically altered derivative of vincamine that features certain memory-improving properties. Uncertainty surrounds the compound's mode of action. According to certain research, vinpocetine (Figure 6) may improve cerebral blood flow while having little impact on peripheral blood flow.

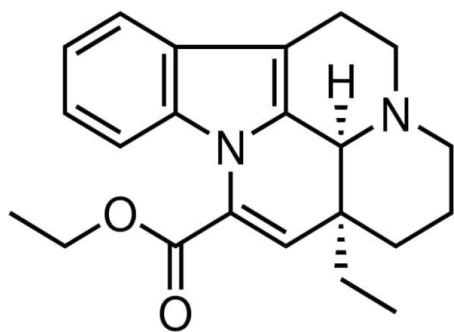


Figure 6. Vinpocetine

It has been used orally to improve cerebral blood flow, oxygen, and glucose uptake by the brain as well as memory, and to prevent age-related cognitive deterioration [13].

Strong anthelmintic activity can be seen in the leafextract. Aqueous, methanol, ethyl acetate, and ethanol extracts of *Catharanthus roseus* were discovered as the least effective during the treatment when injected into rats at a dose of 30 mg/155±15 gram of body weight each morning. Piperazine citrate was diluted with water to a normal concentration of around 50 milligrams/milliliter before being placed into Petri dishes. The synthesized substances (aqueous, methanol, ethyl acetate, and ethanol) were prepared in a small amount of water and diluted to prepare two concentrations, i.e. 100 milligrams per ml and 1 milligram per ml, near 25 milliliters of compound solution with water is prepared for each substance. As a control, use regular saline. For each concentration, three earthworms of about comparable size— from 3 centimeters to 5 centimeters in length and between 0.1centimeters to 0.2 centimeters in width—are selected and put in Petri dishes at room temperature. The duration of total paralysis and death is noted.

Each sample's mean death and paralysis times were calculated. Each worm was regularly exposed to external stimuli, which stimulated and promoted movement in the earthworms, to determine death. The time it took for the worms to lose their ability to move was measured as the paralysis period. Conclusively, *Catharanthus roseus* extracts in water, methanol, ethyl acetate, and ethanol demonstrated anthelmintic efficacy [14].

Vinpocetine's ability to stop stomach mucosal damage brought on by a variety of noxious substances and its antisecretory activity were investigated in rats. Vinpocetine carried on by 96% ethanol in a dose-dependent manner whether given orally or intraperitoneally prevented the growth of stomach lesions. The maximum level of protection was seen when vinpocetine was injected intraperitoneally 30 minutes before ethanol exposure, and its impact persisted 120 minutes later. Vincamine administered orally also had gastroprotective effects in this model.

## 7. Future Directions and Potential Applications

- A. Areas of further research needed to enhance understanding
- B. Potential development of novel therapeutic agents based on *Catharanthus roseus* compounds
- C. Integration of *Catharanthus roseus* into mainstream healthcare practices

## 8. Conclusion

- A. Summary of the key findings and implications
- B. Closing remarks on the significance of *Catharanthus roseus*

Anti-cancerous properties are exhibited by the plant due to the presence of alkaloids [15-18]. Vinblastine can, however, be chemically or biologically changed into vincristine [19].

*Catharanthus* alkaloids stop the growth of cancer cells including leukemia, neuroblastoma, Hodgkin's disease, and tumors of the breast, ovary, lung, colon, rectum, and testis.

As a result of its binding to tubulin, it prevents microtubule formation. Vinblastine is a part of the preferred regimen. When used in conjunction with other anticancer medications, vinblastine frequently has a cure rate of over 90% in individuals with testicular carcinomas.

Vincristine inhibits the formation of microtubule structures by attaching to the structural protein tubulin dimer. The cell cycle's metaphase stage is where mitosis is stopped when the microtubules are disrupted. At submicromolar doses ranging from 10 nM to 1 M, both VCR and VLB are active. These medications cause "end-capping" or the "poisoning" effect by attaching to the microtubules' developing ends. Additionally, it has been observed that these substances also cause tubulin to aggregate at higher concentrations (> 10 M), which leads to the development of tubulin paracrystals [17-20].

When rats were given a methanolic fraction of fresh leaves to treat after being given alloxan to lower their blood glucose levels, it was discovered that the serum protein returned the rats' blood glucose levels to normal [21].

The effects of administering *C. roseus* leaf juice to healthy and diabetic rabbits were tested, and the results were contrasted with those of glibenclamide and the usual medication. They claimed that after giving juice treatment to both normal and diabetic rabbits, blood glucose levels decreased in a dose-dependent manner [22-24].

In the antidiarrheal effect study, Wistar rats were used as test subjects and as looked at the in vivo antidiarrheal effect. Castor oil was used to cause experimental diarrhea in rats that had previously received extracts delivered. In the two tests, common medications like loperamide and atropine sulphate were employed. Alkaloids, tannins, triterpenes, flavonoids, and saponins were all found in the extract after the preliminary phytochemical screening.

The outcomes showed that the *C. roseus* ethanol extract possesses a substantial effect. These findings support the use of this herbal medication as a general treatment for diarrhea within folk medicine [3].

*Catharanthus roseus* has wound healing activity [4-6]. According to the current study, *C. roseus* has antioxidant activity that may be measured by DPPH assays at various concentrations (200µgrams), (400µgrams), (600µgrams), (800µgrams), and 91000 µgrams). 800 microgram displays the highest level of antioxidant activity (81.70%) among the five different concentrations examined. Medicinal plants are of enormous interest to the global medicinal and cosmetic business, making mixtures of them an attractive target for patent claims. There are numerous plants known for their antioxidant capacities.

Most cell types can partially withstand oxidative stress thanks to two main mechanisms: ROS-scavenging enzymes like superoxide dismutase (SOD), catalase, and different peroxidases, as well as tiny antioxidant compounds like ascorbate, polyunsaturated fatty acids, or sugars, primarily mannitol. Free radical reactions' part in biological processes is becoming a hotly debated topic [7].

This plant has anti-oxidative properties [8-9] also used as an anti-arthritis agent, in a study, the substantial soft tissue swelling, and joint space constriction was observed in Freund's adjuvant-induced arthritic rats is indicative of bone damage in the arthritic condition. This bone deterioration is unprecedented in those treated with the conventional medication methotrexate (0.75 milligrams/kilogram), and there is also only a little joint swelling. Similarly, as compared to Complete Freund's adjuvant, histological tests on *Catharanthusroseus* extracts showed considerable prophylaxis against bone damage by revealing less soft tissue swelling and narrowing of joint gaps after 40 days of treatment (negative control group [10].

It has hypotensive and hypolipidemic efficacy. The commercial beta-blocker medication atenolol and *Catharanthusroseus* leaf extract were given for a week, through the intraperitoneal (i.p.) method. The effects of *Catharanthusroseus*' leaf extract on hypotension and lipidemia were examined. A crossover strategy was used to compare the effects of atenolol with those of adrenaline-induced hypertensive rats [11].



Four groups were formed by randomly dividing the animals. To compare the pharmacological activities, groups I and II were assigned control rats given normal saline, groups II and III were made up of rats treated with *Catharanthus roseus* leaves extract, and group IV was made up of rats treated with atenolol after being given adrenaline to induce hypertension. A week of intraperitoneal (i.p) administration of *Catharanthus roseus* leaf extract and the commercial medication atenolol at the appropriate doses every morning till the experiment was completed. Before and after the treatment, the group I and group II rats' body weights, blood glucose levels, serum triglyceride levels, serum cholesterol levels, and heart weights were all measured [12].

*Catharanthus roseus* acts as a memory booster by improving the brain's capacity to use glucose and oxygen, stimulating brain activity. Not the Madagascar species, but the aerial portion of the garden periwinkle is used to improve memory. Vincamine and its chemically modified derivative Vinpocetine are the primary chemical components in charge of the activity. Vincamine, an alkaloid derived majorly from *Vinca minor*, is believed to improve cerebral blood flow and oxygen utilization in the brain. Vincamine is a component of the pharmaceuticals Aethroma, Centracetam, and Dipervina (Figure 5).

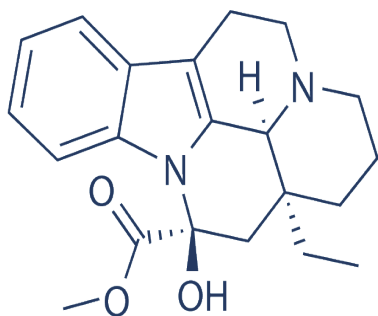


Figure 5. Vincamine

Vinpocetine often referred to as cavinton or ethyl apovincamine, is a chemically altered derivative of vincamine that features certain memory-improving properties. Uncertainty surrounds the compound's mode of action. According to certain research, vinpocetine (Figure 6) may improve cerebral blood flow while having little impact on peripheral blood flow.

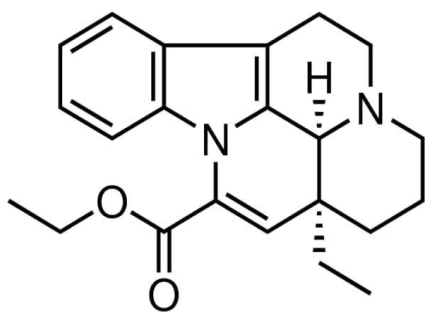


Figure 6. Vinpocetine

It has been used orally to improve cerebral blood flow, oxygen, and glucose uptake by the brain as well as memory, and to prevent age-related cognitive deterioration [15].

Strong anthelmintic activity can be seen in the leaf extract. Aqueous, methanol, ethyl acetate, and ethanol extracts of *Catharanthus roseus* were discovered as the least effective during the treatment when injected into rats at a dose of 30 mg/155±15 gram of body weight each morning. Piperazine citrate was diluted with water to a normal concentration of around 50 milligrams/milliliter before being placed into Petri dishes. The synthesized substances (aqueous, methanol, ethyl acetate, and ethanol) were prepared in a small amount of water and diluted to prepare two concentrations, i.e. 100 milligrams per ml and 1 milligram per ml, near 25 milliliters of compound solution with water is prepared for each substance. As a control, use regular saline. For each concentration, three earthworms of about comparable size— from 3 centimeters to 5 centimeters in length and between 0.1 centimeters to 0.2 centimeters in width—are selected and put in Petri dishes at room temperature. The duration of total paralysis and death is noted.

Each sample's mean death and paralysis times were calculated. Each worm was regularly exposed to external stimuli, which stimulate and promote movement in the earthworms, to determine death. The time it took for the worms to lose their ability to move was measured as the paralysis period. Conclusively, *Catharanthus roseus* extracts in water, methanol, ethyl acetate, and ethanol demonstrated anthelmintic efficacy [13].

Vinpocetine's ability to stop stomach mucosal damage brought on by a variety of noxious substances and its antisecretory activity were investigated in rats. Vinpocetine carried on by 96% ethanol in a dose-dependent manner whether given orally or intraperitoneally prevented the growth of stomach lesions. The maximum level of protection was seen when vinpocetine was injected intraperitoneally 30 minutes before ethanol exposure, and its impact persisted 120 minutes later. Vincamine administered orally also had gastroprotective effects in this model.

Vinpocetine's ability to protect cells from ethanol-induced damage was inhibited by pretreatment with indomethacin, which raises the possibility that a prostaglandin-mediated mechanism was at play. The protective effects of prostaglandin E2, sucralfate, and tripotassium-dicitratebismuthate were compared with those of vinpocetine. Additionally, phenyl-bulazone- and acetic acid-induced chronic stomach ulcers were used to demonstrate vinpocetine's antiulcer activity. Vinpocetine injected intraduodenally reduced stomach acid output in pylorus-ligated rats when histamine was activated. The vinpocetine action discovered in these studies is suggestive of vinpocetine's potential clinical utility as a gastroprotective medication [14].

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**Conflicts of Interest** Authors declare that there is no conflict of interest.

**Consent** Not Applicable

**Materials and Method** Not Applicable

**Authors Contribution** All authors contributed equally.

**Data Availability** Data will be provided on demand.

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# Solid Waste Management Threats to African Cities' Rivers

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**Abstract:** Africa's cities and rivers face threats from solid waste and wastewater pollution. These rivers no longer support people and environmental functions. A good example of cities with rivers are Nairobi, Kampala, Juba, Khartoum, Cairo, and Addis Ababa. This research adopted a mixed-methods inquiry on solid waste management in Africa. The research finds that Africa's rivers have become canals of waste, posing public health concerns and threatening the sustainability of environmental functions. Studies have reported heavy metal contamination, chemicals, and organic pollution that are above the recommended levels by the WHO. Citizen engagement, awareness, and instruction on waste segregation are extremely poor. Africa's cities are often characterized by informal settlements, which suffer from inadequate sanitation, waste management practices, and water-borne diseases, resulting in deterioration of both surface and groundwater quality and environmental health. The situation could get worse as the continent lacks well-engineered waste management infrastructure, enforcement, and technical capacity. In conclusion, the study indicates that African cities rivers are under threat from poor solid waste management practices, as most of these cities lack infrastructure, resources, and technological capacity to address these problems. The study recommends exploration of river engineering principles and practices, capacity building of the city river authorities, institutionalizing city river water quality monitoring to selected and suitable academia, and appreciating the private sector's efforts to promote waste recycling technologies to benefit cities circular economies.

**Keywords:** Africa's cities, rivers, solid waste, infrastructure, segregation

## 1. Introduction

Solid waste management is a significant global environmental challenge that has gained increasing attention in recent years. The world has become more aware of the risks associated with waste, which pose a serious threat to our natural habitat. These risks include water and air pollution, as well as the degradation of our natural environment, thus jeopardizing sustainability of important areas like nature reserves, forest, open spaces, public parks, and rivers. Many cities in Africa have suffered damages to its storm drains and wastewater drainage systems due to clogging by solid waste. The devastating flood events witnessed in African cities can be attributed to the improper manipulation of rivers and water channels, as well as inadequate sanitation and management practices. The poor management of waste in Africa can also be attributed to various factors, including weak organizational structures, lack of appropriate skills, inadequate budgets, weak legislation, insufficient enforcement, low public awareness, corruption, conflict, political instability, and a lack of political will. Ultimately, the root of the issue lies in a failure of governance [1].

## 2. Materials and Methods

### 2.1. Materials

- a) Research articles, publications, and reports related to solid waste management and its impact on African cities' rivers
- b) Data sources, such as government records, environmental agencies, and non-governmental organizations (NGOs), that provide information on waste management practices and river pollution in African cities
- c) Maps and satellite imagery to identify the location of rivers and waste disposal sites in African cities

### 2.2. Methods

- a) Literature Review: We conducted a comprehensive review of existing literature on solid waste management and its effects on rivers in African cities. Analyzed relevant studies, reports, and articles to understand the current state of waste management practices and their impact on river ecosystems.

b) Data Collection: We collected data from various sources, including government records, environmental agencies, and NGOs, to obtain information on waste management practices, river pollution levels, and the extent of the problem in African cities.

d) Field Surveys: We visited various visits along Nairobi River as an example African cities river in East Africa to observe the impact of solid waste pollution. We also observed waste disposal practices, identified waste dumping sites near rivers, and assess the level of pollution in the rivers. Document these observations through photographs, and analysis of the field notes.

e) Stakeholder Interviews: We also carried out interviews with stakeholders involved in waste management, such as local resident associations, waste management authorities, environmental experts, and community leaders, and gather their perspectives on the challenges, existing practices, and potential solutions for solid waste management in African cities.

f) Data Analysis: The collected data was analyzed using appropriate statistical methods and tools. The impact of solid waste pollution in Nairobi River as an example presented with extent of pollution through chemical and physical parameters and identified was key contributors to waste mismanagement, and the impact of solid waste on the health of rivers in African cities. Due to the cost limitation, we didn't manage to conduct specific case studies to understand the unique challenges the cities face in managing solid waste and protecting their rivers.

### 3. Results

This result presented in this extended abstract is based on the literature reviews only for this article.

#### 3.1. Results of Literature Review

##### 3.1.1. Results

Based on the literature review conducted on the topic of solid waste management threats to African cities' rivers, according to AUDA-NEPAD (2021), and UNEP-CSIR (undated), African cities waste composition and production is 57% organic waste, 9% paper, 13% plastic, 4% glass, 4% metals and others. Its scientifically assumed that Africa is recycling only 4% of its waste in 2018. Most of these wastes are disposed of primarily in landfills, where the leachates become a real threat to the rivers and most often, dumpsites lack gas and leachate management systems. A sizeable amount of uncollected solid waste also finds its path to the rivers as the case of Nairobi, Mbagathi and Kandisi rivers. The AU has proposed to the continent governments that the African cities should be recycling at least 50 per cent of the waste they generate by 2023. This is a dream far to achieve as nothing much has happened at various member countries. If such high policy driven rate of Africa waste recycling is achieved, then it implies that waste might present important socioeconomic potential for African nations transformation. Nairobi and Mombasa counties governments has made attempts to promote establishment of waste to energy facilities but trembly failed due to lack of political will from high-levels. The continent has witnessed solid waste management policies evolve to specificity in terms of focus, functions, and scope. For example, Kenya government enacted into law a new sustainable waste management act in 2022. This law makes it obligation of the household to segregate the waste at the source. The problem is that government did not provide any support waste management infrastructure and mechanisms for community engagements to drive this goal. Further, there was a policy shift from criminalizing solid waste action or inaction to promoting good practices to benefit the circular economy and environmental sustainability.

The other key findings are summarized below:

- a) Poor waste management practices: Many African cities face challenges in effectively managing their solid waste. Inadequate waste collection systems, limited recycling facilities, and improper disposal methods contribute to the pollution of rivers [2]. Many cities have not achieved much of the river restoration agenda due to low technical and funding capacity of the projects.
- b) Impact on water quality: Improper waste management leads to the contamination of rivers, resulting in degraded water quality. The presence of hazardous substances, including heavy metals and chemicals, poses a significant threat to aquatic ecosystems and public health [3].
- c) Health risks: The pollution of rivers due to improper waste management increases the risk of waterborne diseases such as cholera, and typhoid among others. Communities living near contaminated rivers are exposed to health hazards, including gastrointestinal illnesses and infections, especially those living in the informal settlements [4].
- d) Environmental degradation: Solid waste, particularly non-biodegradable materials like plastics, accumulates in rivers, causing physical damage to the ecosystem. It disrupts the natural flow of water, affects aquatic biodiversity, and degrades the overall ecological balance [5].

- e) Socioeconomic implications: The inadequate management of solid waste in African cities negatively impacts tourism and local population, as polluted rivers deter visitors. Additionally, the costs associated with cleaning up and addressing the consequences of river pollution burden local economies and governments [6].
- f) Policy and governance gaps: Weak legislation, lack of enforcement, and limited political will contribute to the challenges faced in solid waste management. Inadequate budgets and organizational structures further hinder effective waste management practices [7, 8].
- g) Community participation and awareness: Engaging local communities and raising awareness about proper waste management practices are crucial for addressing the threats to African cities' rivers. Community involvement, education, and the promotion of sustainable waste management approaches can contribute to long-term solutions [9].

#### 4. Discussion

These findings highlight the urgent need for improved waste management systems, strengthened policies, and increased public awareness to mitigate the threats posed to African cities' rivers by improper solid waste management practices [10]. Investment in solid waste engineering infrastructure remains a priority for many African cities with objective of protecting rivers, wetlands, green spaces, and other spaces. It is fundamentally important to recognize and appreciate the national government of Kenya efforts to establishing Nairobi River Commission on 23<sup>rd</sup> February 2023. The objective of the commission is to aimed at restoring the lost glory of the Kenyan capital through Nairobi River restoration and environmental sustainability. This is effort in the right direction. Impact of solid waste in African cities rivers coupled with environmental degradation and climate change could worsen the ecological functions of this critical ecosystem. According to the Digital Standard Newspaper of 1<sup>st</sup> August 2023, Kenya Chief Justice took issue with all government and private institutions polluting the Nairobi River that they should be arrested and charged.

#### 5. Conclusions

Based on the literature review conducted on the topic of solid waste management threats to African cities' rivers, it is evident that there are significant challenges and risks associated with the improper management of solid waste. The literature highlights the detrimental effects of poor waste management practices on the quality of rivers in African cities. The literature indicates that inadequate waste collection systems, limited recycling facilities, and improper disposal methods contribute to the pollution of cities rivers. This pollution leads to degraded water quality, health risks for communities living near contaminated rivers, environmental degradation, and negative socio-economic implications. Furthermore, the literature emphasizes the importance of addressing policy and governance gaps, including weak legislation, lack of enforcement, and limited political will. It also underscores the need for community participation and awareness to promote sustainable waste management approaches.

The continent has witnessed solid waste management policies evolve to specificity in terms of focus, functions, and scope. For example, Kenya government enacted into law a new sustainable waste management act in 2022. This law makes it obligation of the household to segregate the waste at the source. The problem is that government did not provide any support waste management infrastructure and community engagement to drive this goal.

Further, there was a policy shift from criminalizing solid waste action or inaction to promoting good practices to benefit the circular economy and environmental sustainability. This is a great development that will incentive the waste management sector. The government departments will not be suing each other in the court of law for the failure of one as happened in the past where national environment management authority was taking the local government to court for failing to provide waste management services. While these findings provide valuable insights into the solid waste management threats to African cities' rivers, further data analysis is required to gain a more comprehensive understanding of the extent of the problem, specific contributing factors, and potential solutions.

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# The reality and cause of global warming and what can be done about it

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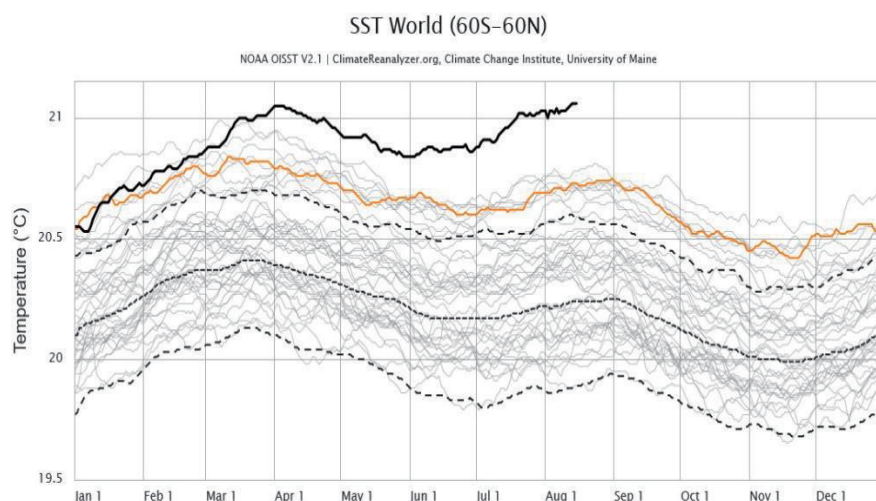
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**Abstract:** The global surface temperature, whether measured through traditional thermometry or modern satellite radiometry, is clearly increasing. Empirical analysis of temperature datasets show global temperatures increasing at about 0.15°C/decade, and “business-as-usual” forecasts of time to breach a 1.5°C threshold vary from 10 to 20 years, and 2.0 °C thresholds from 15 to 50 years hence. Warming primarily at the poles have reduced the meridional thermal gradient, giving rise to loopy meridional jets that tend to stall causing deluge or excessive heat culminating in floods or wildfire disasters such as those in Maui, Canad, Greece and California. A simple model greenhouse gas driven radiative imbalance yields a surprisingly accurate comparison with the temperature record. If left unchecked, continued reliance on fossil fuels will lead to accelerating natural disasters which will inevitably increase the on-going melt of the great ice-sheets in Greenland and the Antarctic; this could yield an Eemian-like world in a few hundred years resulting in sea-levels 5m or higher than today. Alternative energy sources such as solar, and small module nuclear are discussed which can reduce or eliminate CO<sub>2</sub> increases. More radical strategies such solar-geoengineering to affect the solar constant may be necessary, but whether such a cure may be worse than the disease must be very carefully considered.

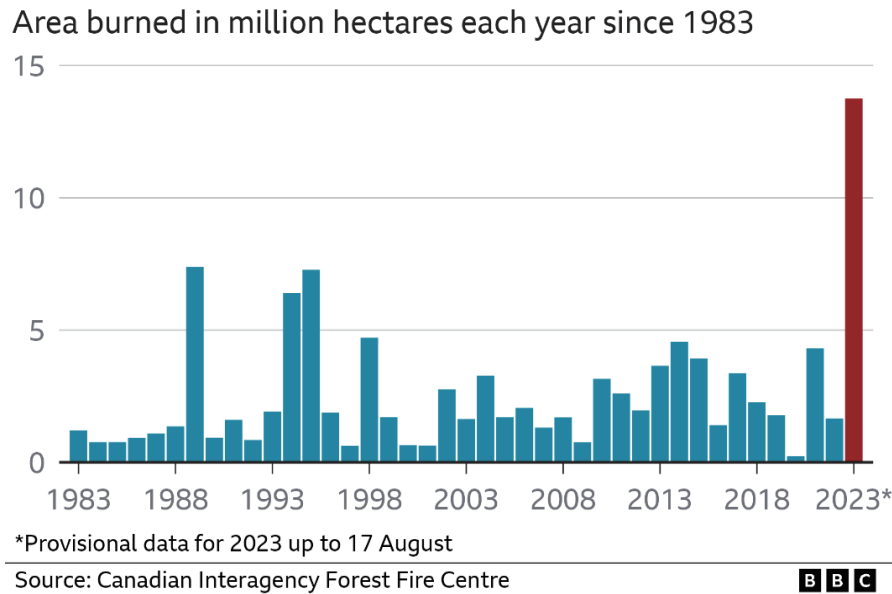
**Keywords:** climate change, greenhouse gases, atmospheric CO<sub>2</sub>, sea-level rise, solar geoengineering

## 1. Introduction

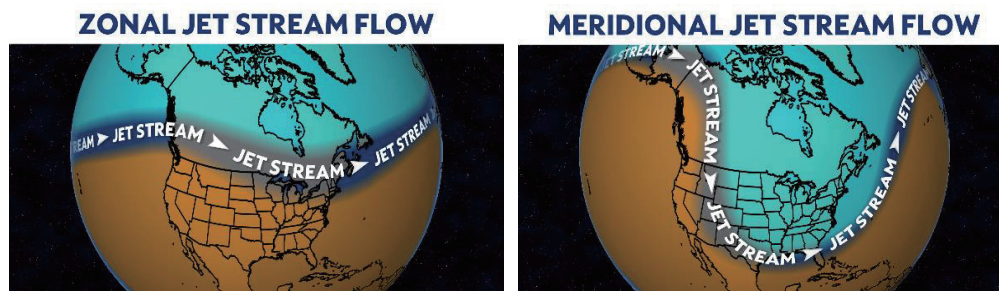
### 1.1 Recent extreme weather events



**Figure 1.** University of Maine’s Climate Re-analyzer [1] shows an ocean surface warming event 4σ away from the 1979-2022 dotted-line median. El-Nino and the Tonga underwater volcano (that expelled tons of water-vapor into the atmosphere) are likely contributors on top of a “climate signal” that sits near the orange 2022 line above +2σ.



**Figure 2.** Canadian wildfires have burned an astronomical amount of land this year with over 1000 fires still active, two-thirds of which remain out of control [2].



**Figure 3.** Normal zonal vs loopy meridional jets. Large loops can stall, creating hot or cold zones. If they pinch off they become long-lived “heat domes” or “extended polar breakouts”; loopy jets can also deliver a lot of tropical moisture northward in repeated pulses or storms as they did winter of 2023 in California [3]-[4].

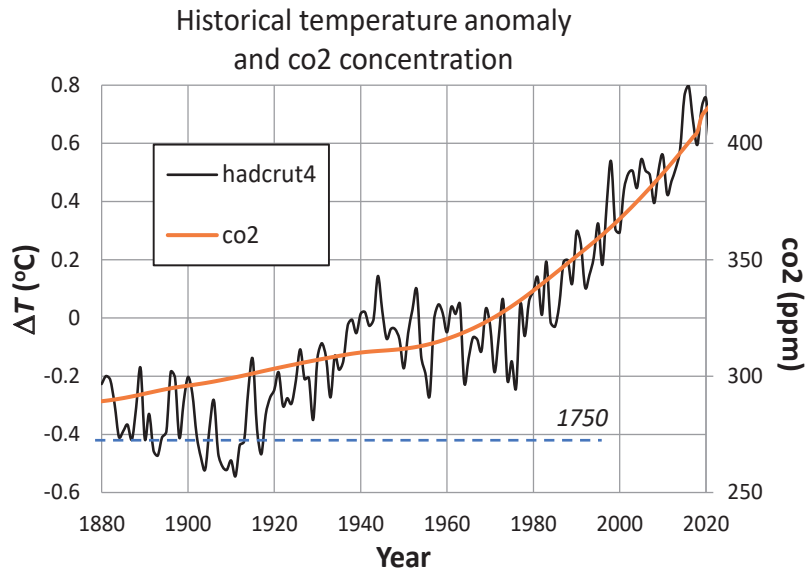
## 2. Methods and Materials

Satellite data is provided by the University of Alabama at Huntsville (UAH) maintained on Roy Spencer’s website [5]. Thermometric data from the Hadley Climate Research Unit (HadCRU) is used [6]; version 4 (hadcrut4) is augmented by the last 5 years of version 5 data matched so the year over year difference is the same. Greenhouse gas (GG) concentration data is obtained from Scripps [7] and Meinhausen, et.al. [8]. Forcing formulas based on quantum chemistry of infrared light absorption are obtained from the IPCC website [9] and Etminan, et. al. [10]. Data is then loaded into Excel spreadsheets enabled the calculation of model results forward in time, as well as the drawing of figures in Section 3.

## 3. Results

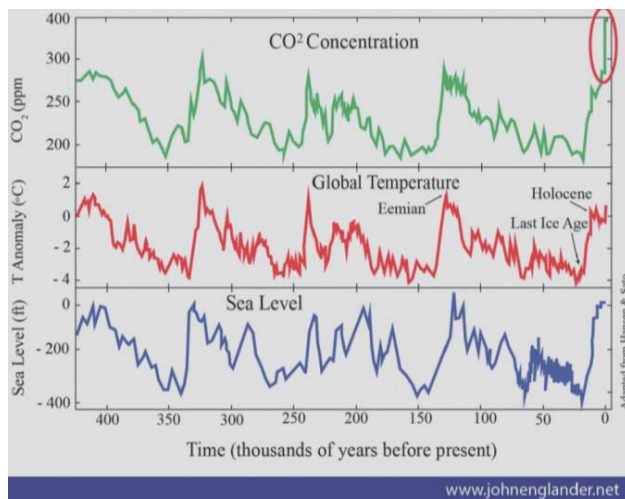
### 3.1. Effects of increasing atmospheric CO<sub>2</sub> concentration on global mean temperatures

According to the hadcrut4 global surface-averaged temperatures have risen 1.2°C since 1750 (see Figure 4), most of it in the last 60 years or so. For comparison CO<sub>2</sub> concentrations (CO<sub>2</sub>) are plotted on the same graph and the curve looks very much like a “smoothed” version of the temperature rise.



**Figure 4.** Temperature (left-scale) and CO<sub>2</sub> (right-scale) and are compared. Drawing a “smooth curve through” the temperature data would be well approximated by the CO<sub>2</sub> curve.

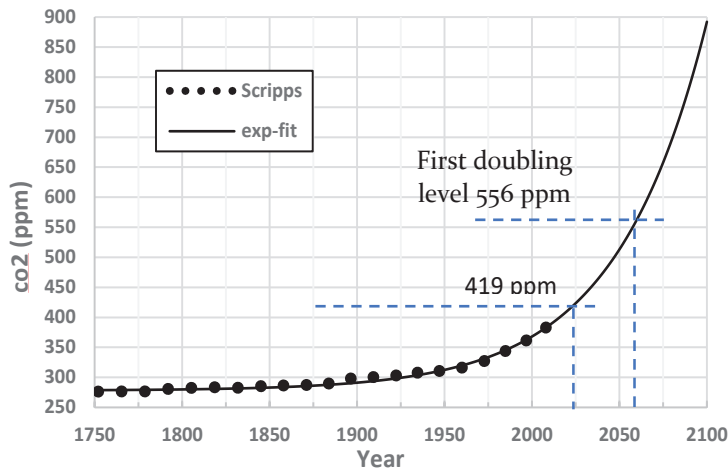
The correlation is self-evident. The overall rise from the pre-industrial era (1750 say) has taken it from about 280 ppm to about 420 ppm today [7, 8]. This is more than the entire range observed during the 100-Kyr ice-age cycles of the last half-million years (see Figure 5) where CO<sub>2</sub> oscillates between 180 ppm at cold troughs and 280-300 ppm at warm peaks. Simultaneously, temperatures and sea-levels oscillate in phase with it, varying in ranges of about 10 °C and 130 m, respectively.



**Figure 5.** Natural 100-Kyr cycles of temperatures, sea level and CO<sub>2</sub> dance in phase [11]. Cold temperatures correspond to ice ages, limit vegetation, dramatically lower sea-levels, and oceans absorb CO<sub>2</sub>. Circles denote recent highs of CO<sub>2</sub> and temperature. Note that CO<sub>2</sub> has exploded out of the “natural” cyclic behavior; this is an *anthropomorphic* signal.

Of course, correlation does not necessarily imply causation. And in fact, the correlated rises and falls of temperature and CO<sub>2</sub> in Figures 4 and 5 are different in nature. In the natural cycles of Figure 5 temperature change leads CO<sub>2</sub> change, partly through temperature dependent solubility of CO<sub>2</sub> in oceans. Now, the response time for that exchange between ocean and atmosphere is on the order of centuries due to the nature of the ocean’s “mixing layer”, but in Figure 4 there is no observable response time (i.e., less than a few years). Therefore, the recent temperature rise cannot be a solubility response - must be something else.

Is this evidence causation, i.e., does increasing CO<sub>2</sub> cause observed warming? Scientists claimed that very thing beginning in the mid 1800's [12]. In Figure 6 we see CO<sub>2</sub> rises exponentially. In 1896 the Swedish



**Figure 6.** The first CO<sub>2</sub> doubling is in 2056; the next in 2110. Each doubling yields a temperature increase of 2°C to 3°C called the “doubling sensitivity”

Nobel Laureate in chemistry, Svante Arrhenius hypothesized that the atmosphere warms roughly 5 °C for every doubling of CO<sub>2</sub> [13]. His approach relied on the concept of “radiative forcing” that drives temperatures away from an initial equilibrium temperature  $T$  according to

$$\Delta T = \lambda \Delta F \quad (1)$$

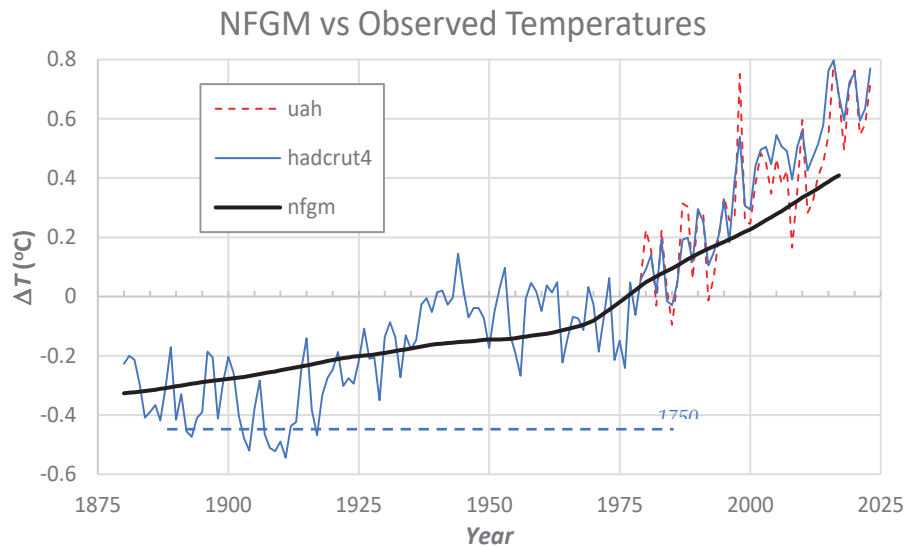
where  $\lambda$  is the “sensitivity parameter” and  $\Delta F$  is the net forcing (units of W/m<sup>2</sup>). The latter can be decomposed into a sum over individual contributions  $\Delta f$  such as changes in land-use, solar intensity or CO<sub>2</sub>. It has been determined that when CO<sub>2</sub> changes from an initial value  $C_0$  to a later value  $C$  the CO<sub>2</sub> forcing is

$$\Delta f_{\text{CO}_2} = 5.35 \text{ W/m}^2 \ln C/C_0 \quad (2)$$

So by combining eqs (1) and (2) you can quickly see how temperature can rise along with CO<sub>2</sub>. Doubling CO<sub>2</sub> then yields a 3.7 W/m<sup>2</sup> forcing. Computer models often play a key role in evaluating the doubling sensitivity, where estimates typically range from 2 °C [14] to a 3 °C [15] or more. From Figure 6 we can deduce that in just over 30 years we expect temperatures to rise 2 to 3 °C above those of the pre-industrial era; add another 60 years and there will be an additional 2 to 3 °C if man continues business-as-usual.

### 3.2 A simple model reveals causal mechanisms for global warming

In this section we show that CO<sub>2</sub> a direct and primary causal mechanism global warming. A simple radiation budget of Earth’s surface shows that at equilibrium the energy input into the Earth’s surface (from absorption of visible sunlight) equals energy output from Earth’s surface (from emission of infrared radiation). Using the law of Stefan-Boltzmann for emission yields an equilibrium temperature  $T$  in terms of Earths’ albedo (reflectivity) and solar intensity in the normal way. But a change to the atmosphere (by adding GG, for example) can disturb that equilibrium; in fact, when we add a small forcing to the energy input side, ignore feedbacks, and keep the surface homogeneous (no separation of land atmosphere and ocean) the temperature will shift by a small amount  $\Delta T$  away from  $T$ . Forcings are from Prather, et. al. [9] and Etminan, et. al. [10]; since GG forcings dominate this is called the no-feedback greenhouse model or NFGM [16] (see Figure 7). It is somewhat cooler than the observed temperatures after about 1990, but



**Figure 7.** Global temperature from hadcrut4 is plotted along with the NFGM from 1880 to 2018, as well as UAH data. Temperature fluctuations about the NFGM are due mostly ocean-atmosphere oscillations, although volcanic eruptions depressed temperatures near 1884, 1902, 1964, 1983, and 1992.

that is understandable due to the extreme nature of its simplifications. Regardless, it serves as a convincing case that GG increase is the primary cause of global temperature rise. The closeness of fit to data seems to imply that, at least to this point, the thermal inertia of oceans which acts to slow the temperature rise is nearly offset by feedback which is net positive that acts to speed the rise.

#### 4. Discussion

The effects of climate change are a kind of “slow cook” with subtle changes happening over a lifetime. This, likely along with shortsighted financial reasons and the complexity of the climate system, have led many to minimize the global warming (including this author in the past) or even deny it is anthropomorphic in nature. I think the NFGM serves to put that discussion to rest.

Indeed, as the exponential increase of CO<sub>2</sub> begins to bite, we see some of the predicted environmental fears realized: extreme rainfall surges, regional climate changes (such as droughts), heat-domes and so on. A 1.2 °C rise in global temperatures is already here; a 1.5 °C warming is “in the pipeline” even if all GG emissions are stopped completely now. This summer was already a taste of that 1.5 °C rise when Canada, Greece and Lahaina burned, then Greece and Libya drowned. We risk experiencing a future Eemian-like environment, 5 m or higher sea-levels likely due to extensive melting of the Greenland and Antarctic ice-sheets. Although that melt may take centuries, sea-level rise is already accelerating from roughly 6-in per century up from 1880 to 2013, to 12-in per century now, and will only accelerate in a business-as-usual approach. The conclusion is simple: the trend of GG emission into the atmosphere must not just be stopped, it must be reversed. Recommendations for action are found in 4.2.1 to 4.2.4 below.

##### 4.1. Replace fossil fuels with small modular nuclear and solar

Fossil fuel as an energy source must be replaced, both in transportation, and for the grid. Small modular nuclear reactors designs are now becoming available. These are inherently stable platforms that can passively cool, as opposed to the “one-off” designs requiring active cooling to avoid instability from either human error (e.g., Chernobyl or Three-mile Island) or natural disaster (Fukushima). Solar should be a given, as long as the return on energy is positive (it may not be beyond 35 or so degrees latitude). Fusion is the ultimate answer, but it is still a decade or more out. Clean energy can provide EV charging or hydrogen fuel production to help clean up transportation. EV needs faster charge-up times to be accepted on a large scale. Forced acceptance cannot be the answer – that is tyranny, and that will yield worse consequence than climate change.

##### 4.2. Organic agriculture can sequester CO<sub>2</sub>



#### 4.3. Develop a culture of planting trees, vegetation, in cities and in remote areas using drones

#### 4.4. Buy time through solar geoengineering

I believe mankind will continue to be slow to come to grips with the ever accelerating warming problem. We must consider a limited reduction of the solar intensity reaching Earth, selectively perhaps in the polar or sub-polar regions [17, 18]. We don't want to reduce agricultural output (so at the poles make sense), but want to reverse warming where it counts most (again the poles), and short-lived aerosols that naturally occur anyway (such as SO<sub>2</sub>) would limit unforeseen damage if miscalculation occurs. We have already altered our atmosphere for the worse, on repeated occasions and varied ways; we may just have to alter it again in a well thought out, thoroughly responsible way this time to avoid an increasingly difficult future.

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# **Social/ Circular Economy/ Restoration/ Future Automobile**

# Headwing-Economics - Moving Towards Global Mutual Prosperity

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**Abstract:** The futurist David Wood predicts that abundance for all – beyond a world of scarcity and conflict is possible. The word 'abundance' here means that there will be enough for everyone to have an excellent quality of life. No one will lack access to healthcare, accommodation, nourishment, essential material goods, information, education, social engagement, free expression, or artistic endeavour. This is good start to define what 'mutual prosperity' should look like. However, for abundance and prosperity to occur mutuality must come into play. Mutuality is the sharing of a feeling, action, or relationship between two or more parties, namely co-operation for that benefits people based on the principle of mutuality. Happiness is ensured by the relationships with other human beings which leads to prosperity and abundance for all. Wood (2020) maintains that for abundance to occur a sense of transcendence is needed in which humanity can soar beyond the limits which have stunted human experience and development. An updated social contract is needed.

Today, at a time when the ideology of proletarian public ownership has come to an end, humanity is faced with a new ideology on private ownership called neoliberalism which aspires for the maximization of profit and globalization of private ownership, the elimination of price controls, deregulation of capital markets, lowering trade barriers and reducing state influence in the economy. However, this does not mean that public ownership ideology has completely disappeared or is going to disappear, since it is an alternative ideal set forth by humanity. Private ownership could be argued to be a human right that needs to be protected since we all feel a deep sense of satisfaction and joy with what we own.

Capitalism, socialism and communism are all based on ownership. Capitalism focuses on private ownership whereas socialism and communism mainly focus on social ownership. What is ownership under the Principle of Interdependence n Unification Thought? It is "joint ownership based on true love" which is an important requisite in ownership - a psychological element of love. Private ownership in capitalism where capital monopolizes ownership our shared communal resources leads to egoistic lives that place priority on matter and disregard humanity. The Principle of Interdependence believes that, rather than this capitalism, socialism with its aim of joint ownership is much closer to an ideal.

Historically, resource scarcity and the resulting competition has led to conflict. Some may believe that the fair distribution is simply not possible, and therefore, grabbing the pie is justifiable. Finding the best way to achieving mutual prosperity is one of the great challenges of our time. Public-private research collaboration should be structured towards building knowledge and human capital to benefit all. If a winner-takes-all dynamic plays itself out between countries as well as within them, this will increase social tensions and conflicts and create a less cohesive world. Unless public and private sector leaders assure that citizens have an opportunity to better their lives, social unrest, mass migration and violent extremism could intensify. Ensuring that people are not left behind is not just a moral imperative; it is a critical goal that will mitigate the risk of global instability.

I maintain that the values and practices that underpin mutual prosperity are an entrepreneurship, the equalization of wealth and technology, strengthening social nets, co-ownership, connectivity, inclusivity, sustainable development, food security and good governance.

**Keyword:** prosperity, headwing, ownership, globalization and wealth

## 1. Introduction

Over Finding the best way to achieve a flourishing economy and mutual prosperity in the global village is one of the great moral and economic challenges of our time. Avoiding a quest for mutual prosperity has consequences. Historically, resource scarcity and the resulting competition has led to conflict [1]. Schwab [2] maintains that ensuring people are not left behind is not just a moral imperative; it is a critical goal that will mitigate the risk of

global instability. Hence, an evaluation of current economic models and the proposal of a new social contract is needed.

Rev. Dr S.M. Moon and Dr H.J. Han Moon suggested such a new social contract based on mutual prosperity and a new form of economics using 'headwing' thought. They used this term referring to a society guided by moral and spiritual values that are neither right-wing nor left-wing but something that transcends both [3]. I would like to propose a possible economic definition which I refer to as "headwing-economics". When applied to economic prosperity, the objectives of economic conservatism (private ownership, free market economics, and opportunity) and the objectives of progressive economics (fair distribution of wealth) are both allowed to flourish.

## 2. Methodology

Knowledge production within the field of economics research is accelerating at a tremendous speed while at the same time remaining fragmented and interdisciplinary. This paper relied on the review of economic theory from both con-servative and progressive economists. This was necessary to find a holistic approach to mutual prosperity.

## 3. Discussion

### 3.1. Evaluating Current Models for Economic Prosperity

Over the last three decades, globalization and free-market policies have become the political and economic dominant discourse of our time. Neoliberalism aspires for the maximization of profit and globalization of private ownership as the mechanism for allocating goods and services through regulatory reforms, open competition, and economic growth. Proponents of free market capitalism argue that anything that interferes with the market (such as government regulations and public values), creates economic inefficiency. Regulations strangle initiative, competitiveness, and growth [4].

### 3.2. Issues with Market-Based Capitalism

However, some of the principles and applications of free market capitalism have their shortcomings and create obstacles to mutual prosperity. Current economic models have not always produced the best outcomes for people (enabling poverty), or the environment (enabling pollution and the overuse of resources).

The first systemic economic problem of free-market capitalism is that private ownership can lead to prioritizing individual gain at the expense of the whole of society [5]. The second systemic problem of free-market capitalism is inequality and low standards of living for many. Human development might have progressed over the past 20 years, yet the world still faces increasing inequality within and between nations. Living standards in developed countries are high, but this is not the reality for the majority of our fellow citizens in the world [6].

The third systemic economic problem of free-market capitalism is a lack of opportunities. The argument goes that those who do not rise, have no one to blame but themselves. However, in the United States the reality is that the most privileged Americans have a stranglehold on power and wealth [7, 8]. The fourth systemic economic problem of free-market capitalism is the uneven economic playing field. Proponents of free-market policies argue that the policy makers do not need to consciously redistribute the world's resources and wealth, as this will naturally result from the trickle-down processes that make up the free market. However, an uneven playing field exists because the rich can more easily control environmental assets such as land, water, and forests that are meant to be the common good [9], and in poorer countries, entrepreneurs face economic decline, dilapidation of key infrastructure, hyperinflation, the unpredictable costs of raw materials, the high cost of borrowing money, power cuts, fuel, and water shortages [10].

The fifth systemic economic problem of free-market capitalism is that the rich exert a great deal of influence on the political system. Governments feel compelled to not redistribute wealth because of the fear that the rich will withhold investments or shift assets away from their countries [11]. The sixth systemic problem is the disconnect between our desire for infinite growth that current economic logic demands and the finite resources of Planet Earth [12]. The seventh systemic problem is the disconnect between gross domestic product (GDP) and well-being. Research on developed countries shows that, contrary to popular belief, higher GDP and higher material consumption do not necessarily translate into more well-being [12].

The eighth systemic economic problem of free-market capitalism is the greed and corruption in global economic systems. The globalized world is both a source of progress and a source of vulnerabilities [12].



### 3.3. *Headwing-Economics - Moving Towards Global Mutual Prosperity*

Dr. Moon [13] maintained that free-market principles often overemphasize economic values above social justice and environmental concerns. Democratic capitalism at times degrades human existence to materialism, thus demining the value of human beings. Scharmer and Kaufer [12] argue that transforming our current ego-system economy (the well-being of oneself) into an emerging eco-system economy (well-being of all) means reconnecting economic thinking with well-being of the whole of society.

I argue that the values and practices that underpin mutual prosperity are private and co-ownership, entrepreneurship, the equalization of wealth and technology, strengthening social nets, connectivity, inclusivity, sustainable development and good governance.

#### 3.3.1. Ownership

Capitalism, socialism, and communism are all based on their own conception of ownership. Headwing thought maintains that some form of co-ownership based on love, rather than capitalism is needed [5]. The family is a good model for mutual prosperity. In the family, the needs of the whole (the family) and the needs of the individual are naturally harmonized through love. Co-ownership also exists in communities [14, 15].

Working models for co-ownership and mutual prosperity already exist. For example, The Center for Economic and Social Justice (CESJ) is a non-profit organization in the United States that has a very successful model for implementing co-ownership of businesses. CESJ has developed a commonsense, comprehensive program of monetary, tax, and inheritance reforms called “Capital Homesteading” to liberate every person economically through universal access to significant, direct capital ownership, without redistribution of existing wealth or taxpayer subsidies [16].

#### 3.3.2. Entrepreneurship and Opportunity

Entrepreneurs are agents and drivers of development in most economies of the world [10]. There is a strong correlation between a growth mindset and the ability to move out of the cycle of poverty. However, an empowered mindset needs to be supported by society. Poor people must be helped to discover and use their own abilities and assets [17].

#### 3.3.3. The Equalization of Wealth and Technology – Fair Distribution

The worldview based on mutual prosperity is based on the principle of the importance of the common good and the fair distribution of wealth. Democracies are more stable when there is sufficient per-capita income [11].

The equalization of wealth and standards of living was pursued by communism forcefully, but this failed. Mutual prosperity advocated by Dr Moon takes a different approach. It is about a shared responsibility that is voluntary, based on the ethics of love and justice. Developed countries should be ready to make sacrifices for the sake of under-developed countries. This approach will not bring about the decline of rich countries. The opposite will happen [15].

The World Bank suggests that a new “Shared Prosperity Indicator” can be used to measure income growth of the bottom 40 percent in each country [6]. Jim Yong Kim [18], the former President of the World Bank Group argues that global economic development is good for the bottom line. Strong economic growth in developing countries became an engine for the global economy after the 2008 financial crisis, accounting for roughly 50 percent of all global growth.

#### 3.3.4. Strengthening Social Nets

Notwithstanding the inevitable inequalities generated by the capitalist system, the growth in wealth through the latter half of the twentieth century brought some important economic, social, and health benefits for many citizens. Businesses prospered, labor unions secured high wages, and benefits for workers and government created new social programs (nets) to support those in need [4]. In this sense, the welfare of the people was widely adopted by policy makers in many nations.

#### 3.3.5. Connectivity and Inclusivity

Physical connectivity such as digital infrastructures, science and research cooperation, people-to-people connectivity, the empowerment of women and girls are also means of promoting inclusive growth and the achievement of the United Nations Sustainable Development Goals (UN SDGs). For example, strengthening the financial inclusion of women, and promoting women entrepreneurship in micro, small, and medium enterprises are critical to foster mutual prosperity [6].

#### 3.3.6. Sustainable Development and Equity



The 'three-pillar approach for sustainable development' aims to create a balance between environmental, social, and economic goals. A healthy society gives equal attention to ecological sustainability, economic development, and social justice because they are mutually reinforcing [19].

### 3.3.7. Good Governance

Good governance is critical for mutual prosperity. There are several dimensions to this: individual, institutional, and governmental. Institutional and governmental governance relies on the assumption that most human beings are socially conscious, with a small proportion pursuing personal gain at the expense of the public good. There is no guarantee that the participation of civil society can ensure good governance since unproductive and corrupt conduct permeates both markets and civil societies [20]. Hence, honesty, integrity, commitment to the common good is vital for mutual prosperity.

### 3.3.8. Governmental Governance

National governance constraints that affect a fair economy include political instability, poor governance, a lack of transparency, corruption, and weak legal systems. For example, political stability is often cited as being the main reason for entrepreneurs deciding whether or not to invest in new ventures [10]. The aim of good national governmental governance is to translate the policies of governments into action in such a way that the welfare of society is ensured [20].

### 3.3.9. International Governance

Good international governance has been promoted by international organizations such as the World Bank, International Monetary Fund, Organization for Economic Co-operation and Development, Association of Southeast Asian Nations, Asian Development Bank, the United Nations and many other organizations. These institutions motivate member countries to adopt good governance. The UN SDGs acknowledge that democracy, good governance, the rule of law, and an enabling environment at the national and international levels are essential for sustainable development [20, 21].

## 4. Conclusions

Finding the best way to achieve a flourishing economy and mutual prosperity in the global village is one of the great moral and economic challenges of our time. Hence, an evaluation of current economic models and the proposal of a new social contract is needed. A new social contract using mutual prosperity and 'headwing-economics' is based on private ownership, free market economics and opportunity (which are the values of economic conservatism), and include the fair distribution of wealth (which are the values of progressive economics).

Headwing-economics seeks to harmonize self-interest (freedom and opportunity) and social interest (fairness); the purpose of the individual and the purpose of the whole both being fulfilled. The values and practices that underpin mutual prosperity are private and co-ownership, entrepreneurship, the equalization of wealth and technology, strengthening social nets, connectivity, inclusivity, sustainable development, food security, and good governance.

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# A Prognostic Inspection and Proactive Maintenance System (PIPM) to Bring Snowball Effects on the Transition to the Circular Economy and a Carbon-Neutral Society

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**Abstract:** The Sustainable Development Goals (SDGs) of the United Nations and the international community are consisted of 17 goals and 169 specific goals and are to solve the global poverty problem and realize sustainable development between 2016 and 2030. No poverty, Zero hunger, Good health and well-being, Quality education, Gender equality, Clean water and sanitation, Affordable and clean energy, Decent work and economic growth, Industry, innovation and infrastructure, Reduced inequalities, Sustainable cities and communities, Responsible consumption and production, climate action, Life below water, Life on land, Peace, justice and strong institutions, Partnerships for the goals are 17 goals. Transition to the Circular Economy and a Carbon-Neutral Society could be the main structure to realize these SDGs. A Prognostic Inspection and Proactive Maintenance System (PIPM) of rolling bearings which could renewal service life repetitively about three times and thus it could be an innovative solution to change rolling bearing supply chain. PIPM system of rolling bearings will be a good solution to realize circular economy system and to reduce CO<sub>2</sub> emission significantly. 1 ton bearing of PIPM system can save more than 20 ton CO<sub>2</sub> emissions. PIPM system could be applied to mechanical components which needs replacement repetitively due to fatigue stress and so it could bring snowball effects on the transition to the Circular Economy and a Carbon-Neutral Society.

**Keywords:** Prognostic Inspection and Proactive Maintenance (PIPM) System, Circular Economy, Carbon-Neutral Society, Restoration

## 1. Introduction

Succeeding of the Millennium Development Goals of the United Nations which was launched in 1983, The 17 Sustainable Development Goals (SDGs) of the United Nations were formulated in 2015 by the United Nations General Assembly. The 17 goals and 169 specific targets are to solve the global poverty problem and realize sustainable development between 2016 and 2030. No poverty, Zero hunger, Good health and well-being, Quality education, Gender equality, Clean water and sanitation, Affordable and clean energy, Decent work and economic growth, Industry, innovation and infrastructure, Reduced inequalities, Sustainable cities and communities, Responsible consumption and production, Climate action, Life below water, Life on land, Peace, justice and strong institutions, Partnerships for the goals are 17 goals. The Division for Sustainable Development Goals (DSDG) in the United Nations Department of Economic and Social Affairs (UNDESA) acts as the Secretariat for the SDGs, and the United Nations Office for Sustainable Development (UNOSD) was established in 2011 in Incheon, the Republic of Korea [1, 2]. Francesco Fuso Nerini et al showed in their study that climate change can undermine 16 SDGs, while combatting climate change can reinforce all 17 SDGs but undermine efforts to achieve 12 (Responsible consumption and production) [3].

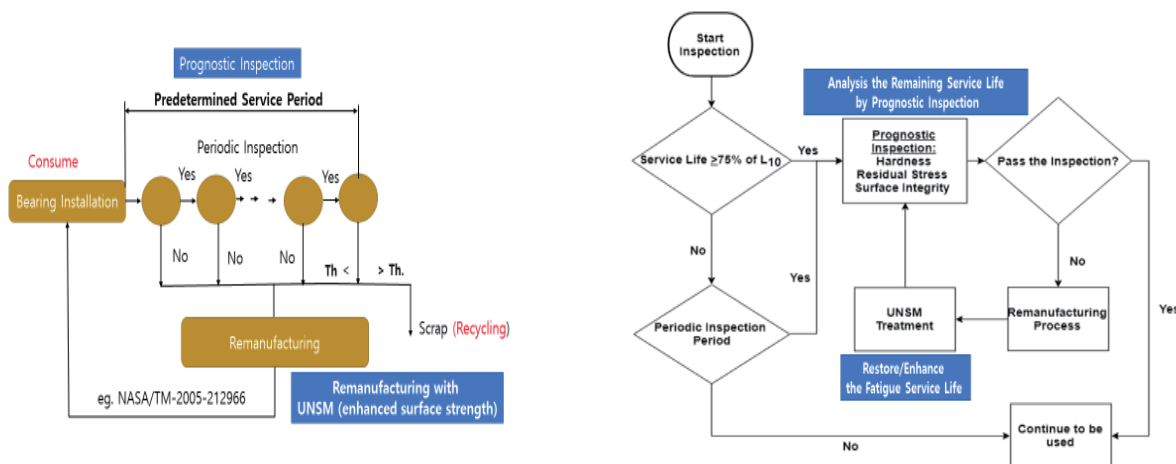
The objective of the IPCC (Intergovernmental Panel on Climate Change), which was created in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), is to provide governments at all levels with scientific information that they can use to develop climate policies. IPCC reports are also a key input into international climate change negotiations [4]. Nationally determined contributions (NDCs) reports are the Government decisions and actions for reduction of the total greenhouse gas emissions (mainly CO<sub>2</sub> emissions) following the Paris Agreement. Final goal of IPCC is to realize net-zero emission and is in line with 'Climate action' of SDGs.

The definition of Circular Economy is “A production and consumption model which involves reusing, repairing, refurbishing and recycling existing materials and products to keep materials within the economy wherever possible. A circular economy implies that waste will itself become a resource, consequently minimizing the actual amount of waste. It is generally opposed to a traditional, linear economic model, which is based on a ‘take-make-consume-throw away’ pattern.” The European Union introduced its vision of the circular economy in 2014 and made Circular Economy Action Plan in 2021, in which scaling up the circular economy from front-runners to the mainstream economic players will make a decisive contribution to achieving climate neutrality by 2050 and decoupling economic growth from resource use, while ensuring the long-term competitiveness of the EU and leaving no one behind. 11 goals among 17 SDGs are significant relationship with Circular Economy in the EU [5]. So transition to the Circular Economy and a Carbon-Neutral Society could be the main structure to realize these SDGs.

A Prognostic Inspection and Proactive Maintenance System (PIPM) is an integrated system of surface modification Technology and non-destructive inspection technology of surface characteristics with remanufacturing system. PIPM could be a new concepts of remanufacturing technology in circular economy and bring Snowball Effects on the Transition to the Circular Economy and a Carbon-Neutral Society.

## 2. Prognostic Inspection and Proactive Maintenance for Rolling Bearings

The concept of the Prognostic Inspection and Proactive Maintenance Program for Rolling Bearings as an extension of remanufacturing was proposed in 2019 as Fig. 1 [6].



**Figure 1.** Concept of PIPM (Prognostic Inspection and Proactive Maintenance) for Rolling Bearings.

Remanufacturing of rolling bearings is well-known methodology not only for saving materials and energy but also saving down time of production in aircraft operation, steel mill operation, train operation, etc. Periodic inspection, maintenance and remanufacturing are common practices and the detail practice for aircraft bearings and train bearings were developed as a standard manual [7, 8].

Built-up fatigue stress in terms of rolling contact fatigue stress and rotary bending fatigue stress could be restored by UNSM (Ultrasonic Nanocrystal Surface Modification) and so the service life could be even enhanced than the original service life of new one [9]. Application results in steel mill operation showed very good compromise to research results of test specimens [10].

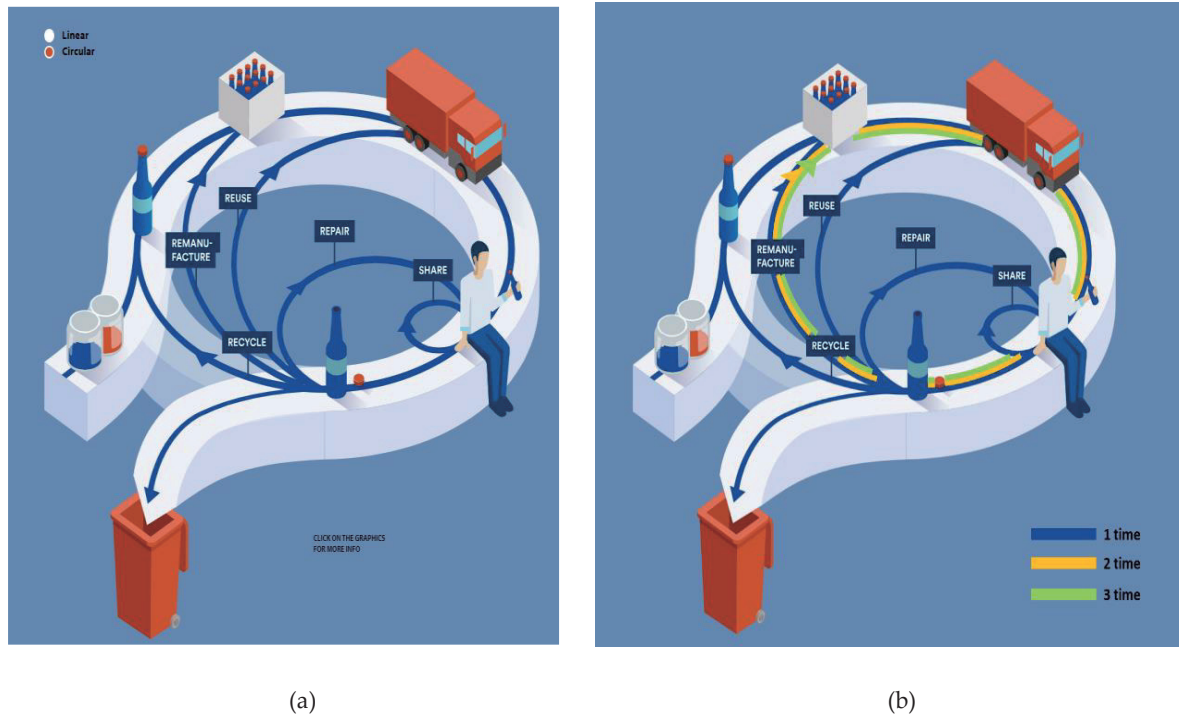
Remanufacturing applications of large size bearings for steel industry showed that the service life of remanufactured bearing together with ultrasonic surface modification (UNSM) is and even improved more than new ones. The reason why the restored service life was more than or equal to new ones was the improved surface roughness and surface hardness and increase compressive residual stress which was the effects of UNSM [11].

The UNSM technology itself is a kind of green technology which use only Max. 1.5 Kw power consumption. But it could induce sever plastic and elastic deformation on the surface till 1,100um depth by the up to 30 Giga Pascal dynamic pressure with the up to 2.4 million times strikes per minute. The main concepts and effects of UNSM are explained in Fig. 2 [12-15].









**Figure 4.** Improved Circular Economy with PIPM system: (a) Current Circular Supply Chain; (b) PIPM Circular Supply Chain.

Conventional remanufacturing process could reduce the purchasing cost about 35% and lead time about 50%. PIPM system with remanufacturing process could reduce another 5% of purchasing cost. But more important effects are saving raw materials and energy and CO<sub>2</sub> emissions. Carbon intensity of steel is 2~4, which CO<sub>2</sub> output ton per steel 1 ton production.

Typical large size bearings for hot rolling line in steel industry which has 1 ton weight. Buy to fly ratio of forging and machining process of bearings is about 16:1, which means 16 ton of raw steel is needed to produce 1 ton product [16-18]. So PIPM system with remanufacturing process of 1 ton bearing can save about 32 Tonne CO<sub>2</sub> emissions.

### 3. Discussion and Concluding Remarks

The current price of CO<sub>2</sub> emission savings per 1 Ton is 50\$, but IPCC estimated that it could be increased up to \$100. So when 96 times of saving is approved, 1 Ton of PIPM system with remanufacturing bearing process could be valued about \$48,000 ~ 96,000. So it is already 2.5~5.6 times of new bearings, because the average price of 1 Ton bearings is \$17,000.

Annual production of bearings in world is about 7 million ton. So it is not difficult to adapt 10% of bearings in the PIPM system with remanufacturing process. The annual savings of total CO<sub>2</sub> emission could be reach up to 67.2 million tons (\$3.36 ~7.72 Billion). This is almost 9.2 % of Korea NDC reduction target 727.6 Mt CO<sub>2</sub>eq by 2030

PIPM system could be expanded to any kinds of metal components which needs periodic maintenance in order to restore their fatigue service life like as snow ball effects, then their expecting savings could become several hundred times in bearings. Typical industries are Electric power industry, Aerospace industry including airway industry, Chemical industry, Gas and Oil industry, Shipbuilding industry, etc.

Nevertheless, total sum of saving look like huge and good enough to shift to adopt PIPM system with remanufacturing process. When we consider a typical Korean steel manufacturers who is using about 4,000 tons of bearings, their savings and benefits are about 38,400 tons of CO<sub>2</sub> and \$1,920,000~3,860,000 respectively. This amount of financial benefit is not considerable motivation for the operation engineer or manager to adopt this system

Policies like carrots (eg. financial benefits) and sticks (eg. mandatory usage rate) to adopt PIPM system with remanufacturing process should be introduced. Especially the application of PIPM systems with the remanufacturing process should become a top priority of policies and cultures in industry and society.

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# Code Case N-931 and UNSM Technology for the Improving Service Life and Safety of Nuclear Power Plant

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**Abstract:** Following the inquiry “What requirements may be used for performance and qualification criteria of surface stress improvement processes (SSIP) to mitigate the potential for stress corrosion cracking (SCC) for Section III, Division 1 and 3 items?” The code case N-931 “Performance and Qualification Criteria for Mitigation of Stress Corrosion Cracking by Surface Stress Improvement: Section III, Division 1 and 3” was developed since 2017 by the task group “Advanced Surface Stress Improvement Technology” in Korea International Working Group of ASME (American Society of Mechanical Engineers). This case provides performance and qualification criteria for the pre-service application of a surface stress improvement process (SSIP) to Section III Division 1 and 3 items potentially susceptible to SCC, as a means to prevent crack initiation. Mitigation of items to the requirements of this case does not modify or change the in-service inspection (ISI) requirements for those items. Items with base material potentially susceptible to SCC due to environmental conditions that have been identified in the design specification, as required by NCA-3211.19(b) (Division 1) or by WA-3351.2 (Division 3). Items with weld material potentially susceptible to SCC due to tensile residual stresses caused by weld repairs at the wetted surface. Paragraphs NB-4451, NCD-4451, and NG-4451 prohibit weld repairs on the wetted surface of items susceptible to SCC unless a mitigation action is applied. This Code Case is to be used for surface stress improvement processes such as ultrasonic nanocrystal surface modification (UNSM), water jet peening, or laser peening that satisfy the performance criteria and qualification criteria defined in this case. Two major technical bases for this code case are PVP2022-85151 and EPRI Report 3002018458. Brief summary of UNSM technology and two technical bases is introduced.

**Keywords:** ASME Code Case, SSIP (surface stress improvement process), UNSM (ultrasonic nanocrystal surface modification), SCC (stress corrosion cracking), SMR (small modular reactor)

## 1. Introduction

ASME, as The American Society of Mechanical Engineers, is a certification body for standardization in the mechanical field. ASME Code Cases is a certification procedure for early implementation of approved code revisions or urgent replacement rules for materials, construction, or in-use inspections that are not covered by the existing boiler and pressure vessel code regulations. Code cases are effective upon ASME approval.

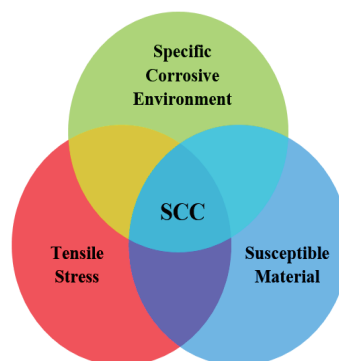


Figure 1. Stress Corrosion Cracking Venn Diagram(.)

Stress corrosion cracking (SCC), as shown in Figure 1, is the most vulnerable part for the life of nuclear power plant equipment. Stress corrosion cracking occurs only when these three conditions are satisfied simultaneously: 1) susceptible material, 2) tensile stress, and 3) corrosive environment [1]. Work to apply SSIP (Surface Stress Improvement Processes) to mitigate SCC started from KIWG (Korea International Working Group) in 2017. UNSM technology is one of the SSIP technologies, and the SSIP technology meets the performance and qualification criteria for SCC mitigation, and N-931 code case has been approved. This code example is based on PVP2022-85151 and EPRI Report 3002018458 and introduces this underlying technology and UNSM technology.

## 2. Surface Stress Improvement Processes

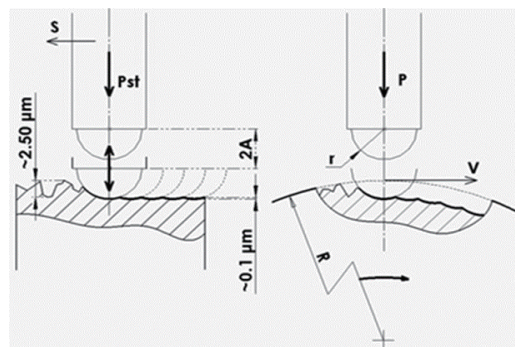
The SSIP available for the N-931 are UNSM (ultrasonic nanocrystal surface modification), WJP (water jet peening), LP (laser peening) technologies, and the characteristics of the technologies are shown in Table 1 [2, 3].

**Table 1.** characteristics of SSIP available in Code Case N-931

Contents	WJP	LP	UNSM
Mechanism	Shockwave		Resonance/Continuous Contact
Source of Impact	Cavitation Bubble	Laser Ablation	Solid Ball/Tip
Source of Energy	Water Jet	Pulse Laser	Ultrasonic Vibration
Contact Pressure and Impulse	~10 GPa Kinetic	~12 GPa Kinetic	~30 GPa Static and Dynamic
Contact Numbers Controllability	Random Process		Deterministic Control
Surface Compressive Residual Stress (CRS)	~1.0 GPa		~2.0 GPa
Effective Depth of CRS	More than 1 mm		
Surface Hardness	Increase The effective depth is shallower than the effective depth of CRS		
Surface Roughness	Rougher		Smoother
Nano Structure Nano Twin	Nano Grain Refinement		

### 2.1. UNSM technology

The main concept and mechanism of UNSM technique are shown in Figure 2. A tungsten carbide ball attached to an ultrasonic device that strikes the surface of a work-piece 20,000 or more times per second with 1,000 to 100,000 shots per square millimeter. These strikes, which can be described as micro cold-forging, bring severe plastic deformation (SPD) and elastic deformation to surface layers and thus generate nano-crystalline structure. This nano-structural modification of the surface layer can improve both the strength (hardness) and ductility (toughness) of the work-piece simultaneously according to the well-known Hall-Petch theory [4, 5]. This process also improves surface integrity, increases surface hardness, produces micro-dimples, and induces compressive residual stress in surface layers. The UNSM effects and their anticipated benefits are summarized in Table 2.



**Figure 2.** Mechanism of UNSM

**Table 2.** The effects of UNSM treatment and their anticipated benefits

Effects of UNSM treatment	Anticipated benefits
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<b>Deep compressive residual stresses</b> (Greater than 1,000MPa into depths of more than 2,000 $\mu$ m)	Improved LCF and HCF endurance limit Improved rolling contact fatigue strength Improved stress corrosion cracking resistance
<b>Micro dimples surface</b> (Area: 1-2 $\mu$ m <sup>2</sup> , Depth: submicron, Pattern pitch: few $\mu$ m)	Reduced surface roughness Decreased friction coefficient Reduced wear rate
<b>Increased hardness</b> (into depths of more than 1,500 $\mu$ m)	Reduced wear rate Improved LCF and HCF endurance limit
<b>Nano-crystalline structure</b> (Grain sizes of 50-200nm into depths of 100 $\mu$ m)	Increased tensile strength and hardness Increased fatigue strength Increased wear resistance

### 2.2. Water Jet Peening technology

The WJP process utilizes cavitation bubbles to produce a shockwave which is generated in a submerged water jet as shown in Figure 1 [6]. The cavitation bubbles are produced by the strong shear force that acts on the boundary between the high-speed jet and the surrounding stationary water, and the bubbles are carried by the high-speed water jet to the material surface. The collapse of the cavitation bubbles generates a large shock pressure more than 1 GPa that causes local plastic deformation.

### 2.3. Laser Peening technology

The physical principle involved in laser peening treatment (also known as laser shock peening (LSP)) is considered to be an energy conversion procedure from a laser to shock wave that results in material plastic deformation by pressure of several GPa. After the passage of the shockwave, the permanent strain remains and the surrounding metal material constrains the strained region as a reaction to elastic strain, thus forming a compressive residual stress on the metal surface [7].

## 3. Development of a Code Case for Application of SSIP

The contents of the developed Code Case N-931 are shown in Table 3 [8].

**Table 3.** Code Case N-931

<b>Case N-931: Performance and Qualification Criteria for Mitigation of Stress Corrosion Cracking by Surface Stress Improvement: Section III, Division 1 and 3</b>		
Inquiry: What requirements may be used for performance and qualification criteria of surface stress improvement processes (SSIP) to mitigate the potential for stress corrosion cracking (SCC) for Section III, Division 1 and 3 items?		
Reply: It is the opinion of the Committee that the following requirements may be used to qualify surface stress improvement processes used to mitigate stress corrosion cracking for Section III, Division 1 and Division 3 items.		
1000	SCOPE	This Case provides performance and qualification criteria for the pre-service application of a surface stress improvement process (SSIP) to Section III Division 1 and 3 items potentially susceptible to SCC, as a means to prevent crack initiation. Mitigation of items to the requirements of this Case does not modify or change the in-service inspection (ISI) requirements for those items.
1100	ITEM APPLICABILITY	The following items may be subject to application of a SSIP <ul style="list-style-type: none"> <li>a) Items with base material potentially susceptible to SCC due to environmental conditions that have been identified in the Design Specification, as required by NCA-3211.19(b) (Division 1) or by WA-3351.2 (Division 3).</li> <li>b) Items with weld material potentially susceptible to SCC due to tensile residual stresses caused by weld repairs at the wetted surface. Paragraphs NB-4451, NCD-4451, and NG-4451 prohibit weld repairs on the wetted surface of items susceptible to SCC unless a mitigation action is applied.</li> </ul>
1200	SURFACE STRESS IMPROVEMENT PROCESSES	This Case may be used for surface stress improvement processes such as ultrasonic nano-crystal surface modification, water jet peening, or laser peening that satisfy the performance criteria and qualification criteria defined in this Case.
1300	EXAMINATION SEQUENCE	The provisions of NB-4422(b), NCD-4423.3(b), and NG-4422(b) state that surface stress improvements shall be performed after examinations required by NB/NCD/NG-5000 are



	<p>completed. However, the required preservice examinations/ inspections (PSI) specified by Section III shall be performed after application of the SSIP.</p> <p>A surface examination shall be completed after surface stress improvement when not required by PSI or when there is no PSI. The acceptance criteria for surface examinations shall be either NB-5340 or NB-5350.</p>
2000 SURFACE STRESS IMPROVEMENT PROCESS PERFORMANCE CRITERIA	<p>To minimize the likelihood of crack initiation, the process shall have resulted in a mitigated stress state in the susceptible material along the entire wetted or susceptible surface under steady state operating conditions (i.e., item subject to operating pressure while at operating temperature). Susceptible material includes the weld, butter, and base material, as applicable. The residual stress plus normal operating stress shall be included in the evaluation.</p>
2100 COVERAGE, DEPTH, and STRESS CRITERIA	<p>A combination of demonstration testing and analysis shall be performed to demonstrate the required capability of the SSIP to produce the required post-mitigation stress state. A demonstration test shall be performed to confirm the post mitigation stress state exclusive of normal operating stresses. The testing shall be used to demonstrate the critical process parameters and define acceptable ranges of the parameters needed to ensure that the required residual stress field (exclusive of operating stresses) has been produced on the mitigated surface.</p> <p>Specimens representative of the geometry, materials, accessibility, and surface condition of the item to be mitigated by a SSIP shall be used for the testing. The nominal wall thickness of the specimen shall be no greater than that of the item to be mitigated by a SSIP.</p> <p>An analysis shall be performed to determine the effect of normal operating loads on the steady-state operating stresses at the surfaces required to be mitigated by a SSIP. The uncertainty in measurement of the surface residual stress shall be considered in the analysis to determine the surface stress including operating and residual stress.</p>
2110 ITEM WELD MATERIAL SUSCEPTIBLE TO SCC	<p>a) To ensure full coverage of the susceptible material, the SSIP application shall extend at least 0.25 in. (6 mm) beyond the edge of welds or weld repair areas on the wetted surface.</p> <p>b) The nominal compressive residual stress field shall extend to a minimum depth of 0.04 in. (1.0 mm).</p> <p>c) The effect produced by the SSIP shall result in a mitigated surface stress state no greater than +0 ksi (+0 MPa) including residual and operating stresses.</p>
2120 VESSEL PENETRATIONS, WITH PARTIAL PENETRATION WELDS, SUSCEPTIBLE TO SCC	<p>a) To ensure full coverage of the susceptible material, the SSIP application shall extend at least 0.25 in. (6 mm) beyond the edge of welded areas.</p> <p>b) The nominal compressive residual stress field shall extend to a minimum depth of 0.04 in. (1.0 mm) on the outside surface of the penetration nozzle and attachment weld surface.</p> <p>c) The nominal compressive residual stress field shall extend to a minimum depth of 0.01 in. (0.25 mm) on the inside surface of the penetration nozzle in areas adjacent to the attachment weld.</p> <p>d) The effect produced by the SSIP shall result in a mitigated surface stress state no greater than +0 ksi (+0 MPa) including residual and operating stresses.</p>
2130 ITEM BASE MATERIAL SUSCEPTIBLE TO SCC	<p>a) The SSIP coverage shall extend at least 2 in. (50 mm) from each side of each weld centerline or at least 1 in. (25 mm) from the weld edge, whichever is larger.</p> <p>b) The nominal compressive residual stress field shall extend to a minimum depth of 0.04 in. (1.0 mm).</p> <p>c) The effect produced by the SSIP shall result in a mitigated surface stress state no greater than +0 ksi (+0 MPa) including residual and operating stresses.</p>
2140 NOMINAL DEPTH OF COMPRESSIVE RESIDUAL STRESS	<p>The nominal depth of the compressive residual stress field is the depth of the compressive residual stress that is reliably obtained in demonstration testing, i.e., for at least 90% of the locations measured.</p>
3000 MITIGATION EFFECTS SUSTAINABILITY CRITERIA	<p>The effect produced by the mitigation process shall remain effective for the design life of the item. Analysis or testing shall be performed to verify that the mitigation process maintains the surface stress condition identified in -2110(c) -2120(d), and -2130(c), under normal</p>

		operating plus residual stress, for at least the design life of the item. The analysis or demonstration test plan shall include startup and shutdown stresses, normal operating pressure stress, thermal cyclic stresses, transient stresses, and residual stresses. The analysis or demonstration test shall account for: (a) load combinations that could relieve stress due to shakedown (b) any material properties related to stress relaxation over time
4000	EXAMINATION CAPABILITY CRITERIA	
4100	VOLUMETRIC EXAMINATION QUALIFICATION CRITERIA	The capability to perform volumetric examinations, as required by the applicable ISI requirements for the relevant volume of the item, shall not be adversely affected.
4200	SURFACE AND EDDY CURRENT EXAMINATION QUALIFICATION CRITERIA	The capability to perform surface and eddy current examinations, as required by the applicable ISI requirements for the relevant inspection area of the item, shall not be adversely affected.
4300	VISUAL EXAMINATION QUALIFICATION CRITERIA	The capability to perform visual examinations of the accessible surface on the item shall not have been adversely affected.
5000	ADVERSE EFFECTS CRITERIA	The SSIP, including vibration effects during application, shall not degrade the item or adversely affect other items in the system, including generation of new flaws.
5100	GEOMETRY EFFECTS CRITERIA	An analysis or testing shall be performed to verify that the SSIP does not result in changes to the item geometry that exceed Section III design criteria.
5200	SURFACE EFFECTS CRITERIA	Analysis or testing shall be performed to verify that the SSIP does not cause erosion of surfaces, undesirable surface roughening, or detrimental effects in the transition regions adjacent to the regions mitigated by the SSIP. The SSIP shall not reduce wall thickness of the item below minimum design thickness.
6000	INSPECTABILITY CRITERIA	The mitigated item, including the weld and weld repair in the repaired region, shall be inspectable by the required ISI examination method(s). Examination coverage of 100% shall be achieved for the required volume and surface area mitigated by SSIP.
7000	DOCUMENTATION	This Case number shall be identified on the Data Report.

#### 4. Conclusions

SMR is attracting attention as a future energy source, and is being developed in the United States with the goal of commercialization in 2027. SCC prevention will be a very important factor in the lifespan of nuclear power plants currently in use and future SMR devices. The most efficient way to prevent SCC is to increase device life through surface modification rather than expensive material development. However, there is no standard to apply so far, so new Code Case N-931 "Performance and Qualification Criteria for Mitigation of Stress Corrosion Cracking by Surface Stress Improvement: Section III, Division 1 and 3" was developed. The SSIPs can be applied to parts where SCC is expected to occur in newly manufactured nuclear power plants through this standard. Currently, a UNSM device for application to SMR parts is being developed, and it will be possible to mount and apply it to devices such as robots and manipulators in the future.

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# Sequential behavior design for monitoring cell voltage

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**Abstract:** As environmental problems such as warming and air pollution have recently emerged, countries around the world are expanding the supply of electric vehicles as part of their eco-friendly policies. However, as electric vehicles are distributed, electric vehicle fires continue to occur. The main cause of such an electric vehicle fire is battery overload caused by battery management system (BMS) malfunction. The existing BMS measured the voltage of the battery by physically connecting each battery cell and controller. However, in electric vehicles, batteries operate up to 1,000 volts or more. BMS, which is a circuit that manages a battery in such a high voltage environment, operates at a low voltage of 5 Volt or less, and thus if a high voltage battery voltage incorrectly affects a BMS board operating at a low voltage, the BMS board is destroyed, causing battery malfunction and battery explosion. Thus, indirect measurement technology that physically isolates battery cells and low voltage control boards is important to compensate for these problems. In the indirect measurement method of the isolation structure obtained from the previous research for safe battery voltage measurement, the voltage monitoring result of battery cells of several mV~several tens of mV was caused by an error due to the device imbalance and temperature characteristics of battery cells found in the parallel structure. To resolve this problem, battery voltage was monitored sequentially on all battery cells with a single indirect measurement path, and thus an inaccurate battery cell voltage monitoring result was overcome at once due to device imbalance and temperature characteristic difference. In a process to sequentially recognize the battery cell voltage as a single path, the voltage (REF\_V) to compensate for a change in monitoring voltage according to temperature could be compensated by also applying the voltage (REF\_V) to compensate for temperature, so the exact battery voltage was recognized at any temperature. As a result of the design, temperature compensation was performed within 5.12 usec based on 16 battery cells, and the proposed single path Multi-Cell technology drove 1.6 mW to reduce power consumption to 1/3 of the existing research results. The research result of this paper automatically generates REF\_V and battery cell voltage, which are temperature compensation voltages, together with a code value so that a battery voltage of multi-cell could be sequentially known, so that the BMS operation could be accurate without the control of the CPU.

**Keywords:** Sequential, isolation, monitoring, Battery Management System, automatically

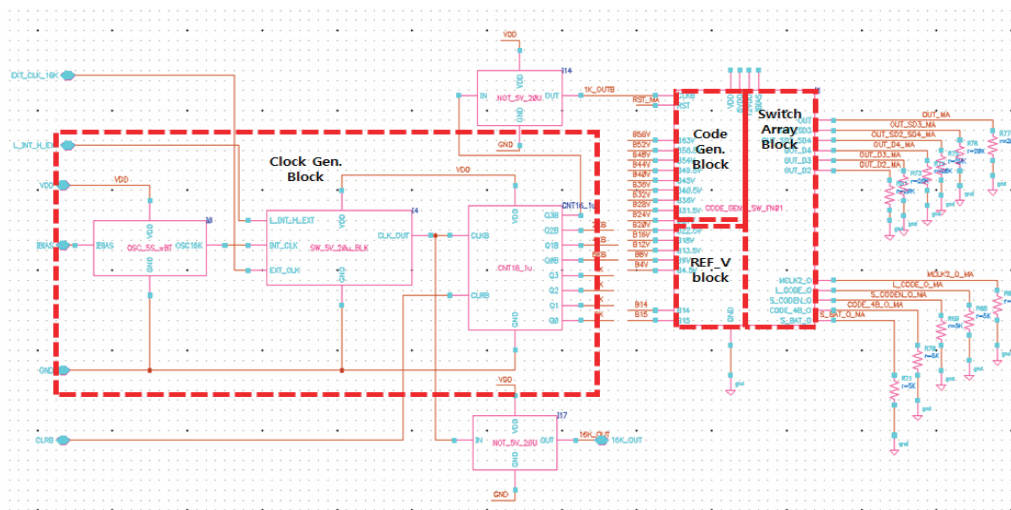
## 1. Introduction

As environmental problems such as warming and air pollution have recently emerged, countries around the world are expanding the supply of electric vehicles as part of their eco-friendly policies. However, as electric vehicles are distributed, electric vehicle fires continue to occur. This electric vehicle fire is mainly caused by excessive battery overload caused by BMS(Battery Management System) malfunction [1]. The existing BMS measured the voltage of the battery by physically connecting each battery cell and controller. However, if the battery voltage operating up to 1, 000V or higher incorrectly affects the control board operating at low voltage, the control board is destroyed and the battery cannot be managed, leading to a battery explosion. Thus, to solve these problems, an indirect measurement technology was proposed and designed to physically isolate the battery cell and the low voltage control BMS board [2]. As battery usage expands, BMSs developed from Infineon, TI (Texas Instrument), and LT (Linear Technology) are being implemented as semiconductors [3, 4]. TI and LT companies have also implemented wireless functions by adding them to BMS circuits. However, TI and LT's wireless functions are limited to transmitting battery cell voltage information obtained through BMS operations to the outside. In terms of delivering battery information to the outside, it is convenient for users (or drivers) to easily obtain battery information, but risk factors that can be destroyed by affecting BMS semiconductor circuits operating at low voltages of thousands of volts have not been eliminated. In the paper [2] that proposed a safe BMS technology by separating a high voltage battery of thousands of volts and a BMS circuit of low voltage operation, there was a difference in temperature characteristics for each LED in using multiple LEDs for each battery cell. As a result,

there is a problem of causing an error in voltage recognition for each battery cell. This paper proposed that it could accurately monitor several battery cell voltages through a single path and compensate the temperature at the same time. Each battery cell was assigned a code to recognize the battery cell voltage by sending it along with a code to determine which battery cell voltage was measured when measuring voltage over a single path.

## 2. SEQUENTIAL BEHAVIOR BMS DESIGN

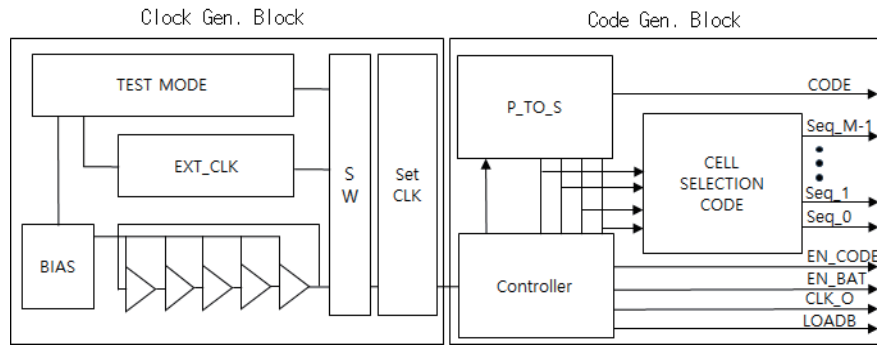
The existing isolated BMS monitoring has a monitoring circuit having a parallel structure for each battery cell, and thus has an error in a monitoring voltage for each battery cell due to a device process differences. In particular, a difference in temperature characteristics of each device according to temperature increases an error in a battery cell voltage monitoring value with respect to temperature. In the technology [2] operating on this basis, it operates with a voltage error of 5 mV. However, accurate voltage recognition for each battery cell through BMS monitoring operations is essential for stable battery operation. In this paper, for the accurate operation of monitoring the battery cell voltage according to the device error of the parallel structure, a BMS monitoring circuit that recognizes all battery cell voltages through one single path is implemented. Figure 1 shows the single-path multi-battery cell BMS monitoring structure that supports high-precision battery cell voltage measurement. As illustrated in Fig. 1, the isolated battery cell voltage monitoring is composed of Switch Array Block, Code Generation (Gen.) Block, and Clock Gen. Block. Clock Gen. Block is a circuit that generates a clock signal required to implement a BMS monitoring circuit that recognizes all battery cell voltages with one serial circuit, and Code Gen. Block is a battery cell that controls the operation of the Switch Array Block. And the Switch Array Block is a circuit that sequentially monitors the voltage of N battery cells through a single-path isolation circuit based on the Seq-M-1 signal obtained from Code Gen. Block. The unit cell battery voltage and the REF\_V obtained are transmitted to an electronic control unit (ECU) having an isolated structure, and thus the battery is managed based on the isolated ECU to support stable battery operation.



**Figure 1.** Proposed isolated structure for battery voltage monitoring.

### 2.1. Timing Control and Battery Code generation circuit design

A circuit that generates a control clock and a battery code is required to obtain a signal required for the operation of the Switch Array Block in Figure 1. For this performance, the Clock Gen. Block and Code Gen. Block in Figure 1 were designed, and Figure 2 shows them in detail.

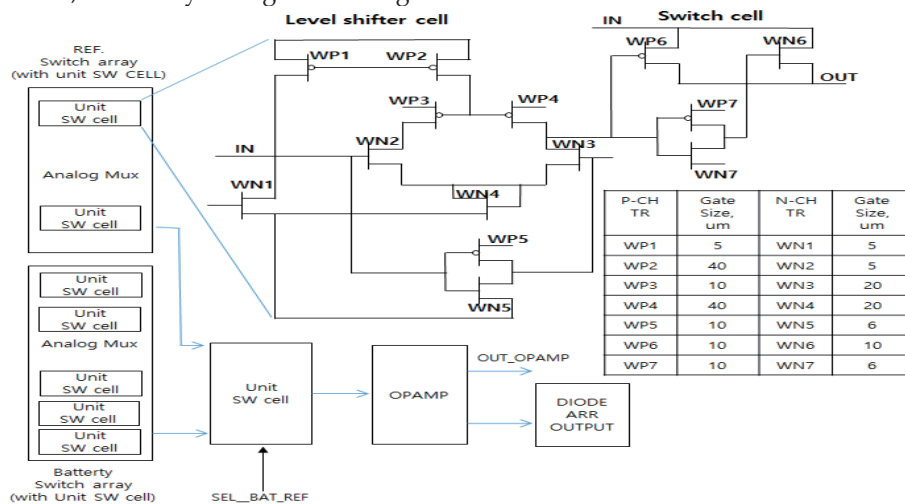


**Figure 2.** Control Clock Generation and Battery Code Generation Circuit.

The Clock Gen. Block shown in Figure 2 is selected between EXT\_CLK from the outside and an internal clock generated internally. Through TEST MODE, EXT\_CLK and internal clock can be selected to verify Code Gen. Block, and the voltage and current of BIAS of the internal clock can be monitored to see if there is any problem with the operation of the internal clock. Code Gen. Block in Figure 2 receives the final clock selected from Clock Gen. Block to generate a signal to sequentially obtain the battery cell and REF\_V voltage output to control the operation of Switch Array Block in Figure 1, and recognizes the EN\_BAT signal, EN\_CODE signal, and the battery cell selection signal, Seq\_M-1 CODE to get the selected battery voltage.

## 2.2. Switch Array Block Design

Figure 3 shows the Switch Array Block operating based on the Seq\_M-1 signal obtained from Code Gen. Block. A signal generated from Code Gen. Block is input to Switch Array Block, and it is sequentially input to the Unit analog Switch(SW) cell together with each battery cell voltage and internal REF\_V (voltage for temperature compensation) to be selected. In order to be used as a reference signal, REF\_V, for temperature compensation, 16 reference signals from 3.0V to 4.3V were internally made with 0.08V unit step. It was output sequentially through the REF Switch array shown in figure 3. In addition, for the battery unit cell voltages to be monitored sequentially, the Battery Switch array shown in Fig. 3 is configured to be output. In measuring all battery cell voltages, the battery cell voltages were measured together with internal (or external) REF\_V to perform a temperature compensation operation. If 16 battery cell voltages are measured until the final temperature compensated battery cell voltage is obtained, all battery voltages are recognized within 5.12μsec time.



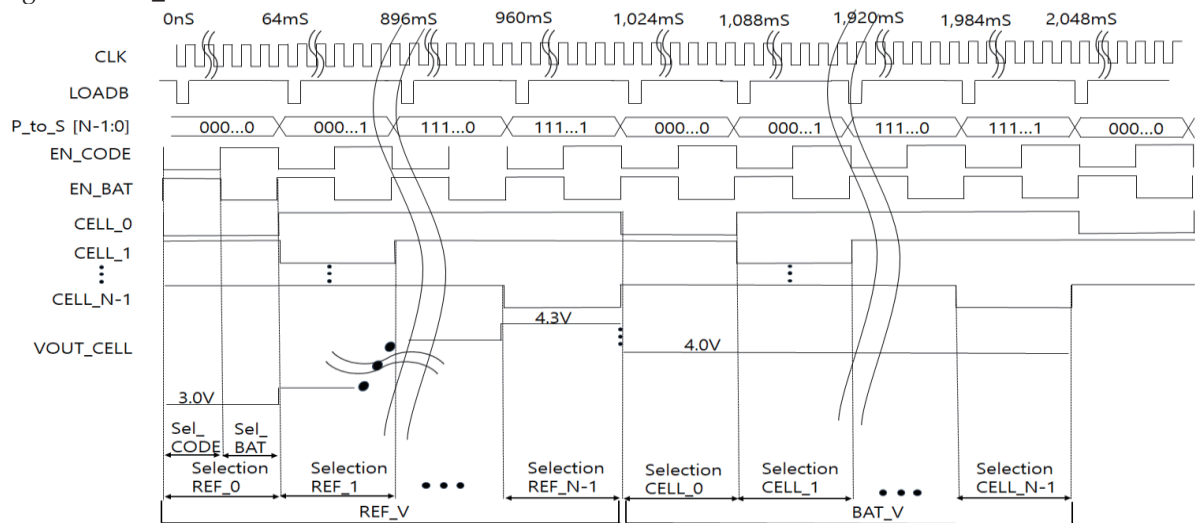
**Figure 3.** Design Switch Array Block Circuit Structure.

## 3. Results

This paper presents a single-path multi-cell-based BMS monitoring circuit. Figure 4 shows the timing chart of the signal in which the designed Switch Array Block, Clock Gen. Block, and Code Gen. Block in Figure 1 operate. In order to sequentially output the voltage of the battery multi-cell to one path, the P\_to\_S[N-1:0] signal, which is a code signal for selecting the battery cell, and the VOUT\_CELL signal, which is a battery voltage, are displayed. The VOUT\_CELL voltage is a signal for outputting the REF\_V voltage and the voltages of the battery cells, and it can be seen in Fig. 5 that the voltage is output with the code signal P\_to\_S[N-1:0] together with the



VOUT\_CELL so as to know which REF\_V and which battery cell voltage. In detail, the EN\_CODE signal receives a code signal in a low state for EN\_CODE, and a battery cell voltage or REF\_V in a low state for EN\_BAT so that the ECU may receive a voltage value separately with a code when receiving a multi-cell voltage and REF\_V.



**Figure 4.** Monitoring voltage Operation Timing Chart.

In order to stably transmit the code signal, a LOADB signal was transmitted before transmitting the code value together with the clock signal. The LOADB signal was transmitted after the half-clock signal after the EN\_CODE signal was generated as Low, and the code signal was transmitted after the half-clock signal after the LOADB signal was generated. In the verification, the half clock speed was set to 20 nsec. After the code transmission, the EN\_BAT signal becomes low after two clock signals after the code value is transmitted to take the battery cell voltage or the REF\_V stably. As shown in Fig. 5, it shows the REF\_V after the VOUT\_CELL output signals (BAT\_V) was sequentially output. It can be found that the REF\_V voltage is output from 3.0V to 4.3V in 0.08V unit. As a result of the design, it was possible to eliminate errors due to differences in characteristics of devices with one LED. Assuming that the battery pack is composed of 16 battery cells, it was verified that each of 16 temperature compensation REF\_V and all battery cell voltages were recognized within 5.12. Internally, the Clock Gen. and Code Gen. circuits were designed to enable BMS operation without a CPU control. In the existing technology [2], 16 LEDs of about 300uW per unit were used, and the total power consumption was 4.8mW (= 0.3mW x 16 cells). However, in this paper, by using one LED of 300uW, the entire power consumption operated at a total of 1.6mW consumption, including 1.3mW, as a single path multi-cell monitoring core function. This can reduce power consumption by 1/3 of the results of previous studies, resulting in reduced battery consumption in the BMS operation.

**Acknowledgments:** This work was supported by a Korea Evaluation Institute of Industrial Technology (KEIT) grant funded by the Korean government (MOTIE) (No. 20022473, Development of 5KWh High-Safety Expandable Battery Module for Electric Vans and Electric Utility Cart).

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# UNSM Device and Equipment for Industrial Application

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**Abstract:** Ultrasonic Nanocrystal Surface Modification (UNSM) technology was developed by IMST(Institute for Manufacturing System and Technology) of Sun Moon University and DesignMecha Co., Ltd. Since the first development, UNSM treatment had been applied in several industrial field. For the industrial application, UNSM device and equipment had to be implemented by the different way. Service life extension of industrial knife for steel industry, paper industry, etc. was the beginning of industrial application. Service life extension of new rolling bearings and restoring or even improving service life of remanufactured bearings for steel industry and cement industry were another success in industrial application. An innovative solution to prolong the service life of the mechanical fuse or breaker “shear pin” in stainless hot rolling line was implemented. Recently several customized UNSM devices to mitigate the PWSCC in Nuclear vessel was developed and application results was filed to the ASME Code Case N-931. In this paper, UNSM devices and equipment depending on the application of products with their effects are introduced and what is ongoing challenge for the future innovation shows.

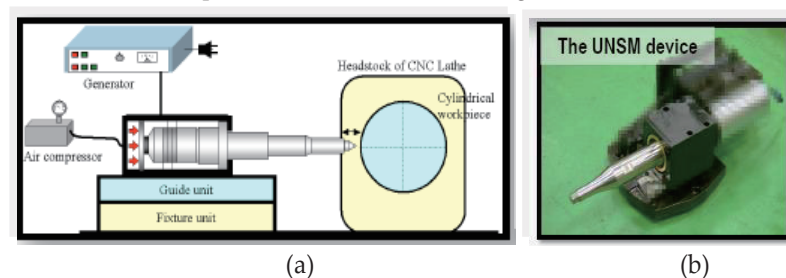
**Keywords:** ultrasonic nanocrystal surface modification, knife, bearing, portable device, rail road, nuclear reactor nozzle

## 1. Introduction

Mechanical posttreatments for some mechanical parts have been applied in various industrial fields and in most cases have been found to give substantial increase of their mechanical properties (hardness, wear, roughness, fatigue strength, etc) [1-5]. Peening technology is the mechanical posttreatment using widely in industrial fields. UNSM (Ultrasonic Nano Crystal Surface Modification) technology is similar with peening technology, patented by DesignMecha Co.,Ltd over the world. UNSM can be applied into several industrial field for improving the service life of mechanical parts. Since the first development, UNSM technology has been improved and commercialized for the applications in several industrial fields during 20 years. UNSM device and equipment had to be implemented by the different way. Service life extension of industrial knife for steel and paper industry was the beginning of industrial application [6]. This paper summarizes several UNSM system depending on the several industrial applications.

## 2. Basic device of UNSM

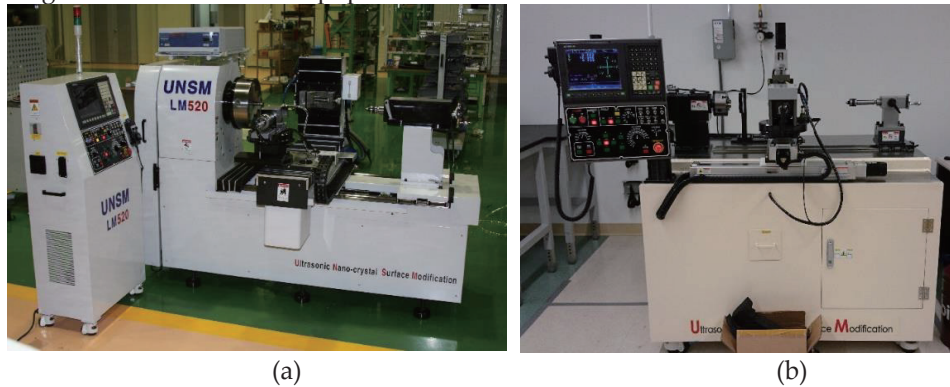
When UNSM device had been developed, Mechanical scheme is Figure 1.



**Figure 1.** Basic UNSM device: (a) Basic scheme; (b) UNSM device.

A special tooling system will be designed and fabricated to integrate the ultrasonic device with the test specimens. The ultrasonic device will be attached to a CNC lathe. Hardware and software devised for the integration of the device into a CNC lathe will also be designed and fabricated. A test sample piece will be fixed in the spindle chuck of the lathe, while the ultrasonic device will be built on the tool slide of the lathe. Regulated air pressure

will be used to give a static tool pressure to the workpiece. UNSM equipment has been developed with this basic UNSM device. Figure 2 shows this first equipment.



**Figure 2.** UNSM equipment with basic UNSM device: (a) Basic equipment for industrial application; (b) Basic equipment for specimen.

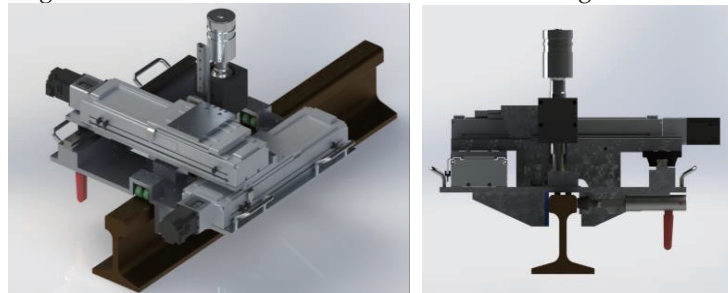
This equipment can treat on industrial knife, bearing, roll and several type of mechanical parts.

### 3. UNSM device for several industrial application

UNSM device has been developed in several types depending on the industrial application.

#### 3.1. UNSM device for Rail road application

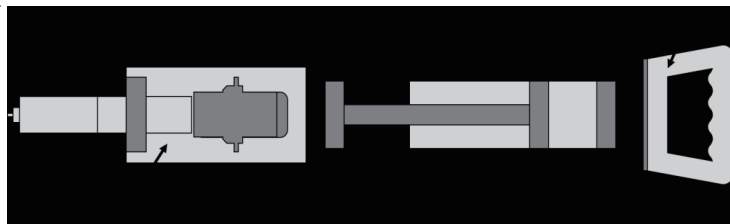
The UNSM process is effective in increasing surface hardness, compressive residual stress and refining grain size and thus increase wear resistance and rolling contact fatigue strength. So the UNSM can be applied on rail road. Also UNSM process can restore the damaged rail to equal or even better in wear and rolling contact performance [7-10]. But rail shape is not easy to treat UNSM with basic device. Therefore New concept of UNSM device had to be developed for treating rail road. UNSM device for rail road shows Figure 3.



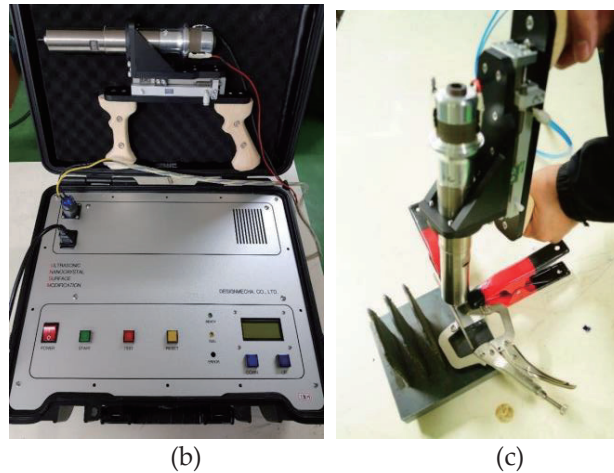
**Figure 3.** UNSM device for rail road.

#### 3.2. Portable device

Portable UNSM device has been developed for UNSM process in which basic device cannot reach. Portable device has to be light weight for hand handling with a pressure control system. The developed device is possible to use without any difficulties by hand handling for operating long time. Figure 4 shows the mechanism of portable UNSM device and it's picture.



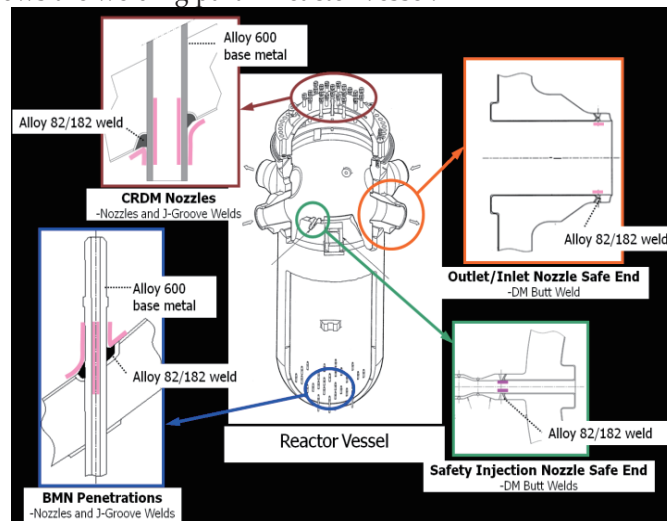
(a)



**Figure 4.** Portable UNSM device: (a) Design concept; (b) Portable Device; (c) Treatment with Portable UNSM device.

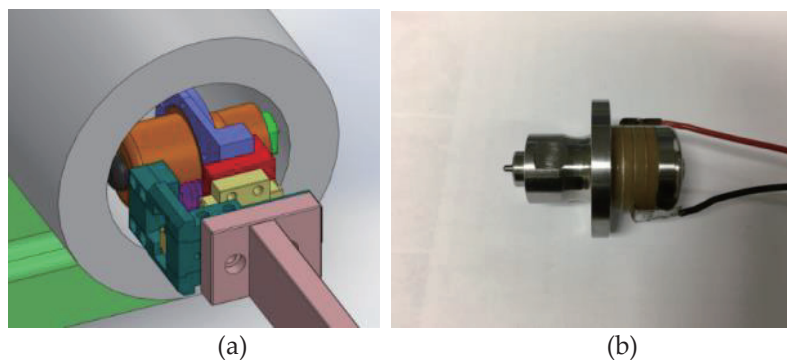
### 3.3. UNSM device for nuclear power plant

UNSM process can be applied on welding parts in nuclear power plant. There are many welding parts in nuclear reactor vessel. Figure 5 shows the welding part in reactor vessel.

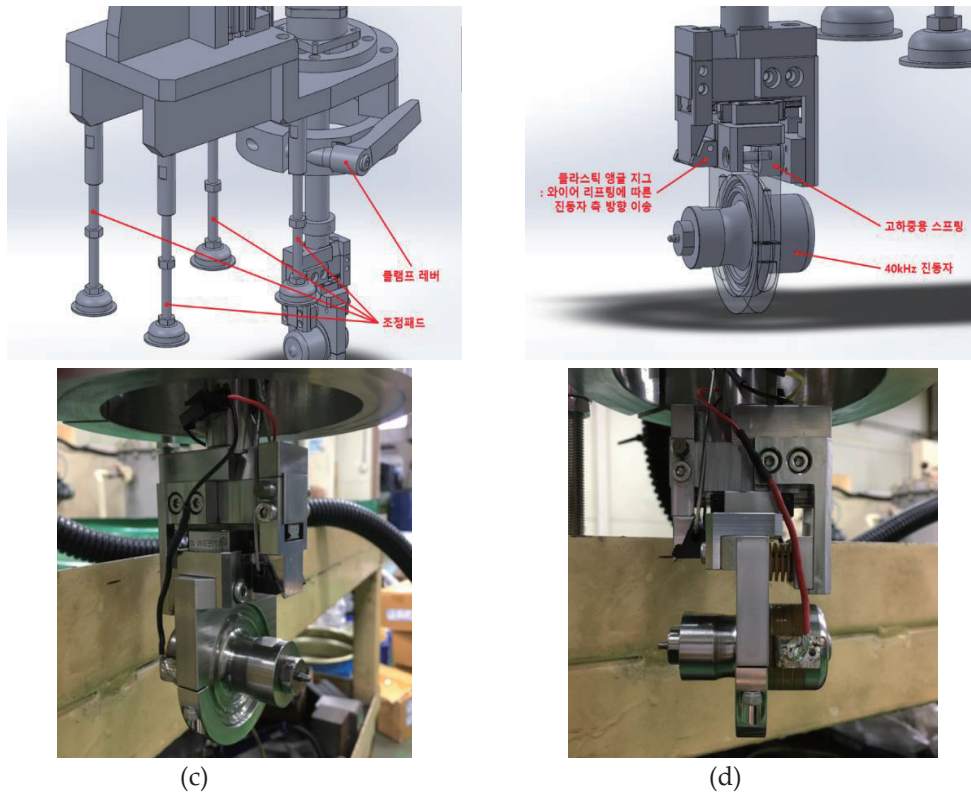


**Figure 5.** Welding parts and UNSM application parts(pink line) in reactor vessel.

UNSM process applied in CRDM nozzle and Outlet/Inlet nozzle safe end. CRDM nozzle and Outlet/Inlet nozzle safe end can be treated by the basic device. Therefore, UNSM device for this application had to be developed. There are two kind of UNSM process. One is the treat on outside and the other is inside of nozzle. Two kind of UNSM device had been developed for treating inside and outside. Figure 6 shows UNSM device for inside UNSM process for nozzle.

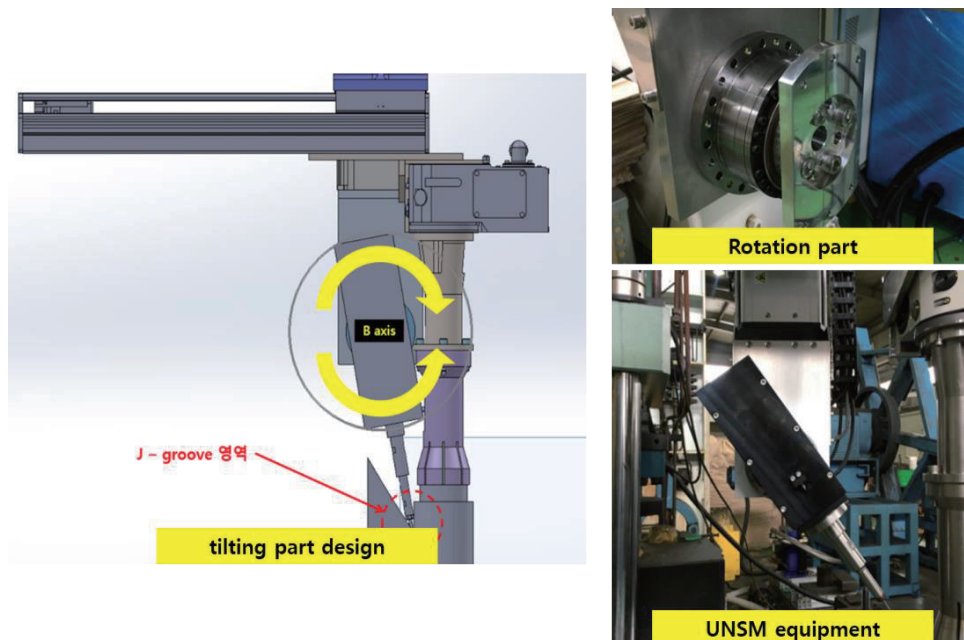






**Figure 6.** UNSM device for inside UNSM process for nozzle: (a) Design for inside UNSM device; (b) Ultrasonic device; (c) UNSM equipment for inside UNSM process for nozzle; (d) UNSM device for inside UNSM process for nozzle.

In CRDM nozzle, UNSM process has to be applied on J Groove in Figure 5. For UNSM process on J Groove, UNSM equipment had to be developed. Figure 7 shows the UNSM equipment for J Groove of CRDM nozzle.



**Figure 7.** UNSM equipment for UNSM treatment on J groove of CRDM nozzle.



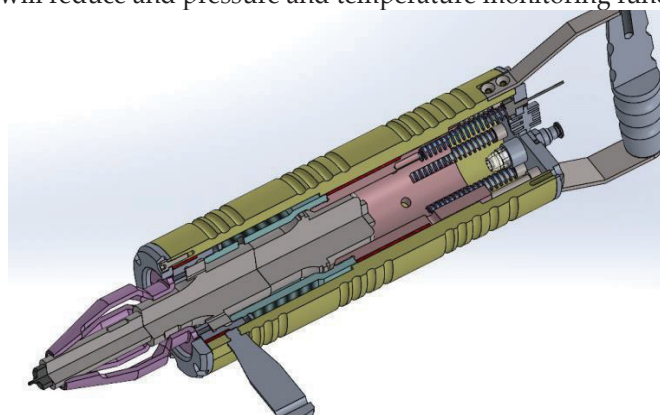


**Figure 8.** UNSM equipment on CRDM nozzle mockup.

Figure 8 shows the setup of UNSM equipment on CRDM nozzle mockup. After application of CRDM nozzle and Inlet/Outlet safe end, ASME code case N-931 is approved. This code case is for performance and qualification criteria for mitigation of stress corrosion cracking by surface stress improvement on welding parts of nuclear reactor vessel: Section III, Division 1 and 3 by UNSM technique.

#### 4. Conclusion

Basic UNSM device had been developed in 2000. Since first development, UNSM device and equipment has been improved or developed newly depending on their application. This improvement and development gave the possibilities to apply UNSM process in several industrial fields. Recently ASME code case N-931 has been approved and give the opportunity of applying UNSM process on Nuclear power plant over the world. Also Portable UNSM device increase the usage of industrial field of aerospace and welding part of construction machine. Figure 9 shows the new design concept of portable UNSM device. For increasing hand handling property, the weight of portable device will reduce and pressure and temperature monitoring function will be added.



**Figure 9.** New design concept of Portable device.

UNSM device will be improved and developed continuously depending on the different type of UNSM process and will be used widely in several industrial fields.

**Acknowledgments:** The development of CRDM and Inlet/Outlet nozzle had supported by Ministry of SMEs and Startups, and the development of new Portable device is supported by KIAT Korea Institute for Advancement of Technology).

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# Balancing Controller Interface Block design

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**Abstract:** Recently, batteries used in electric vehicles have been at risk of thermal runaway, which is a major safety concern. This is because the constant charging and discharging of the battery causes the cells to deteriorate, resulting in a voltage difference between the cells, which leads to overcharging. In an electric car, there are more than 7,000 battery cells that make up the battery pack. Most fires are reported to be caused by poor management of the battery cells. The battery cells must all operate at the same voltage during charge and discharge operations. For this behavior, we need to monitor the unit battery cells on a per-cell basis and perform a balancing action if we encounter a battery cell with a different voltage to bring it to the same voltage. In traditional balancing behavior paper [1], the direct connection between the battery cell and the electrical and electronic balancing behavior circuits causes the high voltage of the battery to cause problems for the low voltage circuits. Another paper [2] proposed to implement self-balancing based on the resistance and current behavior characteristics of battery cells so that the battery voltage behaves evenly, but aged battery cells have incorrect behavior if the battery cell does not follow the resistance and current behavior characteristics of the cell. The paper in [3] proposed an active balancing behavior structure using a photo detector, but it still has a structure where the high battery voltage can affect the low voltage circuit. In this paper, a balancing circuit is proposed as an isolated structure balancing circuit to secure stable balancing behavior in order to overcome the problems of balancing circuit caused by voltage difference and heating caused by high voltage even in the battery combination environment operating up to thousands of volts in the electric vehicle environment. To realize this, we proposed and designed a separate controller interface circuit block and a balancing circuit block.

**Keywords:** Balancing, Electric vehicle, Automation, Charging, Battery, high voltage, unit cell

## 1. Introduction

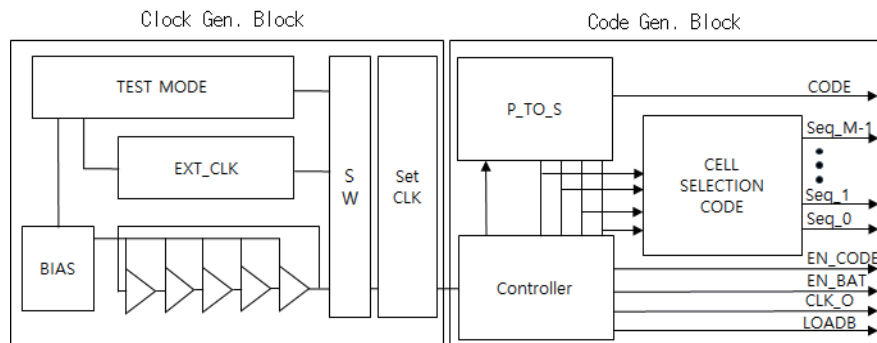
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### 2.2. Switch Array Block Design

Figure 3 shows the Switch Array Block operating based on the Seq\_M-1 signal obtained from Code Gen. Block. A signal generated from Code Gen. Block is input to Switch Array Block, and it is sequentially input to the Unit analog Switch(SW) cell together with each battery cell voltage and internal REF\_V (voltage for temperature compensation) to be selected. In order to be used as a reference signal, REF\_V, for temperature compensation, 16 reference signals from 3.0V to 4.3V were internally made with 0.08V unit step. It was output sequentially through the REF Switch array shown in figure 3. In addition, for the battery unit cell voltages to be monitored sequentially, the Battery Switch array shown in Fig. 3 is configured to be output. In measuring all battery cell voltages, the battery cell voltages were measured together with internal (or external) REF\_V to perform a temperature compensation operation. If 16 battery cell voltages are measured until the final temperature compensated battery cell voltage is obtained, all battery voltages are recognized within 5.12μsec time.

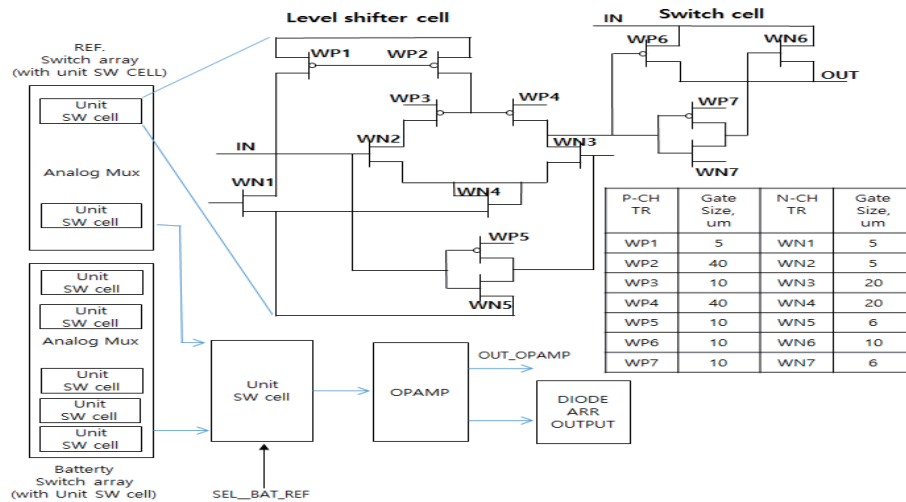


Figure 3. Design Switch Array Block Circuit Structure.

### 3. Results

This paper presents a single-path multi-cell-based BMS monitoring circuit. Figure 4 shows the timing chart of the signal in which the designed Switch Array Block, Clock Gen. Block, and Code Gen. Block in Figure 1 operate. In order to sequentially output the voltage of the battery multi-cell to one path, the P\_to\_S[N-1:0] signal, which is a code signal for selecting the battery cell, and the VOUT\_CELL signal, which is a battery voltage, are displayed. The VOUT\_CELL voltage is a signal for outputting the REF\_V voltage and the voltages of the battery cells, and it can be seen in Fig. 5 that the voltage is output with the code signal P\_to\_S[N-1:0] together with the VOUT\_CELL so as to know which REF\_V and which battery cell voltage. In detail, the EN\_CODE signal receives a code signal in a low state for EN\_CODE, and a battery cell voltage or REF\_V in a low state for EN\_BAT so that the ECU may receive a voltage value separately with a code when receiving a multi-cell voltage and REF\_V.

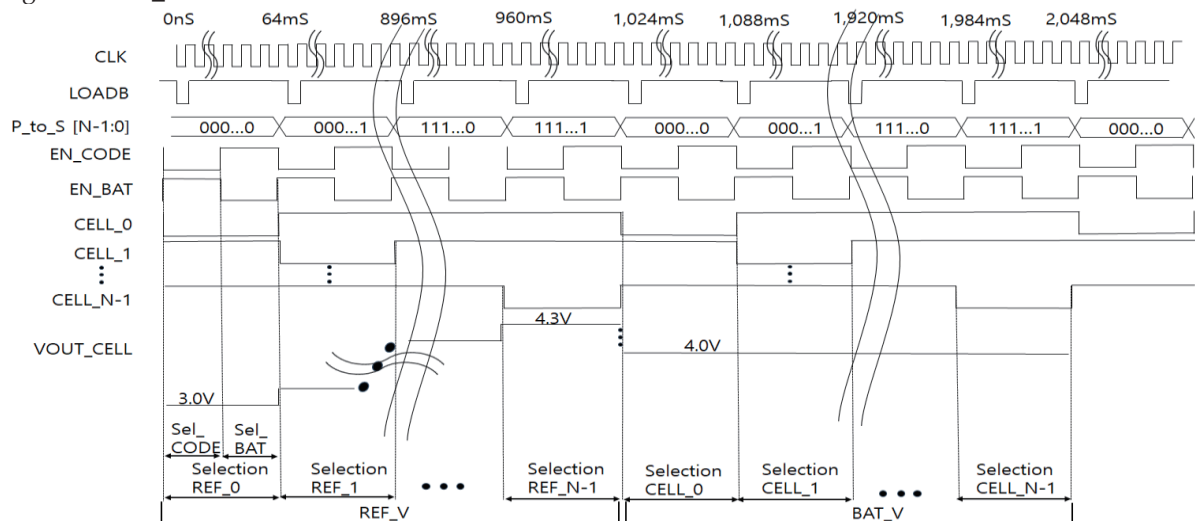


Figure 4. Monitoring voltage Operation Timing Chart.

In order to stably transmit the code signal, a LOADB signal was transmitted before transmitting the code value together with the clock signal. The LOADB signal was transmitted after the half-clock signal after the EN\_CODE signal was generated as Low, and the code signal was transmitted after the half-clock signal after the LOADB signal was generated. In the verification, the half clock speed was set to 20 nsec. After the code transmission, the EN\_BAT signal becomes low after two clock signals after the code value is transmitted to take the battery cell voltage or the REF\_V stably. As shown in Fig. 5, it shows the REF\_V after the VOUT\_CELL output signals (BAT\_V) was sequentially output. It can be found that the REF\_V voltage is output from 3.0V to 4.3V in 0.08V unit. As a result of the design, it was possible to eliminate errors due to differences in characteristics of devices with one LED. Assuming that the battery pack is composed of 16 battery cells, it was verified that each of 16 temperature



compensation REF\_V and all battery cell voltages were recognized within 5.12. Internally, the Clock Gen. and Code Gen. circuits were designed to enable BMS operation without a CPU control. In the existing technology [2], 16 LEDs of about 300uW per unit were used, and the total power consumption was 4.8mW (= 0.3mW x 16 cells). However, in this paper, by using one LED of 300uW, the entire power consumption operated at a total of 1.6mW consumption, including 1.3mW, as a single path multi-cell monitoring core function. This can reduce power consumption by 1/3 of the results of previous studies, resulting in reduced battery consumption in the BMS operation.

**Acknowledgments:** This work was supported by a Korea Evaluation Institute of Industrial Technology (KEIT) grant funded by the Korean government (MOTIE) (No. 20022473, Development of 5KWh High-Safety Expandable Battery Module for Electric Vans and Electric Utility Cart).

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# **Unification Medical Studies**

# Bio-Modulators of Adiponectin (BMA) as PPAR- $\alpha/\gamma$ Agonists: Discovery and Prospects for the Prevention and Clinical Management of Dyslipidemia and Type 2 Diabetes

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**Abstract:** Cardiometabolic disorders such as hypertension, atherosclerosis, dyslipidemia, metabolic syndrome, type 2 diabetes mellitus (T2DM) are reported to be strongly associated with adiponectin (APN) deficiency. APN modulators activate nuclear receptors located on adipocytes known as peroxisome proliferator-activated receptors (PPAR); the latter regulate APN production and both APN and PPARs are linked to lipid and glucose metabolism. We discovered two APN and PPAR modulators made of biomaterial from Japan-grown edible *Sujiaonori* alga only (NBF1), and NBF2 which combines NBF1 and *junos citrus*-derived biomaterial. We conducted clinical and experimental studies from 2016 to 2022 that evaluated the effects of NBF1 and NBF2 on metabolic health. Metabolic markers were assayed using real-time PCR for rat biospecimens and ELISA for human plasma. Results showed that NBF1 induced 2 to 3-fold increase in APN, and markedly reduced C-reactive protein (CRP) (N=32), improved fasting blood lipids (total cholesterol, LDL-c, triglycerides) and glucose (FBG) levels (N=3). In obese and diabetic OLETF rats (N=26), NBF2 increased brown fat mass (~3 times higher vs. placebo controls) and reduced white fat mass; it upregulated PPAR-alpha-mRNA, PPAR-gamma-mRNA and Sirt2-mRNA (2 to 4-fold increase), and normalized fasting blood lipids (cholesterols, triglycerides) and glucose within 6 weeks. Furthermore, in T2DM patients (N=22) who received NBF2 only or combined with metformin (vs. usual medication for controls,) marked decrease of HbA1c (8.8% to 6.7% in NBF2 group vs. 7.5 to 7.1 in controls) and blood glucose (321 to 138.5 mg/dL in NBF2 group vs. 195.6 to 187.5 mg/dL in controls) were observed within 8-12 weeks. This report suggests that both NBF1 and NBF2 have a potential to prevent obesity-associated metabolic disorders, and reverse hyperglycemia and hypercholesterolemia.

**Keywords:** Adiponectin, Dyslipidemia, Hyperglycemia, Ngatu Bio-Formulas (NBF), PPAR receptor, Type 2 diabetes.

## 1. Introduction

Lifestyle and diet-related noncommunicable diseases (NCDs) such as metabolic syndrome, type 2 diabetes mellitus (T2DM), hypertension and others are strongly associated with adiponectin (APN) deficiency. APN is a hormone or a protein produced by fat cells or adipocytes, mainly by the brown adipose tissue [1, 2]. NCDs have become a major public health problem in many countries; they are the leading cause of death worldwide. The world Health Organization (WHO) has reported that NCDs kill about 41,000,000 people annually, an equivalent of 74% of all deaths globally [3]. This suggests that without proper investment to counter those diseases, millions of people will continue to die from NCDs.

Peroxisome proliferation activated receptors (PPARs) regulate APN production, and both APN and PPARs are linked to lipid and glucose metabolism. Thus, PPARs and APN modulators have the potential to prevent lifestyle-related NCDs, including cardiometabolic disorders associated with APN deficiency in subjects at high-risk and reverse the disease course in patients. APN has numerous salutary health effects; it decreases the production of oxidative stress and improves insulin function. Several studies have suggested that low APN is a major risk factor for lifestyle-related NCDs. Furthermore, some studies conducted in Japan have also shown that APN improves smooth muscle functions and promotes healthylongevity [4-6].

In 2016, we launched the research project on APN bio-modulators. Two alga-based formulas composed either only *Sujiaonori* alga biomaterial (NBF1) or mixed with *junos citrus* biomaterial (NBF2); they derived from edible plantspecies mass-grown in Japan. Unlike omega-3 fatty acids and anti-diabetic drugs such as thiazolidine-

diones, which are PPAR-gamma modulators with a relatively weak effect on APN production, NBF1 induced a 2- to 3-fold increase in APN and reduced CRP in humans in our first clinical study [1, 6]. We conducted experimental and clinical investigations aimed to determine the efficacy and safety of the two novel PPARs and APN modulators, “Ngatu Bio Formulas” (NBF1, NBF2) on obesity-associated metabolic disorders, hyperlipidemia and T2DM particularly.

## 2. Materials and Methods

### 2.1. Study design and sample size

An experimental and clinical studies were conducted between 2016 and 2022, both in Japan and the Democratic Republic of the Congo (DRC). In the animal experiment, Otsuka Long-Evans Tokushima Fatty (OLETF) rats and Long-Evans Tokushima Otsuka (LETO) rats were used (N=26), including obese and hyperglycemic OLETF and LETO or normal rats. The first case reports included 2 T2DM patients and 1 subject with hypercholesterolemia, whereas a recent clinical investigation included T2DM patients (N=22) followed in diabetic clinics for over 12 months.

### 2.2. Experimental study

OLETF rats (n=18) were randomly assigned to 3 groups: high or normal dose NBF2 (20mg/kg), low dose (10mg/kg) NBF2 or vehicle group that received tap water (OLETF controls). LETO rats (n=8) were used as normal controls. Biospecimens (white fat or WAT, brown fat or BAT, liver) were taken for the measurement of messenger RNA (mRNA) expression levels of metabolic markers with the use of real-time PCR assays.

### 2.3. Clinical studies

The first case reports consisted in 3 subjects, including 2 diabetic patients and 1 subject with high metabolic risk, who were supplemented with 2.1g NBF2 daily for 4 weeks [6]. The second clinical investigation was a case series including T2DM patients (N=22) followed at diabetic clinics in Tokai area (Japan) and in Kinshasa (DR Congo) : 11 patients received either 2.1g NBF2/day only or in combination with usual antidiabetic medication; 11 other patients followed in the same diabetic clinics during the same period (January 2019 to March 2021) and who continued their treatment as usual (TAU) were used as controls.

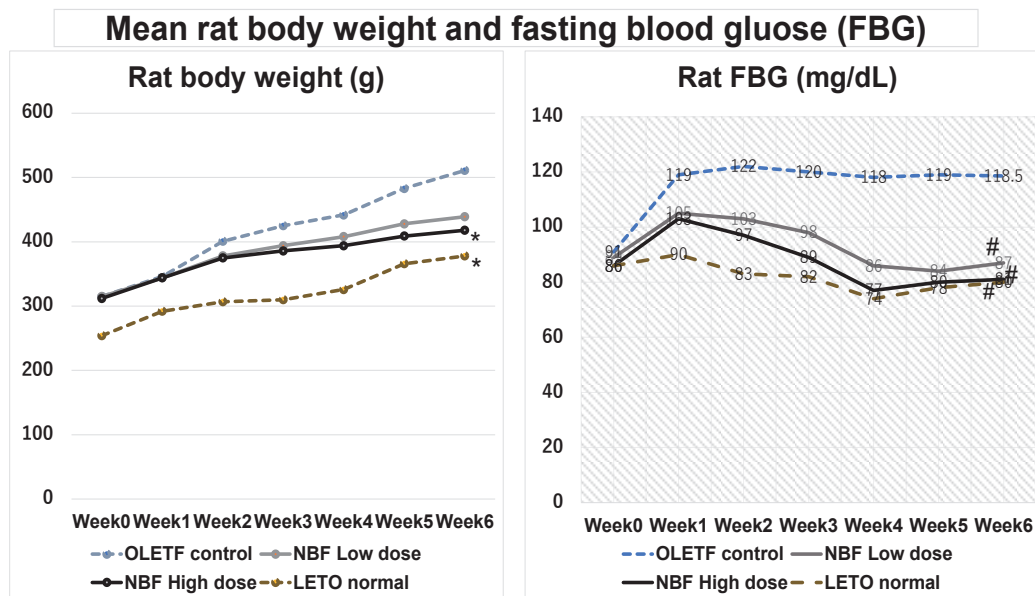
### 2.4. Ethical considerations and data analysis

The protocol of the experimental study was approved by the ethical committee of Kagawa University Animal Center in Japan (ethical approval number: 20656-1). All human subjects provided informed consent prior to participating in the clinical investigations. For the experimental study, group comparisons were performed using ANOVA for repeated measures for weekly rat body weight (BW) and fasting blood glucose (FBG) levels, whereas one-way ANOVA was used for blood lipids and blood pressure profiles whose measurement were performed in the last week of the experiment. For data related to mRNA gene expression of metabolic biomarkers, one-way ANOVA followed by a post-hoc Tukey's test was employed to compare each of the NBF2-treated group to OLETF control group. Regarding clinical data from diabetic patients and subjects with metabolic risk, paired t test was to compare baseline and end-of-study, 4 to 12 weeks depending on the investigation. FBG and plasma lipids were measured at their respective clinics.

## 3. Results

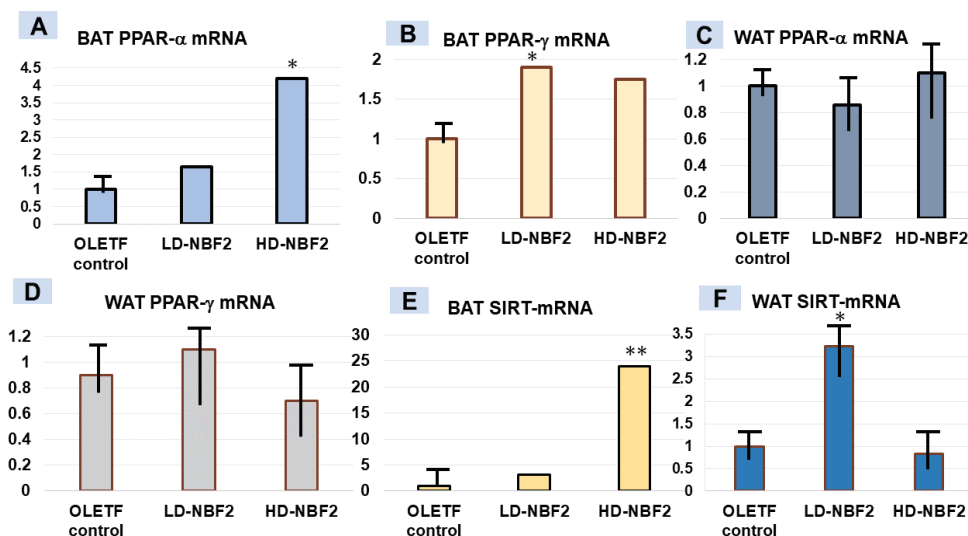
### 3.1. Effects of NBF2 intake on metabolic health markers in obese and hyperglycemic OLETF rats

Treatment with both NBF2 markedly reduced mean body weight, in high dose group particularly ( $p<0.05$ ); it also significantly reduced mean FBG level in both low and high dose groups ( $p<0.01$ ) at week6 as compared with control group (Figure 1). In addition, NBF2 increased brown fat mass by 3 times compared to baseline value, whereas such a change was not observed in the placebo-treated control OLETF rats (not shown). Furthermore, treatment with NBF2 upregulated PPAR- $\alpha$ , PPAR $\gamma$ -mRNA and Sirt2-mRNA (2 to 4-fold increase) (Figure 2), and improved blood lipid profile (cholesterols, triglycerides) (not shown).



**Figure 1.** Effects of NBF2 on bodyweight gain and fasting blood glucose in OLETF rats.

-Legend: g, gram; fasting blood glucose; OLETF, Otsuka Long-Evans Tokushima Fatty rats; LETO, Long-Evans Tokushima Otsuka rats; LD NBF2, low dose NBF2 (10mg/kg/day); HD NBF2, high or normal dose NBF2 (20mg/kg/day). The figure shows a decrease in mean weight of the rats treated with NBF2, in particular by the high dose of NBF2 (vs. OLETF control rats). In both high and low dose NBF2 groups, FBG or glycemia was normalized by the third week of treatment (vs. placebo-treated controls ( $p < 0.001$ ; ANOVA test).



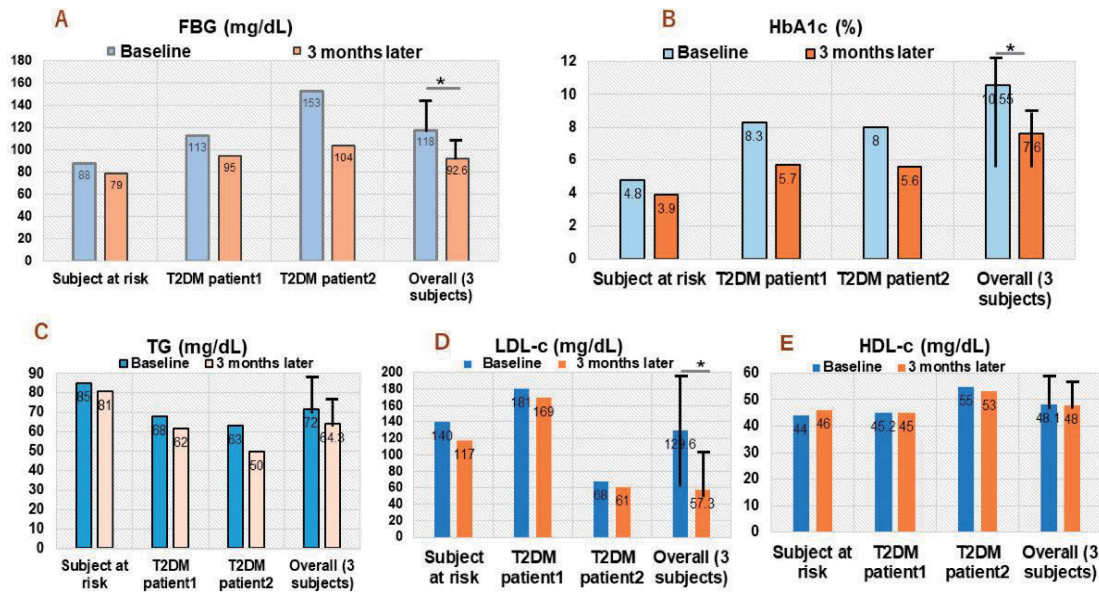
**Figure 2.** Effects of NBF2 on the expression of PPAR-α and PPAR-γ messenger RNA genes in OLETF rats.

Legend: BAT, brown fat; WAT, white fat; LD-NBF2, low dose NBF2 (10 mg/kg/day); HD-NBF2, normal dose or high dose NBF2 (20 mg/kg/day); \*\*,  $p < 0.01$ ; \*,  $p < 0.05$  by ANOVA test. Figure 2 shows an increase in PPARα/γ-mRNA (A, B) and SIRT-mRNA expressions mainly in brown fat, but also in WAT (vs. placebo-treated OLETF controls).

### 3.2. Effects of NBF2 intake on metabolic health markers in humans with metabolic risk and diabetic patients

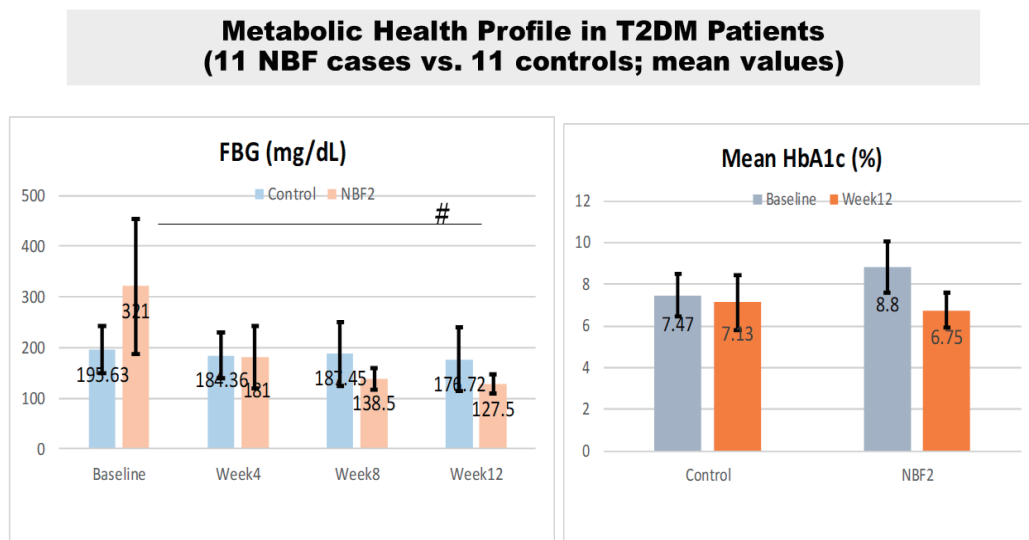
In the first clinical investigation in which 32 apparently healthy adults participated, results showed that NBF1 induced a 2 to 3-fold increase in APN, reduced C-reactive protein (CRP), and improved fasting blood lipid profile (not shown). Additionally, the first clinical case reports consisting in two diabetic patients and 1 adult subject with high metabolic risk showed a tremendous improvement their metabolic health within 4 to 12 weeks under NBF1, as shown in Figure 3.





**Figure 3A-B-C-D-E.** Clinical cases: effects of NBF1 on glycemia, HbA1c, blood lipids (TG, LDL-c, HDL-c) in two diabetic patients and one subject with hypercholesterolemia. Legend: HbA1c, hemoglobin A1c; TG, triglycerides; LDL-c, low-density lipoprotein cholesterol; HDL-c, high-density lipoprotein cholesterol; T2DM, type 2 diabetes ; \* :  $p < 0.05$ . The Figure 3 shows significant decrease in glycemia (A), HbA1c (B) and LDL-cholesterol (D) ( $p < 0.05$  by paired t test)

In the second clinical investigation, 11 diabetic patients who received NBF2 daily were matched to 11 others who continued their usual treatment. Results showed that a significant drop in HbA1c (from 8.8% to 6.7% in the NBF2 group vs. 7.5 to 7.1 in the controls) and blood glucose (from 321 to 138.5 mg/dL in the NBF2 group vs. 195.6 to 187.5 mg/dL in the controls) was observed within 8 to 12 weeks, compared with baseline mean values (Figure 4).



**Figure 4.** Effects of NBF2 on fasting blood glucose (FBG) and hemoglobine A1c (HbA1c) in diabetic patients (N=22). Figure 4 shows a significant decrease in blood glucose ( $p < 0.01$ ) in NBF2-treated patients, as compared to controls. A relative reduction of HbA1c was observed in NBF2 group, but the difference did not reach the significance level at week12.

#### 4. Discussion

This research project explored the beneficial metabolic health effects of two novel bio-modulators of PPAR receptors and APN. In animal model of obesity and T2DM, the intake of NBF2 reduced body weight and glycemia (FBG) to a level similar to that of lean LETO or normal rats. This finding can be explained by the increased brown

fat mass, the upregulation of PPAR-alpha and PPAR-gamma, as well as Sirt2 in rats. APN is known to ameliorate insulin resistance and glucose intolerance. By restoring insulin sensitivity through upregulation of APN production, NBF2 could reverse hyperglycemia. Similar effects on metabolic markers such as glycemia, blood lipids and also HbA1c were observed in T2DM patients and human subjects with metabolic risk.

We previously reported that NBF-contained sujiaonori algal biomaterial has a potential to improve glycemic profile in individuals with high cardiometabolic risk, and in diabetic patients as well [1, 6].

It has been suggested that dual PPAR agonists can efficiently improve insulin sensitivity in T2DM patients with hyperlipidemia [7], and can help to overcome the efficacy and safety limitations of PPAR- $\gamma$  agonists such as thiazolidinediones and fibrates. Thus, NBF1 and NBF2, which behave as dual PPAR activators may improve glucose and lipid metabolism more efficiently.

In conclusion, findings from this research project suggest that NBF1 and NBF2, which contain sujiaonori alga only or in combination with *junos citrus*-derived biomaterial, are PPAR-alpha, PPAR-gamma and Sirt2 modulators, and have a potential to prevent and reverse hyperlipidemia and T2DM.

**Author Contributions:** Conceptualization, NRN; methodology, NRN; software, ANK; Validation and formal analysis, MW, NRN; investigation, MW, ANK, NRN; resources, NRN; data curation, MW; writing—original draft preparation, NRN; writing—review and editing, MW; visualization, MW; supervision, NRN; project administration, ANK.

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**Data Availability Statement:** Study data can be obtained upon request to the corresponding author (NRN).

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**Conflicts of Interest:** The authors declare no conflict of interest.

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# How can ginseng regulate blood sugar levels in African culture?

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**Abstract:** Ginseng holds significant value in traditional Chinese medicine to improve insulin sensitivity and regulate blood sugar levels. It is believed that certain African communities incorporate ginseng into their traditional medicinal practices. One way that ginseng aids in weight management is by enhancing metabolism and raising energy expenditure called thermogenesis that ginseng may promote this process. Ginseng also improves insulin sensitivity by: enhancing glucose uptake in cells and regulating fat cells. Adipokine levels have been demonstrated to be regulated by ginseng in a way that may increase insulin sensitivity. Ginseng increases the pancreas' production of insulin, which lowers blood sugar levels by promoting glucose absorption and utilization, blood sugar levels can be better controlled, and insulin resistance, a condition linked to high blood sugar, can be avoided. The efficacy of ginseng in regulating blood sugar levels can be attributed to its active constituents known as ginsenosides for their potential anti-hyperglycemic effects, enhancement of insulin sensitivity, and protection of pancreatic cells. In the context of African cultures, ginseng is sometimes employed in conjunction with other herbal remedies or conventional treatments, reflecting a holistic approach to managing metabolic disorders.

**Keywords:** Ginseng, Chinese medicine, thermogenesis, insulin sensitivity

## 1. Introduction

Ginseng holds significant value in traditional Chinese medicine, where it has been employed for centuries to address various health ailments. Its reputation stems from its potential to aid in weight management, improve insulin sensitivity, and regulate blood sugar levels. It is believed that certain African communities incorporate ginseng into their traditional medicinal practices, particularly to tackle health concerns associated with blood sugar. Notably, the specific employment of ginseng within African cultures may vary, with different plant parts such as the root, rootlet, berry, or leaf being utilized to harness its potential therapeutic benefits.

## 2. Thermogenesis

One way that ginseng aids in weight management is by enhancing metabolism and raising energy expenditure [1]. The process of producing heat in the body and calorie burning is called thermogenesis, and it has been hypothesized that ginseng may promote this process [2]. This thermogenic action might assist boost caloric burn and possibly promote weight loss. Additionally, ginseng might affect the control of hunger. According to some studies, ginseng may help suppress appetite and increase feelings of satiety, which may lead to lower calorie consumption.

## 3. Insulin Sensitivity

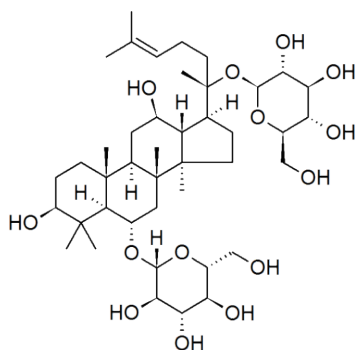
Ginseng also improves insulin sensitivity by: enhancing glucose uptake, improves anti-inflammatory properties, and regulates fat cells. Cells can absorb and use glucose more effectively since ginseng has been demonstrated to boost glucose uptake in cells. In addition to lowering blood sugar levels, this can help insulin sensitivity [3]. Insulin resistance is thought to be exacerbated by chronic inflammation, which disrupts insulin signaling. Because of its anti-inflammatory properties, ginseng can reduce inflammation and increase insulin sensitivity. Insulin sensitivity may be impacted by adipokines, hormone-like molecules released by adipose tissue (fat cells). Adipokine levels, such as adiponectin and leptin, have been demonstrated to be regulated by ginseng in a way that may increase insulin sensitivity.

#### 4. Blood Sugar Level

Ginseng regulates blood sugar levels by: increasing insulin secretion, improving glucose metabolism, and enhances insulin sensitivity. According to research, ginseng increases the pancreas' production of insulin, which lowers blood sugar levels. Ginseng lowers blood sugar levels via increasing insulin secretion and promoting the absorption of glucose from the bloodstream into cells. By promoting glucose absorption and utilization, ginseng can improve how cells use glucose [4]. This aids in controlling blood sugar levels and keeps it from rising too quickly after meals. It has been demonstrated that ginseng increases insulin sensitivity, making cells more receptive to the actions of insulin [5]. As a result, blood sugar levels can be better controlled, and insulin resistance, a condition linked to high blood sugar, can be avoided [6].

#### 5. Ginsenosides

The efficacy of ginseng in regulating blood sugar levels can be attributed to its active constituents known as ginsenosides. [Image 1] These bioactive compounds have undergone extensive investigation for their potential anti-hyperglycemic effects, enhancement of insulin sensitivity, and protection of pancreatic cells.



**Figure 1.** Ginsenosides [7]

#### 6. Conclusions

In the context of African cultures, ginseng is sometimes employed in conjunction with other herbal remedies or conventional treatments, reflecting a holistic approach to managing metabolic disorders.

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**Conflicts of Interest:** The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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# The value of nursing care in the terminal stage in the super-aging society

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**Abstract:** The average life expectancy of people has increased due to the development of science and technology and medical progress, and Japan has become the world's most aged country. It can be said that the elderly do not die so easily and live longer with anxiety and helplessness. In such a background, the problems related to "nursing care" have increased more than "medical care". Both medical care and nursing care have in common that they are directly involved in the care of people, but medical care does not have a radical technique for aging, and especially in the terminal stage of life, "Care" is more important than "Cure". "Nursing care" is not easy, however, most people cannot avoid it in this super-aging society. What should be done to realize better end-of-life care through better nursing care, and what is the value of terminal period? I would like to discuss the rebuilding of family relationships through nursing care and the importance of nursing care for three generations, based on my experience of taking care of many patients in terminal period.

**Keywords:** terminal care, nursing care, three generations, end-of-life care, spiritual world

## 1. Introduction

Japan has become the world's most aged country. The development of Western science and technology and advances in medical science have increased people's average life expectancy, making Japan the world's most super-aged country. On the other hand, it can also be said that the elderly are not so easily lethal, and the period during which they are cared for has become longer (i.e., the "Frail" period). Furthermore, the number of people being cared for and those caring for them is also increasing. The job of caregiving is said to be "hard," "dangerous," and "dirty," and it is not easy at all.

However, through my work, which is home medical care, I have newly discovered the value of nursing care, so I would like to share with you.

## 2. Paradigm shift of medical care

The Nursing care is not only physical. The frail elderly also need emotional and spiritual support, as they live with cognitive decline, anxiety, and feelings of helplessness, which can be extremely painful. They also need the support of caregivers who support the Frail elderly.

### 2.1. From 「Cure」 to 「Care」

For example, is it really worthwhile to create a gastrostomy to administer nutrition to an elderly person with impaired swallowing function? When an elderly person with dementia develops cancer, is he or she to be treated with anticancer drugs?

Rather than simply improving medical practice techniques or discovering the latest treatments, the field of medical care for the elderly sometimes requires the choice not to treat or to quit treatment. And this includes not only the patients but also their families and other people around them.

Even with the development of medical care, cancer cannot be eradicated and aging cannot be conquered, so medical care is undergoing a paradigm shift from "medical care to cure" to "medical care to support". Along with this shift, the mindset of medical professionals must also change.

### 2.2 Differences between medical care and nursing care roles

Medical care is for patients, whereas in nursing care, both the patients and the caregiver are the target of support. Medical care is mainly provided in hospitals or clinics, where treatment of acute illnesses, rehabilitation, and

prevention are provided, whereas nursing care includes medication and rehabilitation, but focuses on support for daily life itself, e.g., meals, toileting, hobbies, and so on.

**Table 1.** Differences in roles during the end-of-life period.

Medical Care	Nursing Care
How to heal	Respect the natural process
How to help maintain daily life	Minimize the consumption of life
How to provide painless end-of-life care	Making the best use of a person's abilities

### 2.3. Evidence of geriatric

Here are some recent geriatric medical evidence.

- Blood pressure of 570 geriatric residents in nursing homes; the group over 160mmHg had the longest life expectancy and the group of less than 120mmHg had the shortest life expectancy [1].
- In a study examining the relationship between the number of medications and death, those taking six or more medications had the highest mortality rates [2].
- Cancer patients in terminal stage, 1 L of daily hydration did not improve symptoms, quality of life, or survival compared with placebo [3].

⇒Are medication or medical treatment bringing happiness to the elderly??

## 3. Value of nursing care

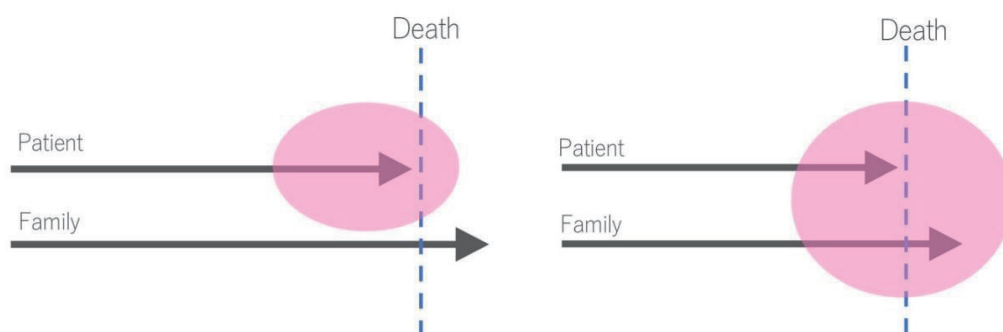
### 3.1. Cooperation between medical care and nursing care

In section 2.2 I discussed the difference between the roles of medical care and nursing care, home medical care is a new style that exists as a link between both. Specifically, multidisciplinary cooperation is indispensable for this practice, and most of the medical treatment for the elderly is designed with "end-of-life care" in mind. While keeping "end-of-life care" in mind, multidisciplinary professionals discuss what can be done with the remaining abilities even in frail conditions, and come up with specific policies.

For example, since the patient has only a few days to live, they can take a bath at the end, visit the grave, eat their favorite food, and so on. In end-of-life care, it is important to reduce anxiety in order to realize better end-of-life care. To achieve this, it is important for medical personnel and caregivers to cooperate well and prepare both inside and outside for the coming death.

### 3.2 Building a new value on end-of-life care through nursing care

Nursing care is giving a new value to end-of-life care. The goal of end-of-life care is not the death of the patient, but includes the family after death. While many professions are involved in the process of death, the family can work on rebuilding relationships during that period. The final moment is not important, but the process leading up to the death is important.



**Figure 2.** Shifting values about death

### 3.3. The True Value of Nursing care

- Holistic Care

Through Nursing care, we can provide holistic care that is physical, social, mental, and spiritual.

- Three generations

A place where three generations become one. Being involved in the care of not just one parent's generation, but the generation above it, enriches one's life.

- ① You can learn about filial piety by watching how your own parents care for your grandparents.
  - ② Seeing how your grandparents treated your parents, you can learn how the parents loved you.
  - ③ Fear is reduced by the fact that it will not be the first time they are caring for their parents (first time, so unknown, scary, and anxious; they will be able to learn how to care for their parents).
  - ④ You can talk to your children about your own experiences in caring for your parents.
- Life on earth is the last chance to release resentment before going to the spirit world, and it is also the best place to show filial piety.

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# Regional Disparities in COVID-19 Burden, and Association between Severe SARS-CoV-2 Infection Outcomes and Metabolic Disorders: Ecological Study of the Pre-Omicron Era of the Pandemic

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**Abstract:** Evidence from epidemiologic studies indicate that metabolic disorders such as obesity and diabetes are high-risk factors for severe COVID-19 and related mortality. Over 30% of people with COVID-19 who require hospitalization suffer from diabetes. This study explored the association between severe COVID-19 outcomes and metabolic disorders, at regional level, across countries of the Organization for Economic Cooperation and Development (OECD). We conducted an ecological study using COVID-19 data of high- and middle-income countries belonging to OECD (N=38), with an estimated total population of 1.4 billion, divided into 3 regions: region 1: Europe & Middle-east; region 2: the Americas (north, central & south America); region 3: East-Asia & Pacific region. The main outcome variables were: (1) COVID-19 case fatality rate (COVID-19 CFR) and (2) the disability-adjusted life years (COVID-19 DALYs). The country-level COVID-19 CFR were calculated using freely available cumulative COVID-19 cases and deaths statistics; similarly, data on overweight & obese population rate, diabetes prevalence and regional COVID-19 DALYs were obtained from both OECD and WHO databases. Overall cumulative deaths were 65,000 per million; regional COVID-19 CFR was highest in the Americas, 2.4(2.6) %. Highest DALYs were found in East-Asia & Pacific region, 22 (0.0) years. Pearson correlation analysis showed that diabetes prevalence was correlated with both COVID-19 DALYs (OR=0.52; p=0.009), and COVID-19 CFR (OR=0.58; p=0.000). The logistic regression analysis showed that diabetes prevalence was strongly associated with COVID-19 CFR (OR=2.65 (1.8); 95%CI: 1.71–9.97; p=0.038) and COVID-19 DALYS (OR=1.39 (0.3); 95%CI: 1.66–2.02; p=0.046). Findings from this study confirm that diabetes is as a major predictor of severe COVID-19 outcomes in OECD countries at regional level.

**Keywords:** COVID-19, Case fatality rate, Diabetes, Disability adjusted life years, Metabolic disorder.

## 1. Introduction

Metabolic disorders (obesity, metabolic syndrome, diabetes, ..) are known as high-risk factors for severe COVID-19 outcomes. Over 30% of people with COVID-19 who require hospitalization suffer from diabetes. Additionally, since the beginning COVID-19 pandemic, obesity has caused concerns given its high prevalence among infected patients [1, 2]. Furthermore, the coexistence of obesity and diabetes is reported to increase the risk of severe COVID-19 [2]. In this study, we searched to explore the associations between COVID-19 burden-related indicators and metabolic disorders at regional level in the pre-Omicron phase of the pandemic (2019-2021), across 38 member states of the Organization for Economic Cooperation and Development (OECD).

## 2. Materials and Methods

### 2.1. Study design and population

This was an ecological study COVID-19 that used data of 38 high- and middle-income countries belonging to the Organization for Economic Cooperation and Development (OECD). OECD countries were divided in three regions: region 1 comprising Europe & Middle-east (Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland,

Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, England); region 2: the Americas comprising the north, central & south America (USA, Canada, Mexico, Costa Rica, Chile, Colombia); region 3 composed of East-Asia & Pacific region (Japan, South Korea, Australia, New Zealand). Taken together, all 3 regions had an estimated population of 1.4 billion. The main outcome variables were: (1) COVID-19 case fatality rate (COVID-19 CFR) and (2) disability-adjusted life years (COVID-19 DALYs), which represent the sum of years of life lost due to premature death from a disease, and the years of healthy life lost due to disability caused by the disease. COVID-19 CFR and DALYs values used of December 2021.

## 2.2. Main outcome variables and definitions

CFR was calculated using cumulative COVID-19 cases and deaths statistics [3] (OECD & WHO health statistics databases) [4, 5]; data on country level overweight/obesity rate, diabetes prevalence and regional DALYs were obtained from OECD database. Fully vaccinated individuals were those who received at least two doses of anti-COVID-19 vaccine.

- CFR: in epidemiology, it is the proportion of people who die from a specified disease among all individuals diagnosed with the disease over a certain period of time.
- DALYs: the sum of years of life lost due to premature death from a disease, and the years of healthy life lost due to disability caused by the disease.

## 2.3. Ethical consideration and data analysis

Data used in this study are anonymous, and informed consent was not necessary. For data analysis, first of all, we performed the normality test (Shapiro-Wilk) for the outcome variable and the potential predictors (metabolic disorders); none of them was normally distributed. Then, we searched to determine the relationship between the outcome variables (COVID-19 CFR, COVID-19 DALYs). To estimate the strength of the association between outcome variables and the predictors of COVID-19 CFR and DALYs, the later were dichotomized and the logistic regression analysis was performed. Stata statistical software version 16 (StataCorp., TX, USA) was used for the analyses, and the significance level was set at  $p < 0.05$ .

## 3. Results

### 3.1. Regional Demographic, Health and COVID-19-related Indicators in the pre-Omicron phase of the pandemic

**Table 1.** Regional distribution of demographics and COVID-19-related health indicators (as of Dec. 2021)

Variables	Region	Mean (SD)
Population (x10,000)	Region1	20,951.5 (26,578)
	Region2	94,757.2 (122,479)
	Region3	52,017.8 (53,392)
Elderly population rate (%)	Region1	18.28 (3.2)
	Region2	12 (4.5)
	Region3	18.35 (6.5)
Full vaccination coverage/1000	Region1	166.77(26)
	Region2	160.07 (39.9)
	Region3	162 (2.3)
Overweight & obese/1000	Region1	61.73 (4.3)
	Region2	69.87 (7.4)
	Region3	47.82 (20.2)
Diabetes prevalence rate (%)	Region1	6.28 (2.3)
	Region2	10.53 (3.4)
	Region3	6.5 (0.3)
COVID-19 cumulative cases per 10 <sup>6</sup>	Region1	145,840 (48,349.5)
	Region2	163,458.7 (216,709)
	Region3	11,344.5 (5,977.8)



COVID-19 cumulative deaths per 10 <sup>6</sup>	Region1	1724 (922.2)
	Region2	2912 (2253.3)
	Region3	88.3 (57.5)
DALYS (in years)	Region1	16.5 (1.6)
	Region2	18.4 (2.2)
	Region3	22 (0)

The most populous region was the Americas, with a mean population of 947,572,000 (+/- 1,224,790,000). Highest rate of full anti-COVID-19 vaccination coverage (as of December 2021) was achieved in the Europe & Middle-east region, 166.07 (+/-26) per 100,000 population. Highest ratio of mean overweight & obese population and diabetes prevalence rate were found in the Americas, 69.87 (+/-7.4) per 100,000 and 10.53 (3.4)%, respectively. Regarding reported cumulative COVID-19 cases and deaths, the Americas was the region the most affected, 163,458.7 (216,709) cases per million and 2,912 (2,253.3) deaths per million population (**Table 1**).

### 3.2. Relationship between Metabolic Disorders (overweight/obesity, diabetes) and COVID-2019 burden-associated health indicators (CFR, DALYs) in the pre-Omicron Phase of the Pandemic

Table 2 shows health system and health indicators that were correlated with COVID-19 CFR and COVID-19 DALYs in the pre-Omicron phase of the pandemic. A strong correlation was observed between diabetes prevalence and COVID-19 CFR ( $R=0.61$ ;  $p<0.001$ ), whereas the correlation between diabetes prevalence and COVID-2019 DALYs was relatively weak with Pearson correlation test. After dichotomization of the predicting variables (metabolic disorders), the logistic regression analysis showed that diabetes prevalence was strongly associated with both COVID-19 CFR (OR=2.65 (1.8); 95% CI: 1.71-9.97;  $p=0.038$ ) and COVID-19 DALYs (1.39 (0.3); 95% CI: 1.66-2.02;  $p=0.046$ ) (**Table 3**).

**Table 2.** Correlates of COVID-19 CFR and COVID-19 DALYS by Pearson correlation test

Predictors	COVID-19 CFR		COVID-19 DALYS	
	rho	p-value	rho	p
Elderly population rate	-0.32	0.053	-0.30	0.069
Full COVID-19 vaccination coverage per 100,000 population	-0.45	0.071	-0.08	0.645
Overweight/obese population (%)	0.31	0.284	-0.33	0.243
Diabetes prevalence rate	0.61	<b>0.000</b>	0.42	<b>0.009</b>

**Table 3.** Predictors of COVID-19 CFR and COVID-19 DALYs

Predictors	COVID-19 CFR			COVID-19 DALYS		
	OR	95% CI	p-value	OR	95% CI	p-value
Overweight/obese pop.	1.42 (0.7)	0.51-3.46	0.500	1.39 (0.3)	0.96-1.99	0.076
Diabetes prevalence	2.65 (1.8)	1.71-9.97	<b>0.038</b>	1.39 (0.3)	1.66-2.02	<b>0.046</b>

## 4. Discussion

This study analyzed the relationship between COVID-19 burden-related outcomes (CFR, DALYs) on one hand, and metabolic disorders (overweight & obesity, diabetes), at regional level, for OECD countries. We found that, of the two metabolic disorders studied, only diabetes was positively associated with both COVID-19 CFR and COVID-19 DALYs, when considering data related to the first and the second year of pandemic, which represent the period before the emergence of the Omicron pandemic.

These findings corroborate results from other studies. An Iranian study [6] conducted among COVID-19 patients showed that those with severe outcomes had diabetes. Furthermore, a review of the literature by Lim and colleagues [7] showed that diabetes was one of the risk factors for COVID-19 mortality.

Diabetes, especially hyperglycemia status, can interact with other risk factors and modulate both immune and inflammatory responses during SARS-CoV2 infection, which can lead to lethal outcomes [7].

In conclusion, findings from this study confirm that diabetes could be a predictor of severe COVID-19 outcomes in OECD countries at regional level, suggesting the necessity for efficient preventive program and management strategy of diabetes to reduce the risk of severe SARS-CoV2 infection and related mortality.

**Author Contributions:** Conceptualization, NRN; methodology, CWM and NRN; software, NRN; validation, ANK; formal analysis, NRN and ANK; data curation, CWM and ANK; manuscript writing—original draft preparation, NRN; supervision, NRN. All authors have read and agreed to the latest version of this paper.

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**Data Availability Statement:** Data analysis in this study can be obtained upon request to the corresponding author (NRN).

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**Conflicts of Interest:** The authors declare no conflict of interest.

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# Poster Session





# Selective excitation of single shear-horizontal wave mode in plates using radius modulation of the annular array MPT

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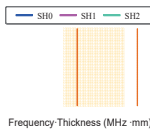
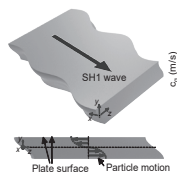
<sup>2</sup> Department of Mechanical and Aerospace Engineering, Seoul National University, South Korea

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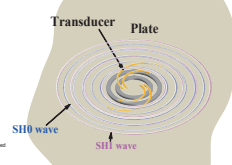
## ASH-MPT for SH1 wave generation

### Why SH1 wave for NDE?



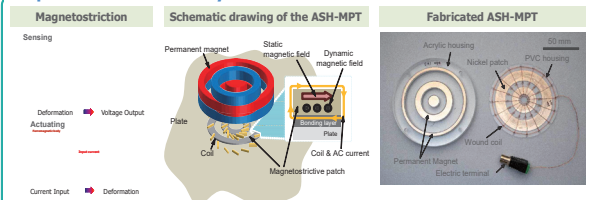
### Issues on SH1 waves

#### Critical issues of using SH1 wave mode



SH1 wave over the 1<sup>st</sup> cutoff frequency is so dispersive that it has good sensitivity with respect to the wall-thinning of the structure<sup>[1]</sup>. SH1 wave is accompanied by unwanted SH0 wave which greatly deteriorates the inspection quality.

### Proposition: Annular Array Shear Horizontal Wave MPT<sup>[1]</sup>

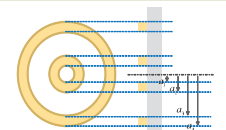


We propose an ASH-MPT to generate SH1 wave without SH0 being accompanied. The transducer consists of two annular magnetostrictive patches (nickel) and permanent magnets<sup>[2]</sup>.

## Optimization Design of the ASH-MPTs

### Optimization of the ASH-MPTs

#### Transducer analysis and the design variables

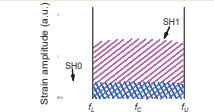


Generated SH wave fields by the transducer<sup>[1]</sup>

$$T_{\alpha\beta}(f, r) = \sum_{n=0}^{\infty} T_{\alpha\beta,n}(f, r) = \sum_{n=0}^{\infty} K_n(f) H_n^{(2)}(k_n r)$$

$$K_n(f) = \frac{\pi T_n}{2 \omega \rho b c_n} \sum_{m=0}^{\infty} [k_{\alpha m} J_m(k_{\alpha m} r_0) - k_{\beta m} J_m(k_{\beta m} r_0)]$$

#### Proposed optimization formula



Proposed optimization design formulation<sup>[2]</sup>

$$\text{Maximize } S_1/S_0$$

$$\text{subjected to } S_1/S_0^{\text{min}} \geq \zeta$$

$$S_i(f, r) = \frac{1}{N} \int_{f_c}^{f_c + \Delta f} |T_{\alpha\beta,n}(f, r)|^2 df \quad (i=0,1)$$

### Design examples

#### Confirmation of the theory by finite element simulations

— SH0 Case2 — SH1 Case2 — SH0 Case1 — SH1 Case1

1  $f_c = 220 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

2  $f_c = 240 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

3  $f_c = 260 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

4  $f_c = 280 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

5  $f_c = 300 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

6  $f_c = 320 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

7  $f_c = 340 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

8  $f_c = 360 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

9  $f_c = 380 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

10  $f_c = 400 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

11  $f_c = 420 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

12  $f_c = 440 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

13  $f_c = 460 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

14  $f_c = 480 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

15  $f_c = 500 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

16  $f_c = 520 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

17  $f_c = 540 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

18  $f_c = 560 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

19  $f_c = 580 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

20  $f_c = 600 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

21  $f_c = 620 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

22  $f_c = 640 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

23  $f_c = 660 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

24  $f_c = 680 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

25  $f_c = 700 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

26  $f_c = 720 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

27  $f_c = 740 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

28  $f_c = 760 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

29  $f_c = 780 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

30  $f_c = 800 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

31  $f_c = 820 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

32  $f_c = 840 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

33  $f_c = 860 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

34  $f_c = 880 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

35  $f_c = 900 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

36  $f_c = 920 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

37  $f_c = 940 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

38  $f_c = 960 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

39  $f_c = 980 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

40  $f_c = 1000 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

41  $f_c = 1020 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

42  $f_c = 1040 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

43  $f_c = 1060 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

44  $f_c = 1080 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

45  $f_c = 1100 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

46  $f_c = 1120 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

47  $f_c = 1140 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

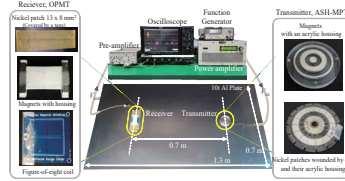
48  $f_c = 1160 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

49  $f_c = 1180 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

50  $f_c = 1200 \text{ kHz}$ ,  $\Delta f = 20 \text{ kHz}$

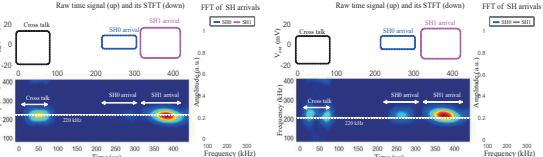
## Experimental Verification of the ASH-MPTs

### Experimental setup



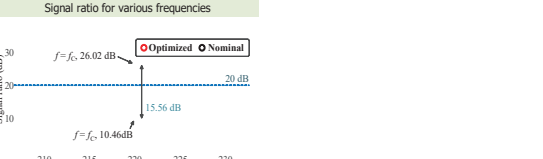
### Experimental results

#### Optimized ASH-MPT at 220 kHz



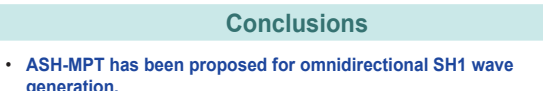
→ In the case of the optimized transducer, SH0 mode appears to negligible with respect to the SH1 mode. While, in the case of nominal case, non-negligible.

#### Nominal ASH-MPT at 220 kHz



→ ASH-MPT achieves great improvement in the ratio between the SH1 mode and the SH0 mode

### Signal ratio for various frequencies



→ ASH-MPT achieves great improvement in the ratio between the SH1 mode and the SH0 mode

## Conclusions

- ASH-MPT has been proposed for omnidirectional SH1 wave generation.

- Optimization formula simultaneously considering the SH1 mode and SH1 mode is proposed to generate SH1 mode without SH0 mode being accompanied.

- Proposed transducer and the optimization design are verified by numerical simulations.

- The experimental results using the fabricated ASH-MPTs confirmed the validity of the transducer and the optimization design.

- Research on the plate imaging system with ASH-MPTs will be carried out as future work.

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# Balancing Controller Interface Block design

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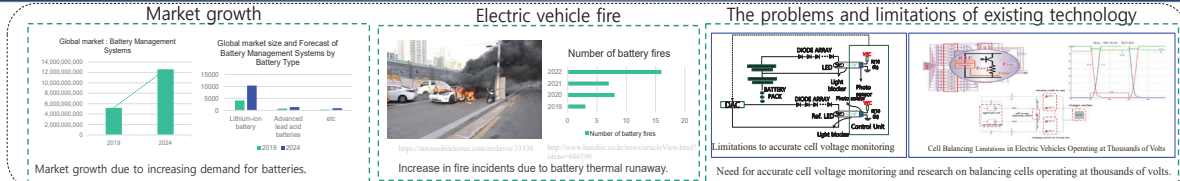
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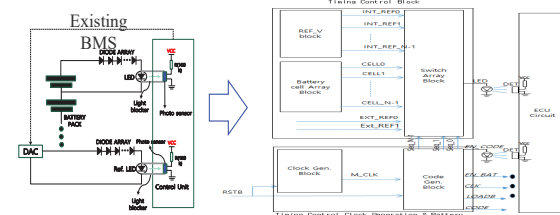
<sup>6</sup> Dept. of Advanced Automotive Eng., Sunmoon Univ. ;innyealoh@sunmoon.ac.kr

\* e-mail address of correspondence : 3445djwgodjw@sunmoon.ac.kr

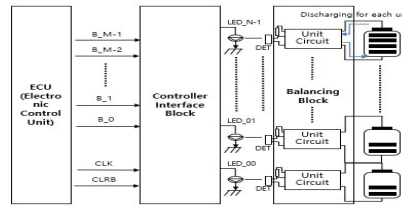


## I. Proposed Technology

### < Proposed Monitoring Method >

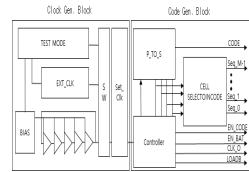


### < Proposed Cell Balancing >

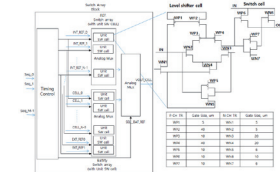


## II. Detailed Design

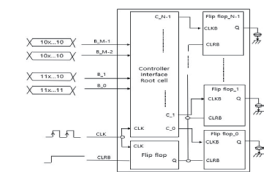
### < CODE/CLK Generation Sch. >



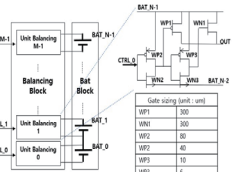
### < Monitoring Switch ARY BLK Sch. >



### < Balancing Controller IF BLK Sch. >

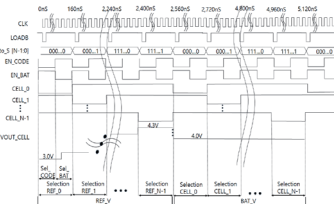


### < Balancing BLK Sch. >

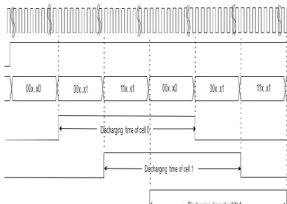


## III. Result

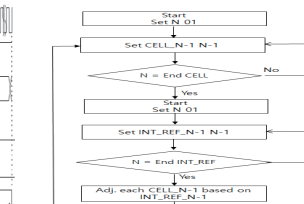
### < Multicell Monitoring on Single Path >



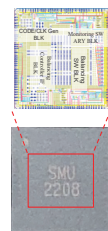
### < Isolated Balancing Result >



### < Temperature Compensation Operation >



### < Layout & Package >



## Conclusion

### < Multicell Single-Path Monitoring >

1. Secure monitoring techniques with proposed isolated single-path multi-cell circuits.
2. Acquired cell voltage with temperature compensation at 5.12 usec for 16 battery cells.
3. Implementing battery cell temperature compensation based on the V\_REF signal.
4. Low-power operation of 1.6 mW. (1/3 less power than the existing BMS.)

### < Isolated Stable Balancing >

1. The proposed isolated structure ensures that the balancing technology operates safely without affecting the high voltage of the battery.
2. Operates on a power consumption as low as 180 uW.

### < Isolated Stable Balancing >

Classification	[1]	[2]	[3]	Proposed Technology
How to connect the battery circuit	Direct connection	Direct connection	Indirect connection	Indirect Connection
high voltage of battery effect on Circuit	Yes.	Yes.	Yes.	None.
Features	Switch control	Sensing a Aged cell	photo detector isolated structure	Flip-flop-based behavior
Remarks	High voltage balancing circuit problems may occur			No high voltage impact



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# Agricultural cooperatives and social transition of a rural village: Case study of agricultural cooperatives in a rural village in Korea, in the 1960s

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## Introduction

The agricultural co-operative movement in Korea in the 1960s is widely known as the top-down rural development movement. It is known that farmers in the village co-operatives only played only limited and passive role, such as distributing fertilizers. However, there are several village co-operatives that can be called as bottom-up rural development movement, where farmers actively initiated them. In such cases, village co-operatives brought substantial social transition to their village.

## Top-down and Bottom-up development

Top-down development	Bottom-up development
<ul style="list-style-type: none"> <li>- The superstructure determines the substructure</li> <li>- The 'top' knows the information for development and the 'bottom' does not</li> <li>- A development plan is a national plan to meet its needs rather than a plan by the people</li> </ul>	<ul style="list-style-type: none"> <li>- The future of a community should be determined by the people themselves, not by an outside agenda</li> <li>- Development builds on the human, material, and institutional resources of a region.</li> <li>- Egalitarian and self-reliant development that meets the basic needs of all members of society.</li> </ul>

## Agricultural co-operative in Song-ra village

This is a case study of an agricultural co-operative in the 1960s in Song-ra Village, Icheon, Gyeonggi-do, Korea. In that village, agricultural co-operatives operated several enterprises that meets villager's needs; their operation records are well preserved. These businesses operated into the 1970s and the examples of them were a cooperative market, a rice mill, a pumping station, a women's shop, a rice bank, a grain bank, a credit union, and a straw bag workshop.



Pumping station(1970~)

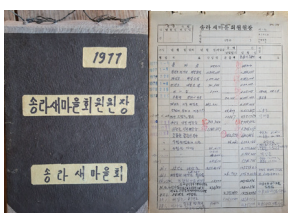


Rice Mill(1962~)

## Methods

### 1) Village Archives Research

- Approx 7,500 pages of documents of the village



### 2) Oral Interview

- Conducted from 2018 to 2020
- More than 10 elderly people



## Function of agricultural co-operative enterprises in Song-ra village

Year of Est.	Name of enterprise	Function
1961	Co-operative market	Purchase necessities in a village
1962	Rice Mill	Process rice with lower cost in a village
1970	Pumping station	Enhance irrigation rate
1973	Women's shop	Purchase necessities in a village
1973	Rice Bank	Loan with low-interest, without collateral in a village
1974	Grain Bank	Loan with low-interest, without collateral in a village
1975	Straw bag workshop	Convenience for produce straw bag
1975	Credit Union	Contribution-based low-interest loans

## Bottom-up development driven by co-operative enterprises in Song-ra village

**First, self-reliant development:** the need of the villagers were the most important factor in the establishment and operation of the business.

**Second,** the effective utilization of the **village's capacities** and the **work of the village leaders** have had a significant impact on the development of the co-operative in the village

**Third,** the **decision-making structure of village councils, voting system, cooperative managing system** contributed to meet the basic needs of all members of village.

## Co-operative and social transition of a village

Traditional village official economic cooperative system (Dong Kye)



Village official banking system (Rice Bank, Grain Bank, Credit Union)

Traditional cooperative irrigation system in a village



Keep the cooperative irrigation system, but improve irrigation rate with a machine (pumping station)

Offer basic goods and services from privately own stores



Villagers took over private shop and co-managed them (Rice Mill, Women's shop)

## Conclusions

In this case village, agricultural co-operatives played vital role to bring social transition of rural community. Despite of previous studies, there were autonomy and spirit of self-help in the agricultural co-operatives in Korea in the 1960s Korea.

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# UNSM Device and Equipment for Industrial Application

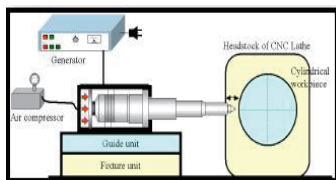
Inho Cho<sup>1\*</sup>, Junhyong Kim<sup>1</sup>, Youngsik Pyun<sup>2</sup>

<sup>1</sup> DesignMecha Co., Ltd., Asan, Korea, <sup>2</sup> Fusion Science and Technology, Sun Moon University, Asan, Korea

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- Ultrasonic Nanocrystal Surface Modification (UNSM) technology was developed by IMST(Institute for Manufacturing System and Technology) of Sun Moon University and DesignMecha Co., Ltd.
- Since the first development, UNSM treatment had been applied in several industrial field.
  - Service life extension of industrial knife, shear pins, etc for steel industry, paper industry, etc.
  - Service life extension of new rolling bearings and restoring or even improving service life of remanufactured bearings for steel industry and cement industry
- Recently several customized UNSM devices to mitigate the PWSCC in Nuclear vessel was developed and application results was filed to the ASME Code Case N-931.

## Basic Device and Mechanism of UNSM



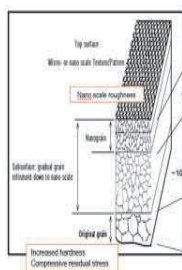
### UNSM(Ultrasonic Nanocrystal Surface Modification) Mechanism and Effects

**UNSM Mechanism: The ultra high and dense pressure creates "High Cycles Severe Plastic Deformation, Elasto-plastic Deformation, Elastic Deformation"**



Total Striking Force  $F = F_s + F_d = F_s + m \cdot a$   
 (m : mass of tool, a : acceleration)  
 $N \sim 60 / 3V$  - Strikes number per unit area (mm<sup>2</sup>)  
 $N \sim \text{speed}/\text{mod} \cdot S \sim \text{feed} \cdot f$  - frequency  
 Total striking force/energy: Deterministic control

- 100,000 ~ 10,000,000 strikes/cm<sup>2</sup>
- Up to 2.4 million strikes/min
- 3 ~ 30 GPa Pressure/stress

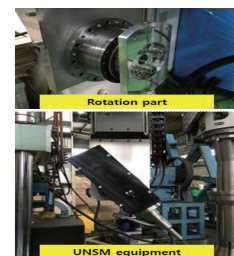
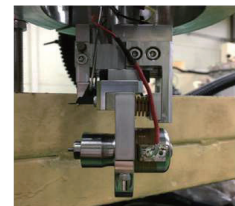
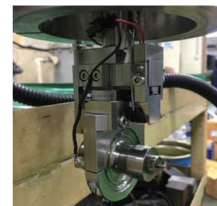
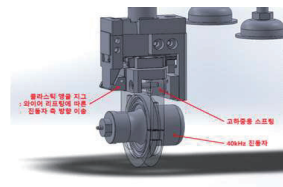
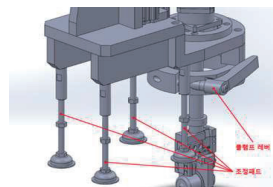


Gradient structure	Performance Improvement
Deep compressive residual stresses (Greater than 1000MPa into depths of more than 2000 μm)	1. LCE, HCF, VHCF Strength
Micro dimples surface and Improved Surface Roughness (Dia. of area: 1-2μm <sup>2</sup> Depth : sub micron, nano scale roughness)	2. Rolling Contact Fatigue Strength
Increased hardness (into depths of more than 1500 μm)	3. Stress Corrosion Cracking Resistance
Nanocrystal structure (Grain Sizes of 50-200 nm into depths of 200 μm)	4. Friction Loss
	5. Wear Rate
	6. Corrosion Resistance
	7/ Corrosion Fatigue Strength

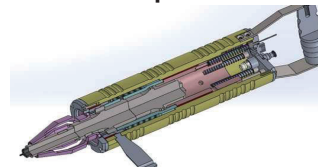
## Basic UNSM equipment for Research & Development Purpose



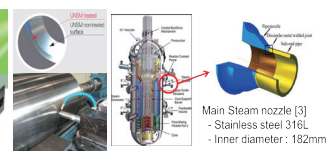
## UNSM Equipment for Nuclear Reactor



## UNSM Equipment for Portable Attachment and Manual Operation



## Typical Products of UNSM Treatment



## References

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# A Study on the Impact of Meditation Environment for Improvement of Meditation

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<sup>2</sup> Chair Professor of Sunmoon University

## 1. Introduction

This paper is a study of the environmental requirements for improving meditation practice and the meditative benefits of landscaping itself. Landscape refers to the preparation of the environment to improve meditation practice and to the effect of landscaping meditation practice acquired in the creation itself. In this paper, we would like to consider what are good environmental factors to meditation practice and the effect of meditation practice in the process of creating an environment. In this study, the following points were presented as research tasks. First, the degree of meditation improvement varies depending on the type of meditation. Second, it is more affected by the meditation environment in the introductory stage of meditation practice. Third, in the creation of an environment for meditation practice itself, the effect of performance can be obtained through meditation practice.

## 2. What is the meditation practice?

In general, the types of practice in the East are divided into mind control (彫心), aware of breath (調息) body control (調身, breath control). Monk Ja-hwang, is adding landscaping meditation (調境) to these three types of meditation. landscaping practice (調境) is to organizes the environment and human relationships around the place of meditation. Meditation practices must be classified from a religious point of view, a healing point of view, and a cultural point of view, and a landscaping meditation must be created accordingly to achieve meditation effectively. The environment of the place of meditation is created according to the nature of the organization in charge of meditation.

## 3. Transcendence and Adaptation of Meditation Environment

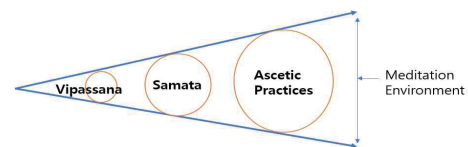
In Buddhism, it refers to five obstacles to meditation (① sensory desire, ② malice, ③ vague and laziness, ④ evil intention, excitement, ⑤ skepticism. If you enter the place of meditation without solving these five obstacles, you cannot reach the ultimate goal of meditation practice. In other words, the concentration and insight gained from meditation are not developed. Therefore, Buddha perceived that the above five things were free of charge and said that he should go into the forest.

Buddha taught the following to extinguish the five obstacles of meditation.

- ① Purify the mind of greed to extinguish greed. ② Compassion for all beings to extinguish evil and anger. ③ Being aware of the light in order to fight off vague and laziness. ④ Purifying the mind by stopping the action of the mind inside. ⑤ Doubts about being good and doubts about being sound.

Buddha refers to seven environmental factors to reach deep Samadhi through Samata practice. ① accepting good food ② a comfortable climate ③ a comfortable attitude ④ an appropriate effort staying away from violent people ⑤ a comfortable person and familiarity ⑥ a confidence in Samadhi refers to the environment and attitude of meditation to enter this Samadhi. An suitable environment for meditation is that it requires a good place to practice and one's own efforts.

Meditation practice Enhancement on Impact of Meditative Environment



## 4. Conclusion

The conclusion obtained in this study is that the improvement of meditation practice is affected by the meditative environment and the degree to which it is affected by the type of meditation varies. Here, the meditative environment refers to factors outside the environment such as meditation time and place of meditation. These external factors make you feel a sense of physical stability, extinguish the disturbance of the mind, and maintain calmness.

In addition, it can be seen that decorating the meditative environment itself has the effect of meditation. This is called landscaping practice. In the process of decorating the meditative environment, five obstacles of meditation are eliminated and the five roots of meditation are enhanced. When the five obstacles are eliminated and the foundation for practice is strengthened, Samadhi and wisdom, the ultimate goal of Buddhist meditation, will be acquired.

Through this study, it was recognized that research on the meditation that had a good effect on meditation practice. was needed. For research in this field, it is proposed that meditation experts and spatial composition experts work together to create a good place to meditation practices.

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# Laccase mediator systems: Virtual screening for Natural Mediators

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## Introduction

- Laccases are taking center stage in green chemistry since they use oxygen as a co-substrate, and release water as a by-product.
- Due to the limited capability to catalyze high molecular weight compounds of bacterial laccases, a mediator system is required.
- Mediators expand their substrate scope to more complex compounds along with catalytic ability increment [1]
- Although chemical mediators' systems application is still constrained due to high cost and potential toxicity.
- A crucial method in the early stages of mediator identification is structure-based virtual screening [2]

## Experimental / Methods / Results

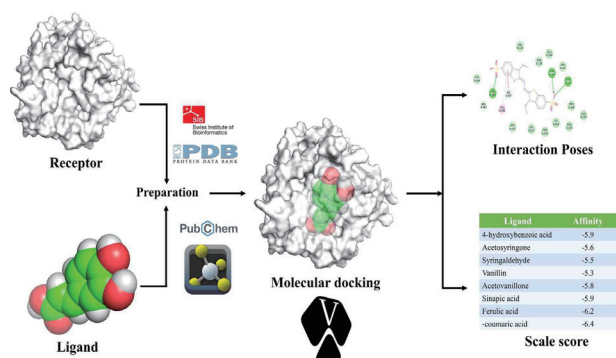


Fig. 1. Workflow summarizing the methodological steps

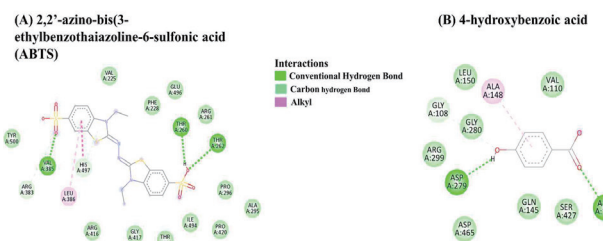


Fig. 2. Interactions of the active site of CotA laccase with ABTS (A); 4-hydroxybenzoic acid (B)

Table 1. Theoretical binding affinities of mediators.

Artificial	ABTS	HOBt	NHPI	VA	NHAN	TEMPO		
Binding energy (kcal/mol)	-7.4	-6.3	-6.5	-6.8	-6.3	-7		
Natural	HBA	AS	SA	V	AV	S	FA	CA
Binding energy (kcal/mol)	-5.9	-5.6	-5.5	-5.3	-5.3	-5.8	-6.2	-6.2

ABTS: 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid), HOBt: 1-hydroxybenzotriazole, NHPI: N-hydroxyphthalimide, VA: Violuric acid, NHAN: N-hydroxyacetanilide, TEMPO: 2,2,6,6-Tetramethylpiperidine-1-yl, HBA: 4-hydroxybenzoic acid, AS: Acetosyringone, SA: Syringaldehyde, V: Vanillin, AV: Acetovanillone, SA: Sinapic acid, FA: Ferulic acid, CA: Coumaric acid

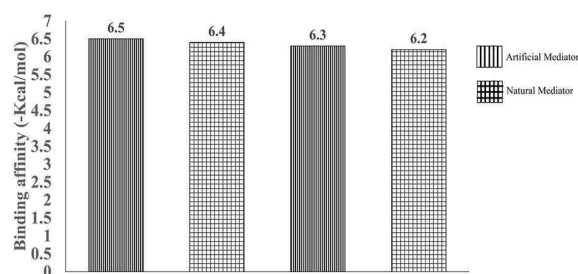


Fig. 3. Binding affinity values (Kcal/mol) of most comparable artificial and natural mediators

## Conclusions

- Caumaric acid, a natural mediator could be potential mediators was found in comparison to the artificial mediator, N-hydroxythallimide determined by a structure-based docking approach.
- Such an approach could reduce the increasing costs of experimental screening.

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# The Principle of Qi Circulation and its Effects on the Mind and Body from The Principle of Creation

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\* e-mail: parkjongug8416@hanmail.net

## Introduction

- This study explores the effectiveness of Qigong massage treatment for skeletal correction and pain relief in people suffering from musculoskeletal disorders such as spinal stenosis, straight neck syndrome, and scoliosis.
- Currently, people suffer from painful diseases such as spinal stenosis, straight neck syndrome, and scoliosis, which are degenerative diseases, and physical and mental problems are also becoming a serious social problem.
- People with musculoskeletal disorders have benefited from counseling and manual massage for healing and pain relief.

## Experimental / Methods / Results

- Creation Principles of Qi Circulation and Mind-Body Therapy
  - (1) How to use your hands to circulate blood
  - (2) How to use your nails to circulate blood
  - (3) How to use your elbows to circulate blood
  - (4) How to Use Your Feet to Circulate Qi
  - (5) How to Use Towels
  - (6) Measure with a protractor

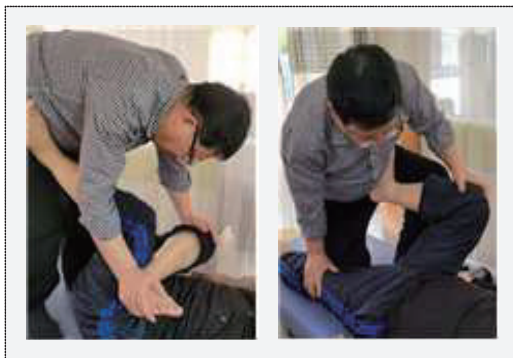


Fig. 1. Spine management (spinal stenosis)

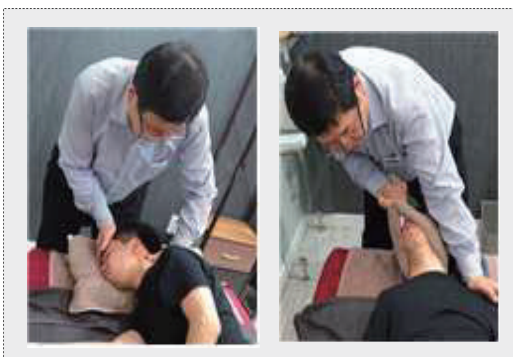


Fig. 2. Cervical spine management (straight neck syndrome)

Table 1. Spinal stenosis, a condition in which the spine is distorted

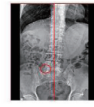

Measurement Tools	Pre- and post-mortem certificates from a healthcare professional, X-ray pre- and post-film with medical devices
Duration	Once a week for 8 weeks for non-surgical individuals with spinal stenosis and left scoliosis, using the principle of Qi circulation and mind-body health based on the principle of creation.
Personalized	Spinal Stenosis: People with left-sided scoliosis pain
Diagnosis name	Spinal Stenosis
Diagnosis Location	Tongyeong City Kim Taeyun Orthopedic Surgery Primary Shot, January 22, 2019
Spinal Canal Stenosis Scoliosis People with pain X-ray film	
	Secondary Shot, March 30, 2019
	

Table 2. Body type condition with cervical spine deformity due to straight neck syndrome



Measurement Tools	Pre- and post-mortem certificates from a healthcare professional, X-ray pre- and post-film with medical devices
Duration	Straight Neck Syndrome. Once a week for 8 weeks, for people with malformed body types, using the principle of Qi circulation and mind-body health based on the principle of creation.
Personalized	People in Changwon City, Age 20s, Gender: Male
Diagnosis name	Straight Neck Syndrome, Malaligned, People with back, neck, and shoulder pain.
Diagnosis Location	원인시 The Large Hospital Specialty, Primary Shot, December 28, 2022
Straight neck Syndrome Malformation People with pain X-ray film	
	Secondary Shot, February 9, 2023
	



Fig. 3. Results of body shape management with cervical spine misalignment due to straight neck syndrome

- Before the correction, her neck was straight (turtle neck), but after cervical spine management (management of qicirculation) and qigong exercise, her neck became normal (C-shaped), and her neck pain, shoulder pain, and headache were relieved.

## Conclusions

- In conclusion, if you consistently apply the principle of Qi blood circulation and mind-body health method based on the principle of creation to subjects with spinal stenosis, straight neck syndrome, deformed body shape, and back, neck, and shoulder pain, the deformed body shape will be restored and the pain here and there will be relieved, and it will be effective in preventing and healing related diseases.

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# Development of ultrasonic nanocrystal surface modification device to improve PWSCC characteristics of reactor nozzle

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## Introduction

One of the problematic parts of nuclear power plants is PWSCC(primary water stress corrosion cracking) occurring in nozzles and heterogeneous welds in nuclear reactors. [1] In order to solve this problem, research and development to improve the PWSCC resistance by relieving the tensile residual stress of the reactor nozzle and inducing compressive residual stress are being conducted worldwide, and one of them is UNSM(ultrasonic nanocrystal surface modification) technology. In this study, a UNSM device is developed to be applied to the inner diameter and welded area of a CEDM(control element drive mechanism) nozzle with an inner diameter of about 70 mm installed on the upper head of a nuclear reactor. In addition, the UNSM device is also developed for the application of the inner and outer diameters of the main steam nozzle with an inner diameter of about 182 mm of a SMR(small modular reactor).

## UNSM technology

A tungsten carbide ball is attached to an ultrasonic horn that strikes the surface at a frequency of 20 kHz as shown on the right Fig.1 resulting in surface severe plastic deformation forming a nanocrystal structure with deep compressive residual stress. [2] The UNSM treatment parameters are listed in Table 1.

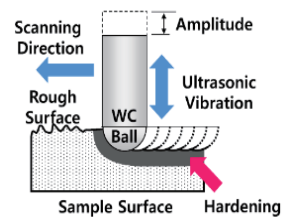


Fig. 1. Schematic view of UNSM

Table 1. Main UNSM treatment parameters

Amplitude, $\mu\text{m}$	Load, N	Rotational speed, rpm	Feed-rate, mm/rev
30	60	60	0.07

## Development of UNSM device

### • UNSM device for CEDM nozzle of Nuclear Power Plant

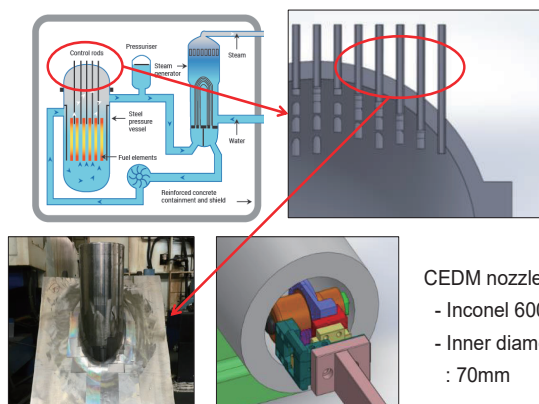


Fig. 2. CEDM nozzle information and compact UNSM unit (40kHz)

CEDM nozzle  
- Inconel 600  
- Inner diameter  
: 70mm

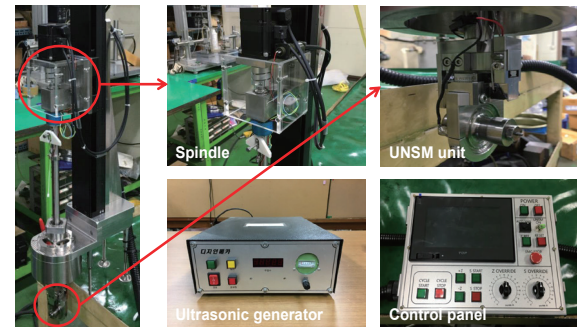


Fig. 3. UNSM device for CEDM nozzle

### • UNSM device for Main Steam nozzle of SMR

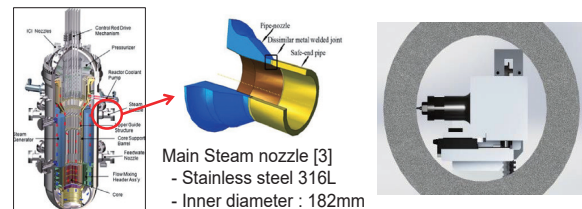


Fig. 4. Main Steam nozzle information and UNSM unit (27kHz)



Fig. 5. UNSM device and UNSM unit for Main Steam nozzle

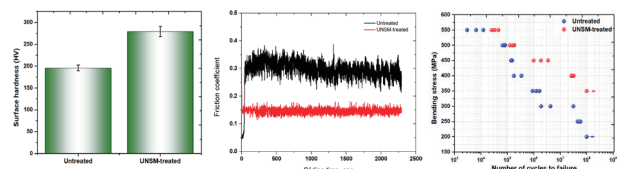


Fig. 6. Surface hardness and friction coefficient, fatigue strength before and after UNSM treatment

## Conclusions

The UNSM device was developed to prevent PWSCC in nuclear power plants. The devices for CEDM nozzle and SMR nozzle internal diameter UNSM treatment were developed. The mechanical properties of the target material were improved after UNSM treatment.

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# The Potential of Oriental Medicine for Supporting Christian Pastors' Health in the U.S.

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## Introduction

- The author, an Oriental Medical Doctor in Nevada, occupies a pivotal role as the director of Las Vegas Young Christianity Leadership Conference (YCLC). This leadership position has afforded the author unique experiential insights into furnishing health-oriented support to American Christian pastors through practices of Oriental Medicine. Considering the differences that set apart Oriental Medicine from its Western counterpart in various ways, the author, who has gained knowledge from their deep involvement in improving the well-being of pastors, now understands how Oriental Medicine can potentially help with the specific health issues that American pastors face. In this report, there is a close examination of the distinctions between Oriental Medicine and Western medical concepts. Furthermore, there is a meticulous investigation into the health challenges encountered by pastors in the United States. This encompasses an effort to comprehend the underlying factors behind these challenges. The paper also discusses the potential of Oriental Medicine to address these intricate health issues. Finally, the author substantiates the presented concepts with tangible evidence, illustrating the actual outcomes observed when pastors underwent treatments such as acupuncture and other approaches from Oriental Medicine to enhance their well-being.

## The characteristic of Oriental Medicine

Table 1. The characteristics of Oriental Medicine comparing to Western Medicine

Aspect	Oriental Medicine	Western Medicine
Philosophical approach	Holistic, balance, harmony	Empirical, scientific, reductionist
Diagnostic characteristic and method	Holistic, comprehensive, Subjective, pulse diagnosis, tongue observation, symptoms	Reductionistic, specific, Objective, laboratory tests, imaging, clinical signs
Treatment modalities and strength	Acupuncture, herbal medicine, and Qi Gong good for pain and chronic diseases [1]	Pharmaceuticals, surgery, advanced technology, good for serious infection, severe trauma, and life-threatening deterioration of major organs
Invasiveness of treatment	non or low invasiveness	minimal, moderate, high depending on the specific medical condition being treated and the chosen intervention.
Evidence base	Some traditional knowledge, limited scientific validation	Strong emphasis on evidence-based practices
Regulation and safety	less strict regulations, need to ensuring safety	Strict regulations, high safety

## The potential of Oriental Medicine on supporting Christian pastors in the U.S.

- The limited number of studies examining the physical health of clergy have shed light on a vulnerable group, revealing elevated rates of obesity and chronic health conditions [2, 3, 4]. The examples of chronic diseases are diabetes, arthritis, high blood pressure, and asthma [4].

The considerable prevalence of obesity and chronic health conditions underscores the necessity for enhancing physical activity and dietary habits among clergy, as both contribute to the development of chronic health issues [5]. From my perspective, these health issues faced by Christian pastors in the U.S. can be attributed to several factors; stress and burnout, a sedentary lifestyle, and poor dietary habits.

## The personal experiences to support Christian pastors' health through Oriental Medicine

- I recount my experiences using Oriental Medicine principles to aid about ten Christian pastors in the US. Many pastors dealt with obesity and chronic issues due to pastoral stress and unbalanced habits. Pastoral responsibilities left little personal time, resulting in unhealthy choices. I proposed Oriental Medicine's holistic approach as a solution and employed acupuncture and dietary guidance. Positive outcomes emerged, like reduced stress and enhanced concentration. I even provided treatments at international conferences, utilizing a massage device. In essence, I used Oriental Medicine to tackle health challenges from pastoral stress and unbalanced lifestyles among Christian pastors. Acupuncture and dietary adjustments yielded positive results, aligning with the idea of the body as sacred, and indicating that this approach can amplify pastors' spiritual contributions.

## Conclusions

- The distinctive principles of Oriental Medicine, including its holistic nature and emphasis on balance, present a unique perspective in contrast to Western Medicine. This report has highlighted how Oriental Medicine's personalized treatments, such as acupuncture and Qi Gong, hold potential to alleviate health challenges faced by American Christian pastors. By aligning with the notion of the body as a temple of the Holy Spirit, Oriental Medicine offers a pathway to enhance pastors' well-being and amplify their ministry impact. The integration of personal experiences underscores the practicality of these approaches. Further exploration and validation of Oriental Medicine's efficacy in supporting pastoral health are warranted, potentially ushering in a new era of holistic care within spiritual leadership.

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# Comparison of activities of CYP106A1 and BaCYP106A6 in glucosteroid

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## Introduction

- Bacterial cytochrome P450s (CYPs) are usually labeled with a three-digit number and show different properties for each family. Enzymes are heme-bound forms, act by receiving electrons from the electron transport system, and mainly exhibit hydroxylation activity.
- The CYP106A family has hydroxylation activity using steroids and terpenoids as substrates. Among them, glucosteroid is a component with strong anti-inflammatory activity, and corticosterone is representative.
- CYP106A1 was studied to show 42 % activity with corticosterone and 19 % activity with cortisol, but BaCYP106A6, which has a high sequence similarity with it, showed activity of less than 20% with both substrates.
- Therefore, *in silico* analysis was used to investigate the interaction between the two enzymes and their substrates and provide insight into their activities. This could contribute to protein engineering research as it provides insight into key residues.

## Experimental / Methods / Results

- CYP106A1 was analyzed for activity based on previously researched papers, and since the structure was not revealed, a structure uploaded to PDB was used.

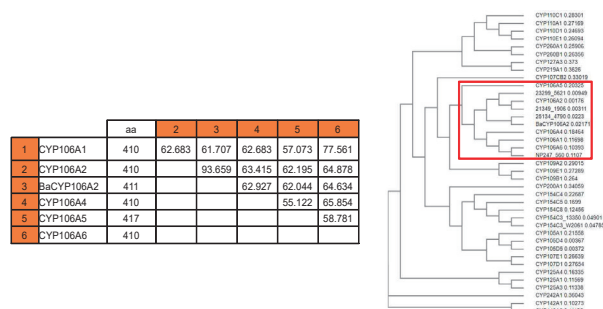


Figure 1. Sequence similarity of CYP106A family and phylogenetic tree of steroid hydroxylase CYPs.

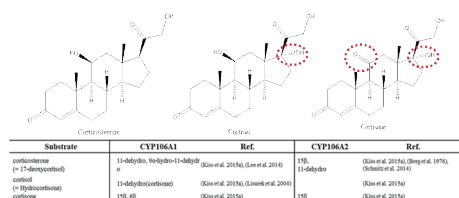


Figure 2. Sequence similarity of CYP106A family and phylogenetic tree of steroid hydroxylase CYPs.

- CYP106A6 analyzed HPLC results based on *in vitro* assay results. Each experiment was reacted for two hours at 30 degrees.

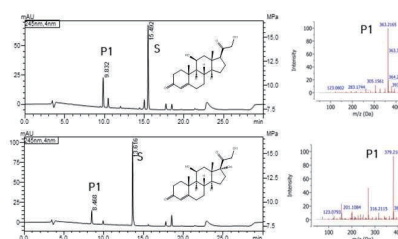


Figure 3. HPLC and LC/MS analysis of BaCYP106A6 in *in vitro* assay with corticosterone and cortisol.

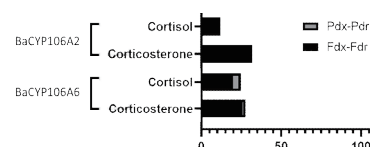


Figure 4. HPLC conversion analysis of BaCYP106A2 and BaCYP106A6 in the *in vitro* assay using corticosterone and cortisol.

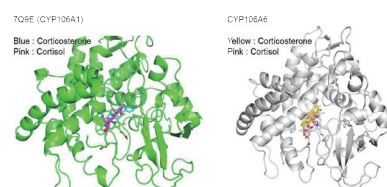


Figure 5. Simulation results through substrate docking of CYP106A1 and CYP106A6

## Conclusions

- The CYP106A family is a rare steroid hydroxylase found in bacteria, and although they are similar, it has been demonstrated that they have different activities depending on the gene sequence.
- In particular, it has been found that dehydrogenation reaction occurs in addition to hydroxylation activity in glucocorticoids.
- To prove the potential dehydrogenation function of CYP106A6, it was compared with CYP106A1, and in conclusion, it is considered that dehydrogenation is possible.

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# Compound K: Application Case of Bioavailability Improvement strategy

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## Abstract

Among the main active component of *Panax ginseng*, there are ginsenoside Rb1, Rb2 and Rc. After oral administration of ginsenosides, intestinal bacteria metabolize them to 20-*O*- $\beta$ -D-glucopyranosyl-20(S)-protopanaxadiol (compound K, CK). CK is known to be the main functional agent, however its poor solubility and permeability sabotage its bioactivity. Previously, we developed cyclodextrin-conjugated CK (CK-cyclodextrin) and used Gelucire44/14 for increasing of solubility of CK. In this study, we evaluated solubility through *in-vitro* dissolution profiles of CK, CK-cyclodextrin, and CK-Gelucire44/14. Furthermore, after confirming that CK-gelucire44/14 had the best dissolution rate, a pharmacokinetic study was conducted in an *in-vivo* rat model. The results suggest that using Gelucire44/14 as a dual application of solid dispersion and self-microemulsifying drug delivery has shown potential as a bioavailability improvement strategy for poorly soluble therapeutics.

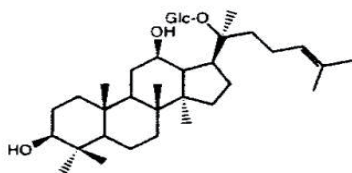


Fig.1 Chemical structure of compound K(CK)

## Results

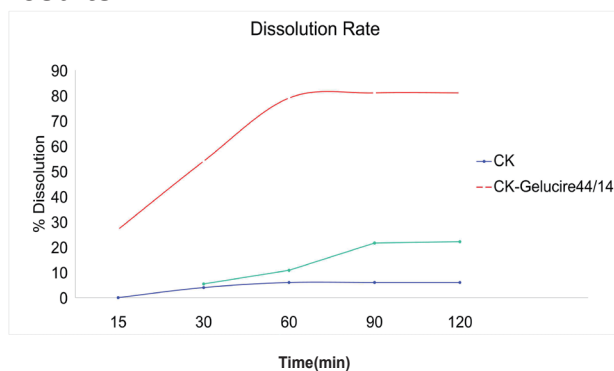


Fig.2 Comparison of dissolution profiles of CK, CK-Gelucire44/14, and CK-cyclodextrin

- As a result of dissolution test in distilled water 900ml with USP paddle method 50 rpm, CK-Gelucire44/14 appeared significant increasing of dissolution rate compared to CK and CK-cyclodextrin
- Therefore, we selected CK-Gelucire44/14 as an agent that used in future study

Pharmacokinetic parameter	(Mean $\pm$ S.D.)
AUC <sub>0-30hr</sub> (ng.hr/ml)	11726.56 $\pm$ 5406.19
Cmax (ng/mL)	1882.25 $\pm$ 211.64
Tmax	2.33 $\pm$ 0.58
t <sub>1/2</sub> (hr)	3.15 $\pm$ 0.35

Table 1. Pharmacokinetic parameters of CK after oral administration of CK (100mg/kg, n=3) in Gelucire 44/14

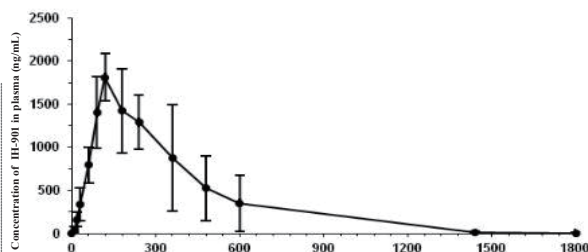


Fig.3 Pharmacokinetic profiles of CK after oral administration of CK (100mg/kg, n=3) in Gelucire 44/14

Pharmacokinetic parameter	(Mean $\pm$ S.D.)
AUC <sub>0-30hr</sub> (ng.hr/ml)	7637.08 $\pm$ 943.79
Cmax (ng/mL)	1637.89 $\pm$ 250.04
Tmax	1.75 $\pm$ 0.35
t <sub>1/2</sub> (hr)	3.05 $\pm$ 0.45

Table 2. Pharmacokinetic parameters of CK after oral administration of CK (100mg/kg, n=2) in cosolvent

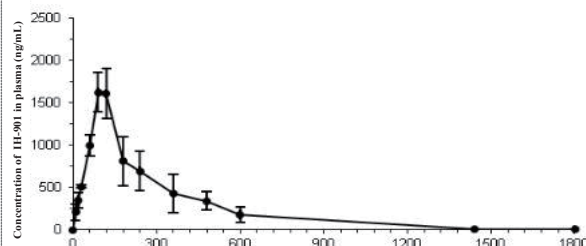


Fig.4 Pharmacokinetic profiles of CK after oral administration of IH-901 (100mg/kg, n=2) in cosolvent

- Pharmacokinetic parameters and profiles of CK after oral administration of CK in Gelucire 44/14 and cosolvent reveal that significant improvement of bioavailability in CK-Gelucire44/14 group.
- These results correspond to the result of dissolution test (Fig.2), supporting our decision of CK-Gelucire44/14 selection.

## Conclusion

Due to the poor permeability of ginsenosides in the intestinal epithelial barrier, the chemical structures of them should be transfer for improving bioavailability. In this study, we modified CK, which is one of the major metabolite of ginsenosides, to achieve an improved bioavailability. Our data suggest that CK, not only appear advanced dissolution rate compared to CK and CK-cyclodextrin, but also appear improved pharmacokinetic parameters after oral administration at *in-vivo* rat model. Based on pharmacokinetics results, we suggest that the approach used to modify compound K to produce CK-Gelucire44/14 can be applied to other therapeutic agents that struggle from poor bioavailability

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# Study on the Mind-Body Connection and Health Effects in True Fathers Exercise

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## Introduction

This study validates the True Father's Exercise (TFE) proposed by Mr. Sun Myung Moon. TFE is an exercise developed by Mr. Moon to maintain health even in harsh conditions. It derives from training and exercises aiming at mind-body unification based on the universal principles, and is a full-body exercise using a special breathing method, concentrating the body's power below the navel ("tiantian" the center of the body). In a short period, it is possible to strengthen nerves, blood vessels, and muscles. However, there are various implementation methods, and the correct one is sought. Therefore, based on the author's experience and background as a health-trainer and martial artist, a hypothesis was made that it's crucial for TFE to focus on consciousness, posture, and breathing (especially the "tiantian", central axis, and breath).

## Experimental / Methods / Results

- In this study, we involved 48 participants from both Japan and overseas who felt some physical discomfort (gender ratio 11:37, aged mainly in their late 50s, ranging from 30s to 70s). They practiced 20 minutes of TFE every morning for 3 months. Training was directly instructed online, emphasizing three points: awareness of "tiantian", how to hold the waist, and deep abdominal breathing. The results over these three months were evaluated through self-assessment checklists, feedback, and posture comparisons using photographs. Participants listed over ten items of current pain or discomfort (all participants), and feedback after three months (30 participants). Photographs were taken from various angles (front, side, forward bend, backward bend, and side bend) and compared with those taken after three months (5 participants). As a result, all participants showed improvement in the checklist, and more than half of the improvements were seen in over half of the participants. Posture measurements confirmed an improvement in flexibility and range of motion in all directions. The summarized feedback is shown in the following graph.

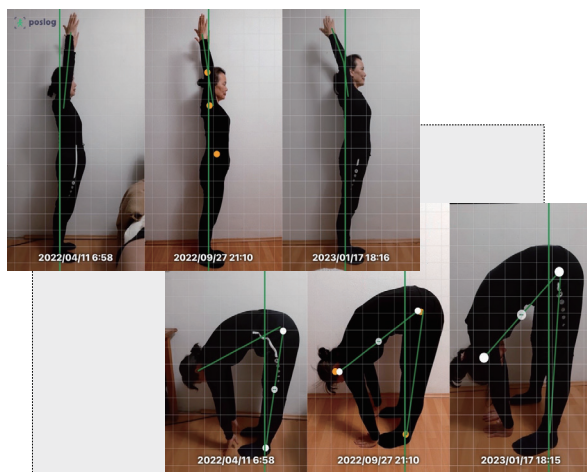


Fig. 1. Comparison photographs of the range of motion due to forward bending and shoulder lifting (every 3 months)

Table 1. Improvement Status in Each Category

Category	Feedback Content	Number of Participants	Percentage
Pain reduction or disappearance	Sciatica, lower back pain, knee pain, shoulder and arm pain, ear pain, neck pain, calf pain	17 people	52%
Improvement in physical functions	Weight loss, muscle increase, flexibility improvement, able to sit in a traditional Japanese style, improvement in cold sensitivity, blood pressure normalization, body temperature normalization, gastritis improvement, improvement in lethargy, improvement in post-sprain symptoms of the wrist, pollen allergy reduction, elimination of body stiffness, improvement in swelling	25 people	77%
Mental improvements	Improvement in forgetfulness, increase in concentration, increase in morale, improvement in mental health (change from negative thoughts to positive emotions)	10 people	31%

Evaluation Method	Details	Number of Participants	Observations
Self-evaluation on checklist	Participants listed 10 or more points of current physical pain or discomfort	48 (All participants)	All participants showed improvement in their checklist. Half of the participants reported improvements in over 50% of the listed items

These results indicate that TFE significantly affects participants' physical and mental health, as well as the quality of daily life. Specifically, with 77% in the improvement of physical functions and 52% in the reduction or disappearance of pain, the results demonstrate the efficacy of TFE in alleviating body pain and enhancing physical health.

## Conclusions

This research has clarified that TFE has the potential to balance the mind and body, improve physical functions, mental health, and the quality of daily life. Particularly, notable improvements were seen among participants with health issues, highlighting the usefulness and broad application range of TFE. Future tasks include a deeper understanding of the mechanisms through which TFE brings these effects, and further exploration of effective ways to utilize TFE based on this research's results. This can deepen our understanding of TFE's effects and potentially expand its practical applications.

# Metabolic profiling of Antarctic moss species and their therapeutic potential

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## Introduction

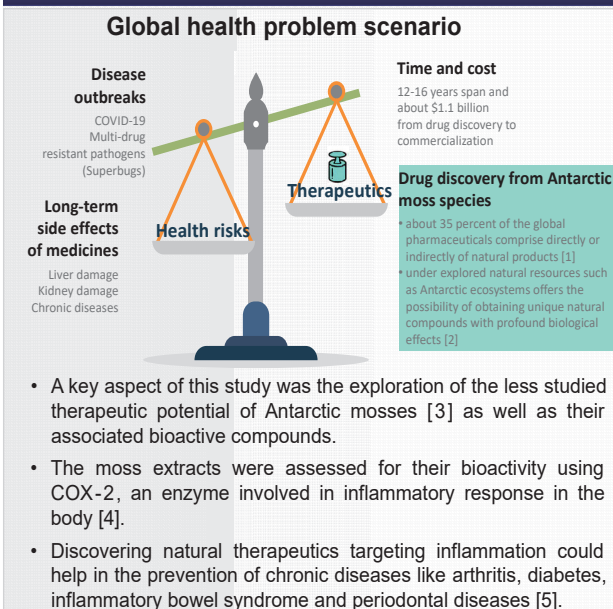


Table 1. Yield and COX-2 activity percentage of acetone and methanol extracts of different mosses sampled from Antarctic region

Extraction solvent	Sample	Yield (%)	COX-2 activity (%)
Acetone	MS-3	4.8	97.31 ± 0.089
	MS-10	5.12	87.39 ± 1.063
	MS-13	12.49	79.54 ± 0.354
Methanol	MS-3	10.71	92.04 ± 0
	MS-10	6.28	78.79 ± 2.658
	MS-13	8.14	95.13 ± 0
Negative control			52.13 ± 4.253

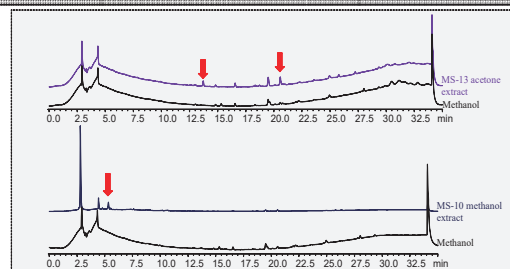
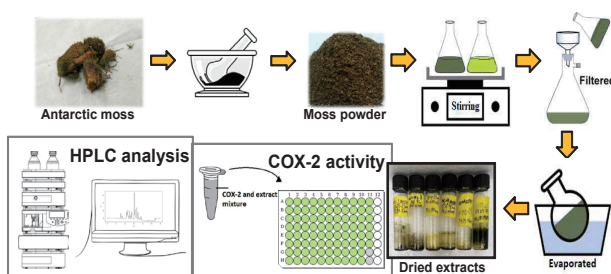


Fig. 1. HPLC chromatogram of methanol and acetone extracts of MS-10 and MS-13 samples with distinct peaks indicated by red arrows

## Experimental / Methods / Results



- To extract compounds, the moss samples were powdered and soaked on solvent such as acetone followed by methanol.
- In subsequent days, the mixture was filtered, and the filtrate extracts dried. Dried samples were dissolved in methanol for detection of compounds using HPLC analysis. For COX-2 activity inhibition assay, samples were dissolved in DMSO and used in the enzyme reaction mixture.
- Percentage yield was calculated for all the samples and COX-2 activity for each sample treatments were expressed as percentage value with respect to the 100% activity control (Table 1)
- Yield was higher for extraction using methanol as solvent compared to acetone. COX-2 activity was lowest for MS-13 acetone and MS-10 methanol extracts suggesting presence of COX-2 inhibitors.
- Following HPLC analysis, MS-13 acetone and MS-10 methanol extracts contained distinct peaks exhibited by distinct compounds (Fig 1).

## Conclusions

- The growing demand for potent therapeutics due to various health challenges highlights the importance of exploring the least investigated sources like Antarctic mosses.
- As seen from the findings in this study, Antarctic mosses hold promising potential to uncover natural treatments for chronic inflammatory disease.
- Further works will include isolation and deriving structure-activity relationship (SAR) of specific bioactive compounds to elaborate our understanding of mechanism of bioactivity.
- Nature has interconnected various species by endowing mutual benefits, enabling them to address each other's challenges; thus, uncovering therapeutic significance and preservation of these vital ecosystems from extinction amid the changing environment ought to go hand in hand towards maintaining a sustainable environment [6].

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# A Comparative Study on Exorcism and the Spiritual Therapy of the Family Federation for World Peace and Unification(FFWPU)

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## Introduction

Is the spiritual therapy performed by FFWPU only in Cheongpyeong? I started with the question, "What are the similarities and differences if they are done elsewhere?" First of all, I looked through the history of psychiatric treatment from ancient to modern times. Next, we looked at the rise and fall of Exorcism chiefly on Catholicism. Although Exorcism has a long history, starting with Jesus, it seems that it has taken a path of decline with the Enlightenment, but it is returning to life with the American spiritual awakening movement. Finally, the similarities and differences between Exorcism and the spiritual therapy of FFWPU were compared.

## Experimental / Methods / Results

Historical research has been conducted through literature and writings. First, research was conducted on the treatment of various mental illnesses dating back to ancient times, followed by a study of the history of Western psychiatry and exorcism. Finally, a comparison and examination were made between exorcism and spiritual healing within FFWPU.

In the 19th century, Adorf Bastian<sup>1</sup> propagated the idea of a common spiritual consistency among humanity through his studies of people from various parts of the world, greatly influencing C. G. Jung. Forest Crements<sup>2</sup> also advocated for the universality of the causes and treatments of illnesses through anthropology. Specifically, (1)if an illness was caused by the invasion of some object from the outside, it should be removed; (2)if an illness was caused by the disappearance of the soul, it should be searched for and reclaimed; (3)if malevolent spirits were the cause, they should be expelled through exorcism; (4)if a taboo was broken, repentance should be performed to appease the anger of the gods; (5)if performed by a shaman, counter-magic should be used against witchcraft. Claude Lévi-Strauss argued that these primitive medical concepts are equivalent to modern psychosomatic medicine. Shamans enter a state of ecstasy to access the spirit world, engage in dealings or battles with the spirits that have stolen souls, and work to recover the lost souls. These healers were depicted as early as around 13,500BC in the cave paintings of Lascaux in France. Galen, a physician and surgeon who served as the personal physician to Roman emperors, also entrusted spiritual healing to the oracle of Asclepius.

The Catholic Church, which dominated the Western world in the Dark Ages, regarded mental illness as possession by demons and had been treating it through exorcism. However, in the mid-18th century, a physician named Mesmer introduced a new technique called magnet therapy and provided treatment. This gained support from prominent figures of the time, including the Habsburg family, Mozart, and Haydn. This development led to a confrontation with exorcists, and magnet therapy emerged victorious, marking the beginning of the Enlightenment era's influence in the medical field<sup>3</sup>.

On the other hand, exorcism continued to thrive and evolve, especially in the United States, in conjunction with the Spiritualist movement that emerged in the 19th century. It is still practiced around the world today. Papal universities include courses on

exorcism and play a role in producing exorcists. One of the most important lectures there is said to be the acquisition of discernment methods between mental illness and demonic possession.

Detailed descriptions about exorcism are provided in Chapter 11 of the Roman Ritual, promulgated by Pope Paul V during the Second Vatican Council in 1614. The 1952 revised edition, after a gap of 350 years, added criteria for distinguishing between mental illness and possession. In the latest research, statistics indicate that 97% of those who seek help are not possessed by demons but are suffering from mental illness<sup>4</sup>.

H.E. Ellenberger, when analyzing exorcism practices from a psychological perspective across various religions, suggests that it is essentially the reverse process of possession and can be considered as a well-structured form of psychotherapy.

FFWPU has acknowledged and continued the tradition of spiritual healing in Christianity that traces back to Jesus' acts of healing. In the relatively short history of FFWPU, several individuals with spiritual abilities have emerged and conducted healing practices. Especially significant is the role of Daemonim, the mother of True Mother, which began in 1995, contributing to various healing miracles ranging from exorcisms to physical and mental ailments. This ministry has continued to evolve and expand over time.

## Conclusion

Table 1. Exorcism and Spiritual Therapy of FFWPU

	Exorcism	Spiritual Tx of FFWPU
Targeted diseases	Mainly cases of demonic possession (Father Milingo also heals illnesses)	All mental and physical disorder (including cases of possession)
Contents of the possessing spirit	Devil (Fallen Angel), Evil Spirit, Witchcraft	Mainly human spirits; evil spirits, grudge spirits (ancestral connections)
Healing on a spiritual level	Evil spirits departing on their own, the power of priests, the power of angels	By the Holy Spirit, absolute benevolent spirits, and angels
Format	Rigorously ritualized. Mainly conducted one-on-one in churches, privately. Prayer is the main focus. (Jesus performed it in public)	Administered by individuals or groups within a certain structured framework, primarily through prayer and laying on of hands, often during times of ministry
Practitioner	Only officially appointed 'certified exorcists' by archbishops and bishops are permitted	Appointed officials by Cheonsi m won and others
Ancestral reconciliation	The ritual of liberation for those who have gone to Purgatory (Intermediate Spirit Realm)	Dispelling grudges and blessings, transformation into absolute benevolent spirits
Use of psychiatric medication	Cases requiring psychiatric medication are entirely entrusted to psychiatric treatment, and exorcism is not performed	Collaborating with a psychiatrist for treatment, actively implementing combined therapy including medication
Place of performance	Primarily within the church, though in cases where the patient is difficult to manage, the ritual may also be performed at home or in a hospital	CheonBo Training center, churches, HJM Hospital, and other authorized locations
Duration of treatment	Can range from a short period to several years	Can range from a short period to several years

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# The Family in the Context of the Principle of Interdependence, Mutual Prosperity and Universal Values

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## Introduction

- This poster is based on the book *"The families of the 21st century and universal values"*, which was published in February 2022 in the Albanian language, and is expected to be published in English as well. Dr. Saemira Gjipali Pino, a sociologist in Albania who served also as the Deputy Minister of Education in the Albanian Government, co-authored the book with me
- A central position in the book is occupied by an analysis of the essence of the Unification Thought and the teaching of Rev. Sun Myung Moon and Dr. Hak Ja Han Moon in which the discussion and approach to the subject of the family, and its preservation, represent highly significant sections
- This poster highlights the importance of the family as an institution ordained by God and the central role it plays in the context of the Principle of Interdependence, Mutual Prosperity and Universal Values

## Methodology

### 1. Family, the Institution Ordained by God

The lifework of Rev. Sun Myung Moon and his wife Dr. Hak Ja Moon has been characterized by a strong emphasis on marriage and family as the center point for the experience of divine love. They teach that true love can be most fully realized in a family where God's love abides.

Family has a central role in all cultures. Through the family, we are linked by blood and by affection. It is the basic building block upon which all other social relationships rest. The highest function of the family is as a school of love and peace:

*As far back as our knowledge takes us, human beings have lived in families. We know of no period where this was not so. We know of no people who have succeeded for long in dissolving the family or displacing it. ... Again and again, in spite of proposals for change and actual experiments, human societies have reaffirmed their dependence on the family as the basic unit of human living-the family of father, mother and children (2).*

The family is also the school of moral and social development, and the source of our most deeply held values. The family is a microcosm of universal love that extends from the intimacy of two people to embrace the entire cosmos.



Fig. 1. The book on which the poster is based

### 2. The Principle of Interdependence, Mutual Prosperity and Universal Values, and the Family

The principle of interdependence, mutual prosperity and universal values is a principle which addresses a certain dimension of Rev. Moon's concept of Godism, namely, the dimension which includes economics, politics and ethics. The basic model of the society of interdependence, mutual prosperity and of universally shared values is the family.

#### *Principle of Interdependence and the Family*

According to the principle of interdependence there are three levels of shared ownership; *family shared ownership, enterprise shared ownership, Worldwide shared ownership.*

#### *Principle of Mutual Prosperity*

According to the principle of mutual prosperity is a theory concerning joint government. Father Moon said that *the ideal political model is an extended form of the love-based family.*

#### *Principle of Universal Values*

The principle of universal values refers to joint ethics. This is an important perspective for the realization of an ethical society, namely, a society of joint ethics, in which everyone observes and practices morality and ethics, both publicly and privately, in society and at home.

The principle of universal values is the core principle of the future society of interdependence, mutual prosperity and universal values. The basic unit of the society of mutual existence, mutual prosperity and universal values is the family. The family is the school of love and ethics. As Mother Moon said *"a peaceful and ideal home is the very starting point and the basic unit for a peaceful world" (5).*

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# Methodology for working process structural balanced mathematical model developing in hydraulic drive elements

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## Introduction

A crucial point in the use of mathematical simulation is the development of an adequate model, whose behavior will correspond, to a sufficient extent and within specific parameter ranges, to the processes in the simulation object. For construction of such models, relevant methods are used [1-3] that are based on various approaches – an imitative one with the use of a differential calculus [4], a qualitatively physical one [5], or a functional one [5]. In each of these approaches, the required degree of approximation of model processes to real processes is achieved by an iterative way. It takes considerable time. Shortening the timelines for construction of models is one of the tasks that must be solved that lies in the plane of the development of effective methods and training in their use.

## Experimental / Methods / Results

Based on the analysis of the process of model construction, it has been established the following. If we take into account that the working process of prototype simulation should be repeated cyclically, and that all actions of the process are mutually coordinated, the basis is created for determining the criteria characteristic of the structure of real processes of the technical object's functioning. Pursuant to the proposed concept, these criteria are as follows. Criterion 1. The availability of such a number of actions of a predetermined content and the order of their execution that lead to achievement of a desired process result (productivity). Criterion 2. The availability in the structure, among the actions of the functioning process, of mutually reverse pairs, which ensures the possibility of its cyclical repeatability (closure). Criterion 3. The location of pairs of actions in the process structure should be mutually coordinated, to ensure the logical certainty of the process (sufficiency).

Fulfillment of the proposed criteria when developing a structurally balanced model increases the topological correspondence between the simulation process and the real object's functioning process.

Appropriated methodology is developed and it is illustrated by an example of the hydraulic damper operated processes simulation (Fig. 1).

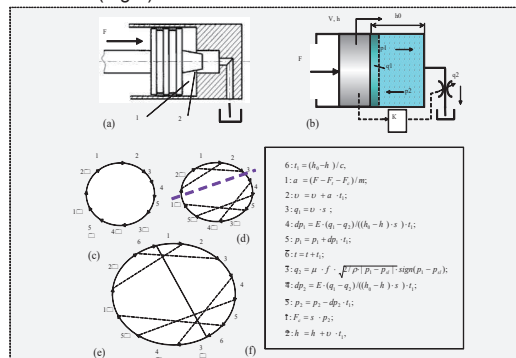


Fig. 1. The hydraulic damper design (a) and calculating schemes (b) and steps of the model creating (c,d,e,f).

Such devices (Fig.1 a,b) are designed for compensation of an external force by creating a counterforce with gradual energy dissipation. They are used, for example, for emergency braking of elevator cabins, in vehicle bumpers, to reduce the negative effects during collisions, in the construction industry - in bridge structures for compensation of changes in operating conditions.

The features of the methodology application are the detailing the work process into separated actions or transformations than their distribution by pairs and combine into closed structure of the functioning process. The mathematical description and model are obtained by replacement the actions their mathematical dependencies and simulators. The criteria using allows obtaining the model correct while it is constructing and reducing the time consumption. The results of the damper work process simulation for the step perturbation force (Fig.2 a) and impulse force (Fig.2. b) confirm the correct and balanced model work..

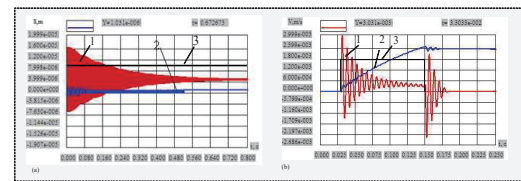


Fig. 2. Results of process simulation in the hydraulic damper under the action of stepwise variation of the perturbation force at the closed (a) and the open throttle and an impulse change of the force (b) ( 1, 2 and 3 – graphs of changing in velocity, piston displacement and force respectively).

## Conclusions

The developed methodology for constructing simulation models uses the functioning process structure, as it has been proposed in the paper [5], but additionally provides instruments for a presentation of such a structure and the criteria it should meet. The idea of a step-by-step transformation of an input signal (influence) into an output signal (productivity) [5] has been developed by means of a detailed elaboration of the functioning process. The consequence of this is a paired relationship of elementary transformations in the cyclic processes of functioning and simulation. Through the use of criteria during construction of the functioning process structure, it becomes possible to carry out the verification stage of the model [3] during its development. This allows reducing both the number of iterations and the timescales for development of adequate and usable models. The mentioned peculiarities create a positive effect when developing the mathematical models of components of hydraulic devices and systems as a whole.

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# Conceptual Model and Approach to Hydro Automatics Complex Technical Object Design

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## Introduction

With further complication of objects, due to technical progress, their design process becomes considerably complicated as well. The developers' understanding of these objects is reflected in the form of a conceptual model. The well-known object conceptual models [1-4] do not reflect enough deeply the object's parts, their functioning and connection with the features. According to conceptual model the design process is not detailed enough too. It longs design process. The Paper objective is increasing the design process efficiency by clarifying the conceptual model based on the details disclosing the mechanism of interaction of the technical object components with the object functions.

## Experimental / Methods / Results

### 1. The main hypothesis and general definitions

The main hypothesis is there is one-to-one relationship between the features and the structure in technical object, therefore, a given set of features determines the structure of an object. The terms features, process and a structure are the base a conceptual model.

### 2. A conceptual model of complex technical objects

A conceptual model of an object describes the object parts, their interconnection within the object, and the result of this interconnection and it is represented in graphical form (Fig.1a). How the model is arranged. Firstly, the model has three basic layers which are the features, the structure and the process. The feature layer reflects a required set of the interconnected object features. The structure layer reflects the object parts and their interconnection. The functional core reflects the object working process. Secondly, taking into account that the conceptual model represents the complex technical object all its layers have a complex organization represented with hierarchical forms. Wherein, the hierarchy of each layer is formed by elementary internal parts which are aggregated into modules. Thirdly, two base layers of the conceptual model such as features and the structure interconnect between each other. This interconnection has a common basis such as cyclic functional process and a certain logic which is

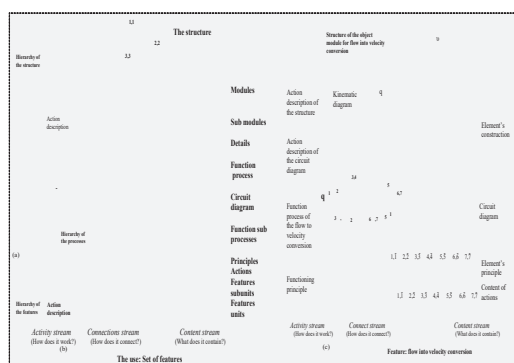


Fig. 1. Conceptual model (a), the design process (b), an example (c)

as follows – the structure ensures functioning and as a result the object obtains a certain set of features. These features form the object application. The direct contacts between the structural and the feature layers take place at the lowest levels of each hierarchy by means of the functional process. Fourthly, the object application is perceived by the environment in form of the object features via appropriate channels contacting with top layers of the feature hierarchy.

### 3. The approach to the complex technical object design

As the basis for an approach it is used the above conceptual model. Input data for any object design are the object application or purpose as a way to achieve application effects which are targets. The design process (Fig.1b) includes the following steps: moving from the object application or purpose to the feature set with hierarchical relations; searching for principles of feature formation; representing of the lower level of the features hierarchy by individual actions; searching for operated principle of each action and symbolize they by graphical symbols; combining all operated principles symbols into circuit; obtaining a set of direct and reverse actions which provides peculiarities of the cyclic repetition processes; obtaining process diagrams of feature formation on the basis of the specified principle and actions; obtaining of the mathematical model and a work process simulation; definition of means for implementation action pairs (direct and reverse); setting parameters of means on the basis of simulation data; integrating the means into modules in accordance with their operation processes; integrating the modules into the object structure on the basis of the overall functional process, kinematic and circuit diagrams.

The detailed mechanism of interconnection between the features and the structure is demonstrated on example of a single-action hydraulic cylinder module. This module illustrates the feature obtaining procedure – “flow to velocity conversion” (Fig.1c).

## Conclusions

In this paper it is proposed a framework to the informative nature of the conceptual model. The terms features, process and a structure are the base a conceptual model. The peculiarities of the model are the closed processes diagrams that are used to detail the mechanism of feature and structure interconnection. Designed conceptual model allows forming the detailed understanding of complex technical objects at the level of relations between the structures, process and features. These understanding and the approach of the object development as well as the rational method of its decomposition allow for addressing practical issues in a timesaving manner.

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# Human papillomavirus infection: vaccine knowledge attitude, and informational behavior among undergraduate students

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## Introduction

- Human Papillomavirus (HPV), a double-stranded DNA virus causing various neoplasia, genital warts, and cancers. It explores transmission risks, particularly among high-risk groups, and emphasizes HPV's prevalence through sexual contact. The relevance of HPV in cervical cancer and the effectiveness of the quadrivalent HPV vaccine are highlighted. The study's focus on assessing HPV knowledge, attitudes, and behaviors among female undergraduates at Government College University Faisalabad is also outlined.

## Experimental / Methods / Results

- Methods:** The cross-sectional study was conducted on students of Government College University Faisalabad (GCUF) from January 10, 2022, to March 20, 2022. Male and female students from different departments were chosen to carry out the analysis. The contemporary study was survey-based and tentative on students of GCUF.
- Results:** About 275 students from different medical fields of Government University and College Faisalabad participated in the current research. Age and gender were chosen as the two major demographic variables. Students were categorized into three groups according to age. The first group included 18-20 years old students while the second group comprised 20 to 22 years old knowledge seekers and in the third group students from 23 to 24 years were placed. The demographic details are listed in Table 1. According to the figures, about 70% of the partakers knew about the mode of transmission and the complications caused by the Human Papilloma Virus while 34% of all the students had no idea about HPV, its transmission, complications, or treatment. The majority of the students were unaware of the Human Papilloma Virus. Only 40% of students knew about HPV.

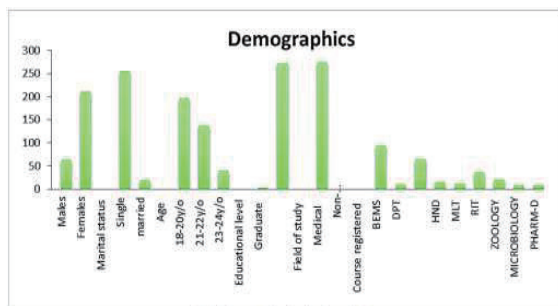


Fig. 1. Demographic Details of participants

Table 1. Major Demographic details of Participants

Variables		Number	Percentage
Age	18-20	197	71%
	20-22	138	50%
	23-24	040	14%
Gender	Males	064	23%
	Females	211	76%

Table 2. HPV General Knowledge

Variables	Number	Percentage
Heard about HPV	110	40%
Had knowledge about genital WARTS caused by HPV	180	65.5%
Knew about HPV vaccination	207	75.3%

- 65% had the idea that HPV causes genital warts and 75% were aware of the HPV vaccine. Moreover, 65% of students thought condoms as a source of prevention against HPV and 54% marked contact with body fluids as a mode of transmission of HPV.

## Conclusions

- The research reveals a significant lack of awareness among university - level undergraduate students regarding HPV infection, its transmission, associated diseases, and vaccination. The study emphasizes the urgent requirement for targeted and comprehensive HPV awareness initiatives, focusing on disseminating information about HPV transmission, associated risks, diseases, and vaccination. As HPV is a primary contributor to cervical cancer, these educational efforts should also encompass strategies for cervical cancer control and prevention, underscoring the importance of updating and enhancing the existing educational programs.

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2<sup>nd</sup> International Conference of Hyojeongs Academy 2023  
20<sup>th</sup> International Conference for Unification Medical Science  
Aug. 31 - Sep. 2, Sun Moon University (Asan) and H.J Magnolia Hospital (Cheonan), Korea

# How to overcome the difficulties of describing acupuncture

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## Introduction

It is very difficult to describe acupuncture as a medical paper.

The conventional report of acupuncture is to record the position of the points, time, depth, tools used, and report the effect.

However, it is so simplified that it does not convey the essence of the treatment. Therefore, the reproducibility is low.

Also, it doesn't convey the wonderfulness of acupuncture.

The results of acupuncture vary greatly depending on the practitioner's ability, condition, and patient's.

In addition, the practitioner's intention and the direction of mind also greatly affect it.

## Experimental / Methods / Results

Factors that affect acupuncture include:

### 1. Who will stab.

Trusting relationship with the patient, words spoken, hand temperature, electric potential. This also affects the mental state of the patient, blood flow, skin tone. The spiritual power of the hands differs depending on the practitioner. Strong weak, yin and yang, soft. Surgery may be possible by robots, but acupuncture cannot be done by robots.

### 2. Patient condition

Mental state, trauma, fear, family relationships, hope, faith. The patient's mind also affects blood flow.

Especially when you are under mental stress, your breathing becomes shallow and it becomes difficult to move.

Also, the classic says that fear affects the qi of the kidneys. Fear reduces visceral function and lowers body temperature. The Divine Principle says that Adam and Eve, the first human ancestors, were terrified when they sinned at the bottom. This may be related to the fact that the reaction point of the kidney qi is located in the lower abdomen.

### 3. Treatment environment

The influence of the people around you, this means that the qi of the people around you is projected onto the patient.

### 4. Where to pierce acupuncture

The position of the acupuncture point is expressed in two-dimensional coordinates, but in reality it is two-dimensional on the skin, but the point to be reached is three-dimensional.

In addition, subcutaneous acupuncture points often appear a few seconds after the prick. Acupuncture points on the skin are the gateway to the real treatment point. Sometimes they follow a labyrinthine path under the skin to reach the treatment point.

In some cases, there are no acupuncture points on the skin, so you move the acupuncture needle in the air and wait for the acupuncture point to appear. The entrance to the acupuncture point is in the air.

### 5. How to use your mind

It is important where you place your awareness when piercing acupuncture.

There is a big difference between concentrating on acupuncture and not concentrating on acupuncture.

It is also effective to move mind from the tip of the needle to the affected area.

You can guide qi with the power of your mind.

## Conclusions

- In this way, acupuncture is very delicate and uses human spiritual sensitivity and spiritual power. Therefore, in order to describe it in a thesis, it must be simplified, superficial, and expressed by removing the spiritual aspect. This cannot convey the goodness of oriental medicine. It is difficult for Eastern medicine and Western medicine to be on the same playing field.
- The unification of Eastern medicine and Western medicine is only possible with a Eastern medicine as the main focus.

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# A Brief Comparison on The Image of God in Christian Theology and in Unification Thought

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## Introduction

- Human being is created with the Image and likeness of God. The Image of God is the doctrinal home of human uniqueness.
- "The unification view (Divine Principle of Family Federation of World Peace and Unification: FFWPU) on the Image of God" was explained and compared with three views (Substantive view, Functional view, and Relational view) of Christian theology. Unification view is basically agree with three views and further more give us integrate understanding of three views in light of the relationship of God, Man, and all things.[1] Recent developed view was not introduced to this study
- A study on the Christian and Islamic theological anthropologies regarding the concept of Image and likeness of God showed that "the three roles of human beings on earth, namely, 'to be the representative of God,' 'to have dominion over the world,' and 'to be a relational being' discover the sharing of human beings in the lordship of God and consequently, they reflect God in their lives and deeds" [2] Recent developed "dynamic view" was not introduced to this study.
- A clue to solve or answer to the issues or problems on the difference between Man and Woman, Bride and Bridegroom, and Father and Mother, and on the environmental and climate change should be sought in the understanding the Image of God.

## A Brief Comparison on the Image of God between Christian Theology and Unification Thought

### ◆ Four views in the Christian Theology [3-8]

- Human being is created with the Image and likeness of God.

#### 1. The substantive view:

The most dominant in Christian history. Human intellectual and rational prowess that makes us divine Image bearers

#### 2. The functional view:

The Image of God entails that humankind functions as 'God's vice-regent on earth'. This is not to say that the Image of God is to be found precisely in dominion, but rather that it is the consequence of being in the Image of God.

#### 3. The relational view:

Human uniqueness is rooted in the special relationship with God "I-Thou relation" and/or 'human beings' unique relational abilities with other humans and creatures.

#### 4. The dynamic view:

The Image of God is not something completely given to humanity at the beginning of creation but is instead completely gained through history and in conformity to Christ. Human uniqueness in this model relates to Christ and in our sanctification/ transformation towards him. We could say that human uniqueness is related to our special ability to transform and grow, often in distinctly moral and spiritual ways, towards Christ who is himself the full Image of God.

### ◆ View in Unification Thought [9]

Human beings were created in the Image of God as children of God.

- But due to the fall of the first human ancestors they have become separated from God. They can restore their original nature, however, by living in accordance with God's Word, thus coming to receive God's love

1. An original human being is a united being of Sungsang and Hyungsang resembling the Divine Image.
2. The harmony of a man and woman together, as an original couple, is a harmonized yang and yin, resembling the Divine Image.
3. An original human being is a being of unique individuality, resembling the Divine Image.
4. An original human being is a being of heart resembling the Divine Character, that is, a person of character who practices love; in other words, a loving person, or a person of love (Homo amans).
5. An original human being is a being of logos, resembling the Divine Character, that is, a being of norm, who lives according to the Way of Heaven, or the law of the universe.
6. An original human being is a being of creativity, resembling the Divine Character, that is, a heart-centered ruler of all things.
7. An original human being is a being with position, oriented toward dual purposes and having a connected being consciousness

### ◆ Relationship between Christian Theology and Unification Thought

Unification Thought	Christian Theology
1 A united being of Sungsang and Hyungsang	The substantive V
2 The harmony of a man and woman together	The functional V The relational V
3 A being of unique individuality	The relational V
4 A being of heart that is, a person of character who practices love	The dynamic V
5 A being of logos, that is a being of norm or the law of the universe.	The dynamic V
6 A being of creativity, that is a heart-centered ruler of all things	The functional V
7 A being with position, oriented toward dual purposes and having a connected being consciousness	The relational V

### What should be studied? Open Discussion

- Man & Woman, Climate change, Economic inequality, Cultural difference, etc

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# A Suggestion to collaborate with the Movements of the Sustainable Development Goals (SDGs) and Intergovernmental Panel on Climate Change(IPCC) of UN, and Circular Economy of EU for Realization of Co-existence Idea of Unification Thought

Youngsik Pyun<sup>1,2\*</sup>, Auezhan Amanov<sup>2</sup>, Junhyung Kim<sup>3</sup>

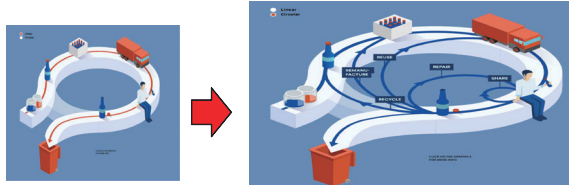
<sup>1</sup>DesignMecha, Asan Korea <sup>2</sup>SunMoon University, Asan Korea \*pyoun@sunmoon.ac.kr

## Introduction

- The Sustainable Development Goals (SDGs) of the United Nations(Dept. of Economic and Social Affairs) and the International community are consisted of 17 goals and 169 specific goals: To solve the **global poverty problem** and realize **sustainable development** between 2016 and 2030.



- Circular Economy (CE) of EU is a model of production and consumption : To realize **sustainable development**



- The Intergovernmental Panel on Climate Change (IPCC) is an Intergovernmental body of the United Nations : To advance scientific knowledge about **climate change** caused by human activities and to realize **Carbon-neutral society**.

WMO(World Meteorological Organization)

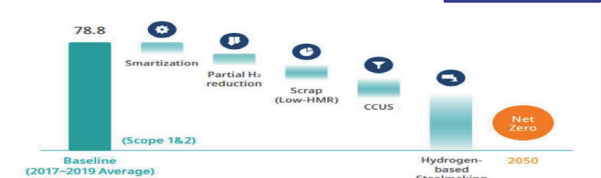
+ UNEP(UN Environment Programme)



## How to realize ? Inter collaboration

- Inter collaboration between Governments, NGOs, Academic societies, Economic societies, etc driven by UN(UNDESA, UNEP, WMO) and EU for SDGs, Circular Economy and Carbon Neutralization .
- Campaign, Social and cultural movements, Policies like carrots (eg. financial benefits) and sticks (eg. mandatory usage rate) to adapt new normal for realization of 16 SDGs, Circular supply chain, and Carbon Neutralization till 2050.
- Technical Innovation with Big data, AI, New science & technology
- Korean Updated Nationally Determined Contributions(NDC) : To reduce total national GHG emissions by 40% from the 2018 level, which is 727.6 MtCO<sub>2</sub>eq, by 2030. 40%. the Republic of Korea's goal of carbon neutrality by 2050
- Typical POSCO Road Map
- Typical Technologies of Germany steel Industry

Pathway to achieving the carbon neutral ambition (million tCO<sub>2</sub>) POSCO Road Map



Overview of possible key technologies for a predominantly carbon-neutral Germany Steel Industry

Steel	Key technology	Earliest possible market readiness
	Direct reduction with hydrogen and smelting in the electric arc furnace	2025 – 2030 (phase-in with natural gas)
	Alkaline iron electrolysis	likely after 2050
	Hisarna® process in combination with CO <sub>2</sub> capture and storage	2035 – 2040
	CO <sub>2</sub> capture and utilisation of waste gases from integrated blast furnaces	2025 – 2030
Chemicals	Key technology	Earliest possible market readiness
	Heat and steam generation from power-to-heat	From 2020
	CO <sub>2</sub> capture at combined heat and power plants	2035 – 2045
	Green hydrogen from renewable energies	2025 – 2035
	Methanol-to-olefin/aromatics-route	2025 – 2030
	Chemical recycling	2025 – 2030
	Electric steam crackers	2035 – 2045
Cement	Key technology	Earliest possible market readiness
	CO <sub>2</sub> capture with the oxyfuel process (CCS)	2025 – 2030
	CO <sub>2</sub> capture in combination with electrification of the high temperature heat at the calciner	2030 – 2035
	Alternative binders	2020 – 2030 (depending on product)

### What is the biggest obstacle to intercollaborate ?

**Conflicts: Economic Inequality, cultural differences and generational gap between G7, OECD, Under Developing Countries and even among same country.**

### What could be an innovative solution ?

- Co-existence, Co-prosperity and Co-righteous are Rev. Moon's concept of Godism, which can map to economics, politics and ethics respectively and guide the gateway to peaceful & ideal society.
- Co-existence: To realize a unified world without national boundaries, the future economy will be one global economy in which regional bloc economies are organically and harmoniously united
- The final goal of 17 SDGs, IPCC and CE is in line with the goal of Co-existence integrated with Co-prosperity and Co-righteous.
- New normal and cultures under Co-existence, Co-prosperity and Co-righteous of Unification Thought; **No More Economic Inequality, Cultural Differences and Generational conflict**

## How to inter collaborate with UN and EU?

- Begin simple service and feasible activities with UN and EU
- Join SDGs/CE/IPCC Movement as a supporter (eg. WFPF, Peace Road of UPF)
- PR service in 'Earth and I' and 'Unification Movements'
- Join to a committee or conference of UN and EU as a supporting members /organizers/ experts.
- Create the Value added activities: Benchmark pro and cons of 'Korean Association for Supporting the SDGs for the UN'

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# Aspect of In vitro - In vivo Correlation for Analyzing Complex Dissolution Profile of Atorvastatin

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## Abstracts

Although generic drugs are designed to contain identical amounts of active pharmaceutical ingredient (API) as the original drugs, it is difficult to achieve bioequivalence (BE) during the development of generic drug. Especially, *in vitro* dissolution test occasionally appears complex dissolution profile which is tricky to proceed to perform formulation study. Herein, we deeply analyzed the complex dissolution profile of atorvastatin to achieve BE of generic drug. In this context, we interpreted stability of atorvastatin and impurity H in working solution of various pH. After the identification of stable pH range, we calculated relative reaction factor (RRF) value for proper validation process. Our research not only suggest adequate validation and dissolution test are required for generic development, also suggest an aspect of *in vitro-in vivo* correlation by accurate and precise *in vitro* analyzing.

## Results

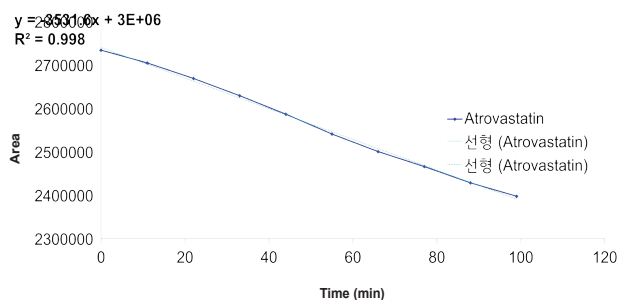


Fig.1 Concentration profile of atorvastatin

- As shown in the above graph, atorvastatin appears time-dependent negative correlation at pH 1.2 solution.
- Thus, we decided to identify an impurity of atorvastatin

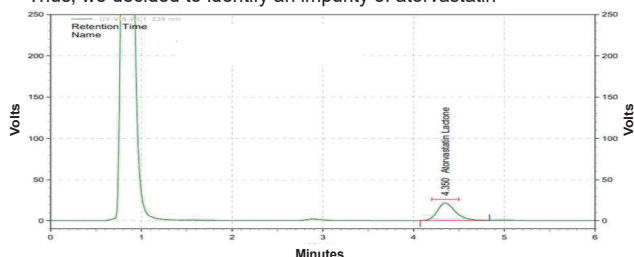


Fig.2 Peak confirmation of impurity H at pH 1.2

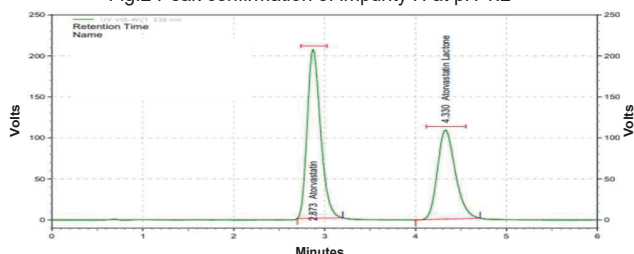


Fig.3 Peak confirmation of atorvastatin at pH 1.2

- As appeared in HPLC result, we identified impurity at pH 1.2 solution as an "atorvastatin related compound H" (so called impurity H).

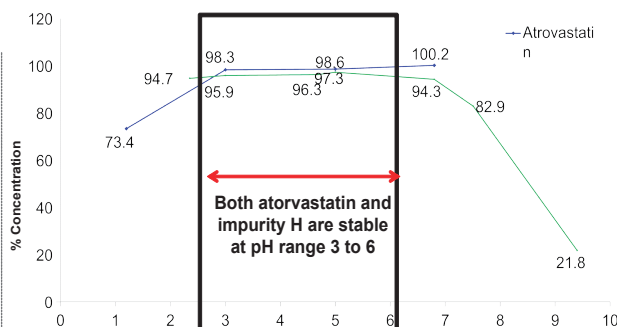


Fig.4 Working solution stability of atorvastatin and impurity H

- To obtain a stabilization method of atorvastatin and impurity H at pH 1.2 working solution, we confirmed working solution of various pH by neutralization of working solution.
- As a results, we revealed that both atorvastatin and impurity H are stable at pH range 3 to 6.

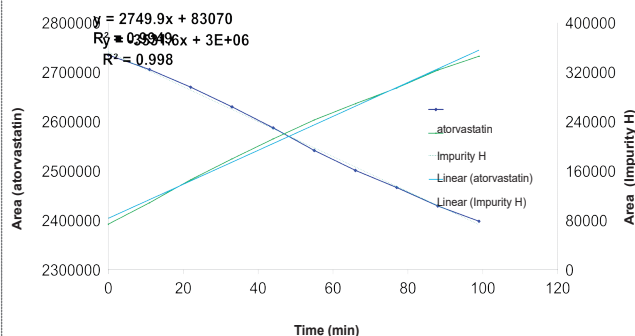


Fig.5 Time-dependent area value change of atorvastatin and impurity H at pH 1.2 solution

- For an appropriate validation and dissolution test, we calculated RRF value from linear slope of atorvastatin and impurity H

## Conclusion

In this study, we conducted precise analyzing of atorvastatin at pH 1.2 solution. Despite of exist of impurity, we analyzed atorvastatin by step-by-step approach to calculate RRF value. These accurate *in vitro* dissolution interpreting supports *in vivo* dissolution profile based on the understand of drugs mode of action in low pH environment. Collectively, A close understanding of degradation product is not only required, but also contributes to *in vitro-in vivo* correlation of the generic drugs.

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# Special Session

# The Nucleus of Cheon Il Guk is Sexual Integrity

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## Introduction

The essence of Cheon Il Guk, by definition, is when two become one. It is therefore of fundamental importance for each member of CIG to become integrated, both mind and body, as one harmonious being. The most challenging area of life for humankind to become harmonious is that of sexuality.

Since the fall of Adam and Eve, humanity has been highly dysfunctional in the area of sexuality, and therefore could never reach our fullest potential as a species. High Noon has been embarking on discovering exactly what is at the root of our dysfunction with sexuality, and how to restore it back to the original standard created by our Heavenly Parent and explained by our True Parents.

## Experimental / Methods / Results

- We have held surveys of thousands of young leaders within our movement about the nature and extent of their struggle with pornography.
- We have developed several online programs to help men and women aged 16 - 75 to identify their sexual dysfunction, heal it, and build sexual integrity in their lives.
- Our programs have hundreds of participants from all over the world and have been attended by single people, Blessed couples, and non-church members.
- We have continued to hone our approach to facilitate groups, develop mentorship programs, and refine our content in order to yield the best possible healing for the most amount of participants.
- The results have been that through our programs and approach, we've saved countless Blessings from breaking, supported hundreds of young people to get confidently to the Blessing Ceremony, helped numerous individuals to break permanently free from pornography addiction, brought a large number of second-generation back into our faith communities by healing their pain, and much more.
- This endeavor has been made possible by a very small and dedicated core staff, an international volunteer base, leveraging technology, and persistent spiritual conditions.



Fig. 1. Event during European Tour

Table 1. Statistics

Survey	4,000 Young Unificationists from 80 Countries
82%	Males watch pornography
48%	Females watch pornography
63%	Tried to quit but failed
43%	First viewed porn between age 11-13
85%	Never spoke to their parents about porn use

## Conclusions

- Although we have Blessed families around the world who are well-versed in True Parents' teachings, many continue to struggle with addiction to pornography.
- This is a massive hindrance to the providence of the Heavenly Parent.
- Pornography has many personal, familial, and social repercussions which are preventing humanity from reaching its potential and postponing the fulfillment of the establishment of Cheon Il Guk.
- The next generation of leadership is monumentally more powerful, spiritually clear, and amply able to take on responsibility when they build sexual integrity in their personal lives.
- According to True Parents words, God-centered sexuality plays a major role in becoming a powerful Blessed Central family, and therefore educating young people before and after the Blessing Ceremony is of urgent and fundamental importance. [1]
- Our shame associated to sexuality is a habit of the fallen world, and only by speaking about heavenly sexuality with reverence in the appropriate settings do we live in what True Parents call the High Noon light. [2]

## References

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# Completion of a new paradigm (medical providence) for the Unification movement by 2024

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## Introduction

- From Overseas Medical Service to Building Overseas Medical Communities.
- In 2014, True mother founded the "Cranes Club" to create a community (platform) for 2nd generation who are active in society, and she gave us the Word to "know the root" for 2nd generation who are active in society. On March 23, 2019, True mother established the HJ Magnolia Global Medical Foundation to unite the world's medical providers into community. On October 6, 2019, True mother gathered 2nd generation medical professionals in Nagoya and gave us the Word that we should know the truth of history and become medical professionals who unite with Korea and live for the world.
- For the new era unification movement, it is important to build a community (platform) in which the 2nd and 3rd generation can participate as owner of the unification movement in a new paradigm based on the creation principle. For the new era, it is necessary to transform the paradigm from one of influencing society to one of creating a community (platform). In medical providence, a paradigm shift from overseas medical service to the establishment of overseas medical communities is needed.

## Experimental / Methods / Results

- (i) Background of the establishment of a community of medical practitioners in the 2nd generation area The Era of Overseas Medical Service (The History of Japanese 1st generation professionals Medical Service) Starting in Korea in 1971, 1st generation professionals medical service has been conducted in Iran, Africa, the Philippines, Indonesia, Bangladesh, India, South America, Mongolia, Nepal, and other parts of the world, and 1st generation have made strides to live for the world. Because Japan has a tradition of medical professionals living for the world and the foundation of Isshin Hospital, a community (platform) of 2nd generation medical professionals was launched in 2016. 2nd generation medical professionals have also continued in that activity, dispatching doctors and nurses to Leda, South Korea, and Cambodia from 2022 to provide short-term overseas medical services. Through our overseas medical service activities, we have learned that wherever we go overseas, there are Japanese missionaries, and while the local people need medical care, Japanese missionaries living overseas also need medical consultation.



Fig. 1. Korean Medicine Training Program for Japanese medical professionals in Korea.

- (ii) Toward the Era of Overseas Medical Communities On June 12, 2022, we had meeting for 2nd generation medical professionals with President Sang-kyun Kim and had an opportunity to connect with HJ Magnolia Global Medical Foundation, and learned that our unification movement has a global foundation. There are HJ Magnolia International Hospital, ilhwa, and Sun Moon University in Korea, Wungu University of Oriental Medicine in the U. S., and Isshin Hospital in Japan. After that exchange meeting, HJ Magnolia International Hospital invited us to conduct a Korean Medicine Training Program for Japanese medical professionals (4 doctors and 8 medical students) in Korea. And then we had a Korea-Japan joint medical service in Japan.

Table 1. MESH community (2nd generation medical professionals)

Occupation	Composition
Doctors	4 0
Nurses	1 4 0
Paramedical	6 0
Doctor Students	3 0
Nursing Students	5 0
Paramedical Students	3 5
Other	6 0

- (iii) Japanese medical professionals can contribute to world peace. We could connect with Korea from 2022 and build a community to create world peace together with Korean Ambassadors for Peace and Korean medical professionals. By conveying the message that we want to unite and live together beyond the medical profession, we experienced that we can transcend historical issues and border barriers and become One Family that wishes for the unification of North and South Korea and world peace.

## Conclusions

- 2nd generation medical professionals are seeking a community (platform) to live for. Through medical services, we feel it is meaningful to use our expertise to address the concerns of families at the consultation level. We are confident that this consultation-based medical service can be expanded to other countries online. We are launching a new project as a platform for medical professionals who live for the world. We are building an online medical service consultation platform, a modern version of the Doctors Without Borders. Japanese medical professionals are united through the MESH community. Based on this, we would like to build a platform for health consultation for Japanese missionaries around the world and expand it to Korea and English-speaking countries. We would like to become one with the HJ Magnolia Global Medical Foundation created by True Mother, operate it so that we can provide medical consultation needed by missionaries around the world on a sustainable basis, and complete the building of an overseas medical community by 2024.

## References

- List references in order of appearance in the text.
- Follow the reference format of the extended abstract.



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# “Envisioning the Future Living Environment” Forums with Professors

Maiko Shimogawara

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## Introduction

- At present, there are various environmental issues that plague the world including climate change, pollution, environmental degradation and resource depletion. Although many individuals and institutions have made efforts to resolve these issues, we have not been able to find genuine solutions due to the confusion of ideologies and the absence of an appropriate value system. Professors World Peace Academy (PWPA) strives to develop a new God-centered culture on college and university campuses for the welfare of humankind. In the past, PWPA hosted in-person seminars and conferences in almost every country to engage professors and scholars in discussions on “academic contributions to world peace”<sup>1</sup> and have published educational materials and journals to share their research centered on God-centered absolute values<sup>2</sup>. In recent years, PWPA-LA has introduced the use of online and hybrid forums. Based on these efforts, professors and scholars, regardless of their specialties, agree that we must first elevate the morality of people by implementing absolute values in every field in order to create a future living environment that is beneficial for all people.

## Experimental / Methods / Results

- In April 2023, PWPA-LA hosted 8 online forums on the topics political science, interfaith, culture-sports-arts, economy, science, environment, education, and media. There were insightful keynote addresses for each topic given by professionals specializing in their respective field as well as Q&A sessions between professors and students. The program created opportunities for the speakers and professors to engage in deeper dialogue and foster new connections based on their knowledge and expertise as well as their desire to realize peace through their specialties.
- In June 2023, PWPA-LA hosted a hybrid event at California State University, Los Angeles for professors and scholars to convene and discuss on the topic of absolute values and the unity of religion and science. There were four keynote addresses given by Dr. David Blekhman, professor of Engineering, Computer Science and Technology at CSULA, Dr. Michael Stenstrom, distinguished professor of Civil and Environmental Engineering at UCLA, Dr. Philip Aka, adjunct professor of Law at Indiana University, and Dr. William Keepin, executive director of Satyana Institute.

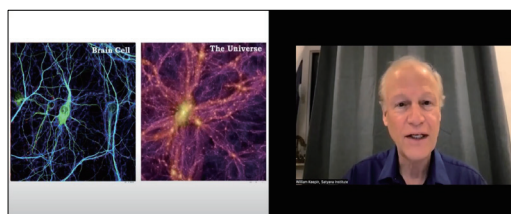
Forum Topic	Speaker(s)
Interfaith	Dr. Thomas Selover
Culture, Sports, Arts	Professor Grace Apiafi
Political Science	Dr. Seung-ho Lee
Economy	Mr. Alan Jessen
Science	Dr. Rattan Lal
Environment	Dr. David Blekhman
Education	Dr. Eric Rodriguez, Dr. James Hurd
Media	Professor Joel Campbell

Table 1. Online Forum Speakers

Fig. 1. Hybrid event panel discussion



Fig. 2. Hybrid event keynote speech on “Uniting Natural and Esoteric Sciences”



- Those professors and scholars that participated in the online and hybrid event, regardless of their specialties, agreed that we must first elevate the morality of people by implementing absolute values in every field and thereby creating a just and harmonious future living environment for all.
- For future conferences, we will consider implementing alternative methods of outreach in order to reach more professors and scholars. We will also consider providing more time for deeper discussion among professors during the forums.

## Conclusions

Although throughout history we’ve witnessed the misuse of knowledge in various fields and disciplines and the result of those actions, there is hope through the unity of professors and scholars who strive to use their specialties and knowledge for the betterment of humanity and the future living environment. By improving our methods of outreach and allowing more time for deeper discussion among professors and scholars, we hope to inspire others to support PWPA’s mission to develop a new God-centered culture on college and university campuses for the welfare of humankind.

## References

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**2<sup>nd</sup> International Conference of Hyojeong Academy 2023**  
**20<sup>th</sup> International Conference for Unification Medical Science**

Aug. 31 – Sep. 2, Sun Moon University (Asan) and HJ Magnolia Hospital (Cheongju), Korea



# Hyo Jeong Conference for the Unification of the Korean Peninsula

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## Introduction

- The Korean War occurred 5 years immediately after World War II in 1950 fought on the Korean peninsula. The Soviet Union influenced North Korea to aggressively encroach upon South Korea to claim the entire peninsula as their own as another puppet country for communism. Being fundamentally more of an ideological war, North Korea wielded the ideology of communism while South Korea represented the free world of democracy. This conflict never ended with only an armistice signed to temporarily ceasefire and creating a demilitarized zone separating the peninsula into North and South Korea.
- The meaning of Hyo Jeong originated from Dr. Hak Ja Han Moon who defined "hyo" meaning "duty motivated by love, duty that is not compulsory but is happily voluntary, and that provides one's life its deepest meaning" particularly in reference to the honor and respect of a child's love for their parents [1]. The attribution of this term to these conferences as "Hyo Jeong" Conference was rooted in its strong belief that the unification of the Korean Peninsula is possible when people have "Hyo Jeong" to Heaven as their own parent commonly understood in Christian theology of recognizing the Creator as a father figure.
- The purpose of the program is to empower the youth of Korea, Japan, and America to resuscitate the strong desire for unity as leading advocates to unifying the Korean Peninsula. This required offering education to the youth about the history of the Korean peninsula especially in its former state as one nation and their responsibility towards God and the work required to establishing the ideal world of peace.

## Experimental / Methods / Results

- Through an online platform, the Hyo Jeong Conference, as seen in Figure 1 launched in 2020, hosted educational conferences aimed towards South Korean, Japanese, and American youth and students.



Fig. 1 The introduction slide used to welcome online participants to the launch of the Hyo Jeong Conference in 2020.

- Each conference gathered over 200 attendees, some seen in Figure 2 displaying a screenshot of the second Hyo Jeong Conference, and over 1,000 views on popular social media platforms, Facebook and YouTube, garnering a collective view count of over 10,000. These international conferences highlighted the historical and political background of the Korean division as well as the global significance of reunifying the Korean Peninsula.



Fig. 2 A screenshot of some participants joining via Zoom for the second Hyo Jeong Conference held on September 18, 2020.

- We have hosted seven online conferences since February 2020. All conferences are organized by the Collegiate Association for the Research of Principles (CARP) Los Angeles students, advised by a parent organization, Kodan. The conferences were translated into three languages by students, and the video presentations were created by students. Because of their efforts, many speakers, including Christian pastors, college professors, and U.S. congressmen have joined together for this purpose.

## Conclusions

- Through these online conferences, the youth initially sparked in the trinity of Korea, Japan and America can spread to the youth around the world cultivating their recognition of their own important role and responsibility towards establishing peace in Korea. This generates new hope in bringing a formal end to a war of conflicting ideologies of democracy and communism. For this reason, resolving this division between the two Koreas holds the key to unlocking the world of peace.

## References

- [1] Ja Han, H. *Mother of Peace: A Memoir by Hak Ja Han Moon* (The Washington Times Global Media Group, 2020)



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## “North and South Korea Unity Concert & Young Christians Youth Summit”

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### Introduction

- In support of the reunification of North and South Korea, we have been gathering young christian leaders from all denominations in America and sharing the Divine Principle. The Reunification of North and South Korea has been a life-long mission and wish of Rev. Sun Myung Moon and Dr. Hak Ja Han Moon. They have made a long-time investment in American Christianity because christianity has a significant role in the unification process. One of the biggest programs we had was the Unity Concert, sponsored by Bishop Noel Jones, senior pastor of the City of Refuge, YCLC and CARP LA. The theme was “Removing the Line”. The purpose of the Unity concert is to evoke and demonstrate Unity in the body of Christ and encourage unity beyond politics, race, and denomination. In the history of the Korean war, we know that 16 countries fought in the Korean war to stop the evasion of communism. However, this war has never ended, but is in an armistice, meaning war can break out anytime. The leading participating country was the United States, therefore, America needed to take responsibility for its solution. Therefore, in order to bring unity on the Korean Peninsula, America has to unite and remove the line of politics, race and denomination and the line between the 38th parallel.

### Experimental / Methods / Results

- Music is one of the ways that can reach peoples heart and that is what Dr. Hak Ja Han Moon has also mentioned in her recent Memoir. That is why we decided to have a concert to spread awareness about the reunification of North and South Korea by uniting America.
- In order to prepare the spirit leading on to the Unity concert, we had a 2 month of dedicated preparation of offering devotions of prayer together. Every Sunday, the young leaders would go out to mobilize to their designated churches that they have been investing and creating relationships with to invite and share the vision for the unity concert.
- We also held three Youth Summit for Unity program which we gathered young christian leaders and pastors to share the importance of unity of the body of christ. Then on we have had 9 youth summit for unity programs in total.



Fig. 1. Prayer and Youth Summit for Unity

- For the Unity Concert, we had collaboration with influential figures such as Pastor Deitrick Haddon, Insooni, Bishop Noel Jones, and Dr. Teddy Choi. This day was also the first debut of Pastor Deitrick Haddon's new single “Light it Up” which was in collaboration with CARP LA members to promote the reunification of North and South Korea.



Fig. 2. Pastor Deitrick Haddon and CARP LA Dancers

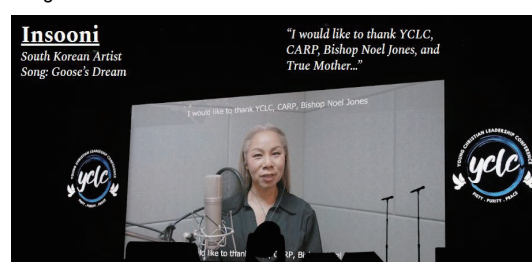


Fig. 3. South Korean Artist, Insooni

Subject	Attendance
Pastors	36
Churches	18
In person Participants	~ 700
Online Participants	~ 10,000

Table 1. Total Attendance

- There were a total of 700 people who joined the Unity concert and we had more than 10,000 people joined online. There were 36 pastors and 18 churches who joined and key, up-and-coming ministers attended. The pastors were ready and excited to involve in Dr. Hak Ja Han Moon's vision for a Unified Korea.
- In the future, we would like to improve on following up with the pastor or churches to continue to revival that we felt to bring unity. Therefore, we would like to implement newsletters, or other ways we can continue to share to the people who have attended so that we can continue to momentum and continue to work together to bring revival in this nation of America and for the reunification of North and South Korea.

### Conclusions

- It has been more than 70 years that the Korean Peninsula has been divided. In order for us to bring the reunification of the Korean Peninsula, we must unite together beyond race, politics and denomination. Therefore, we will continue to work to unite together to bring unity amongst christianity and educating the youth to bring back God at the center, which is the solution.

### References

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