

**Research Article**

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Devastating Effects of Global Warming - Climate Change, on Mutation of the Micro-Organisms Impacting Human Health, on Inducing Environmental Disasters, on Affecting Agricultural Crops and Food Chain, and Suggested Methods to Control Such Calamities

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The effect of global warming- climate change on inducing the unfavorable mutations of the micro-organisms has been experimented using a probiotic bacterium, which is a component of the human microbiota. Suitable techniques were developed to study and to demonstrate the effect of abnormally higher temperatures due to global warming, on the loss of beneficial exochromosomal genes (plasmids) which code for the production of the immunomodulins, which in turn impart optimal health to human beings. The ill effects of global warming on human health, environment, and the food chain have been explicitly presented. A thorough explanation is presented on how global warming contributes to the viral pandemics (COVID-19). The details on specific components of the greenhouse gases which contribute to the maximum global warming are illustrated. The details on genesis of global warming and possible ways and means to control climate change to protect humanity, around the world, has been presented.

Keywords: Global warming; climate change; lac +ve and lac -ve mutants; microbiota; lactococcus lactis var. lactis; tornados; tsunami; hurricanes; plasmids; probiotics; public health

Introduction

I would like to define and point out the differences between global warming and climate change for the sake of clarification, since these terms will be used interchangeably, in this research article. "Global Warming" refers to the long-term warming of the planet. Global temperature shows a well-documented rise since the early 20th century and most notably since the late 1970's. Worldwide,

since 1880 the average surface temperature has risen about 1 °C (about 2 °F) relative to the mid-20th-century baseline (of 1951-1980). This is on top of about an additional 0.15 °C of warming from between 1750 and 1880. Whereas "Climate Change" encompasses global warming but refers to the broader range of changes that are happening to our planet. These include rising sea levels, shrinking mountain glaciers, accelerating ice melt in Greenland, Antarctica



and the Arctic, global warming driven pathogenic viral mutations causing COVID-19 pandemic worldwide, significant increase of wildfires, hurricanes, tornados, earthquakes etc.; and shifts in flower/planet blooming times etc., etc.

These are all consequences of warming, which is caused mainly by people putting out heat-trapping greenhouse gases into the air. The terms “global warming” and “climate change” are sometimes used interchangeably, but strictly they refer to the same thing except with a few minor differences. The side effect of global warming is unwanted climate change. Today, human civilization has been struck with greater disaster, which is more than the cruel wars of the past and present conflicts, which are natural disasters. These include hurricanes, tsunamis, volcanic eruptions, earthquakes, tornadoes, typhoons, cyclones, floods, and COVID-19 pandemic etc. For example, Hurricane Katrina caused over \$150 billion dollars of loss to the state of Louisiana, in addition to killing thousands of people and making literally thousands of people homeless, even in an advanced nation such as the United States. The tsunami of March 2011 in Japan caused over \$100 billion dollars’ worth of property damage, over 30,000 deaths, and in addition inducing physical and psychological trauma to the people alive.

In the year 2017, hurricanes collapsed the City of Houston with over 100 billion dollars’ worth of properties and countless number of human deaths. The same year hurricane Maria destroyed Puerto Rico, Key West, and other satellite countries. Global warming caused severe fires in the state of California from 2017 through 2023, causing hundreds of billions of dollars’ worth of property damage and deaths of thousands of people. The latest tsunami and hurricanes in Indonesia devastated the country. Countless number of natural calamities and disasters took place in the year 2019 through 2023. In addition, according to several scientists, microbiologists, COVID-19 pandemic in 2020-2023, which has infected over 700 million people with a confirmed death of over 7 million, is partly or predominantly due to Global Warming and climate induced viral mutation of Coronavirus - SARS-CoV-2. Scientists in Great Britain and elsewhere in the world proved that the COVID-19 disease causing virus has been mutating drastically causing a rapid spread of the pandemic.

On top of that, countless numbers of tornadoes, earthquakes, cyclones, and floods have caused billions of dollars in property damage, consumed thousands of lives, made millions of people utterly poor, increased diseases, and reopened new viral diseases (which we were thinking were abolished), destroyed agricultural lands, killed the livestock, destroyed marine life, etc. These natural disasters destroyed peace and they have been worse than the olden day wars. At least in a war situation, you can reconcile and stop wars. The current militarized conflicts worldwide also contribute to global warming by means of introducing harmful chemical agents, and particulates from the destruction of buildings and infrastructure into the atmosphere. Natural disasters, however, cannot be stopped with negotiations. They turn out to be the worst of enemies for human beings by taking away their peace. In the modern world, anything we can do to reduce natural disasters, which are the causes for creation of poverty, and pandemic related

health disasters including death of humans and animals, are considered the best tools for the “creation of peace” among nations, governments, and people.

In this connection, it is worthwhile to think what changed in nature to create such disastrous natural calamities to take away human peace worldwide?

The answer to this question is eco-imbalance in nature (with significant mutations of pathogenic viruses and bacteria) due to global warming and climate change. Global warming is created by humans. Unless we control global warming and climate change, humans will not have any peace. Global Warming is due to the emission of greenhouse gases (polluted waters-soil systems and automobile emissions, due to burning of fossil fuels) into the atmosphere. It is also due to a reduction of oxygen in the atmosphere. Although it is not an immediate solution to reduce or eliminate fossil fuels, a practical approach is to improve oxygen in the atmosphere with concomitant reduction of greenhouse gases, using simplified affordable biological systems.

The following questions and answers clarify several facts about Global Warming-Climate Change.

What is Global Warming?

The term Global Warming refers to recent increases in global temperatures caused by man.

What causes Global Warming?

Global Warming is caused by the greenhouse effect which traps the extra heat, which raises the global temperature.

What are greenhouse gases?

Carbon dioxide (CO₂); Methane (CH₄); Nitrous oxide (N₂O); Ozone (O₃); Chlorofluorocarbons (CFC’s); Carbon monoxide (CO). In addition to the above water vapor is also considered greenhouse gas (although particulates are not gases, they do contribute to greenhouse effect).

How do greenhouse gases contribute to Global Warming? In other words, what is the mechanism?

Greenhouse gases are emitted into the atmosphere to form a blanket. These greenhouse gases allow direct sunlight (which is relatively short-wave energy) to pass by them unaffected. The reason for this is that greenhouse gases are poor absorbers of short-wave energy. When the short-wave sun energy touches the earth’s surface, it starts to heat up the earth. Later it radiates back to space in the form of longer-wave energy. The greenhouse gases absorb the longer-wave heat energy and reflect some of it back downwards towards the earth’s surface. This reflected long-wave energy warms up the lower (approximately) ten miles of the atmosphere, where human beings live.

Who monitors Global Warming? And how much did temperature change globally?

The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 by the World Meteorological Organization

and the United Nations Environmental Program. The IPCC consists of more than 2,000 Scientists from all over the world. According to an IPCC report in 2007, globally average surface temperatures have increased by 1.35F (0.74 C) over the last 100 years. According to IPCC projection, by the year 2100, our global temperature will range from 2.0 to 11.5F(1.1 to 6.4 oC), hotter than present. The organization is quite confident (with 90% certainty), that most of the increase in globally averaged temperatures since mid-twentieth century is due to the increase in greenhouse gases created and released by humans by not paying attention to pollution. Man is becoming a geological force comparable to volcanoes and asteroids, to drastically alter the earth's atmosphere and climate.

How much does each greenhouse gas contribute to Global Warming?

Carbon dioxide (CO₂): It is long-lived and causes the greatest amount of Global Warming. Prior to the industrial revolution (1750-1850) the concentration of carbon dioxide in the atmosphere was about 280 ppm and it was stable. Today (2008-2023), the concentration of CO₂ is roughly 35% more compared to the year 1750. In the last 40 years i.e. (from 1970), the carbon dioxide level went up by 18%. This is an astronomical rate of increase. Since carbon dioxide has a lifespan of about 100 to 200 years in the atmosphere its effects could last for centuries. Because of this, in the year 2007 IPCC (International Panel on Climate Change) warned the world regarding continuous rise in temperatures and sea level rises. IPCC also predicted that in 2100, the atmospheric concentration of carbon dioxide could rise to 490 to 1200 ppm i.e., 75 to 305 percent above the pre-industrial period in 1775. Thus, to protect the earth, we have to reduce CO₂ emission.

Methane (CH₄): Methane is 20 to 30 times more efficient at trapping heat than CO₂. Unlike CO₂, the life span of methane is only 9 to 15 years. In the year 2005, the methane readings in the atmosphere were 1,774 parts per billion, which is 150 times more than in the pre-industrial revolution era. The current concentration of methane is the highest compared to the past 650,000 years by scientific predicament. The methane gas comes from bacterial decomposition that occurs in landfills, guts of cattle, partly from humans (improper digestion), rice paddies, shrimp, and fish farming (especially after harvest, due to decomposition by anaerobic bacteria). In addition, it comes from wetlands, swamps, bogs, manure pits, etc., due to bacterial decomposition. Of course, also from automobile emissions, this is from a chemical reaction due to combustion.

Nitrous oxide (N₂O): This greenhouse gas has been on the rise since the beginning of the industrial revolution. Since nitrogen makes up 78% of the atmosphere and oxygen another 21%, whenever fuel is burned these two chemicals are forced to combine to form nitrous oxide. This nitrous oxide is part of photochemical smog which appears in the air of the major industrial cities. In addition, the use of excessive nitrate fertilizers stimulates microbial fermentation in soil and water, thus generating nitrous oxide.

Ozone (O₃): Ozone in the stratosphere does not pose any problem as greenhouse gas does. As a matter of fact, it protects the earth. However, in the lower atmosphere it acts as a greenhouse gas

to trap the heat. Ozone in the lower atmosphere has been steadily increasing, registering a 30% increase since the pre- industrial era, contributing to Global Warming.

Chlorofluorocarbons (CFC's): These are the synthesized compounds used as refrigerants, aerosol propellants, and cleaning solvents. Because of their excessive usage they have accumulated in the environment and started destroying the ozone in the upper layers of the atmosphere. These CFC's break down to chlorine due to the sun's U.V. light. The byproducts of CFC i.e. (chlorine) destroy the ozone layer.

Carbon monoxide (CO): Carbon monoxide is colorless, odorless, and tasteless and at 20 to 50 ppm can cause poisoning due to its affinity to bind to blood in the place of oxygen. According to the available data, it is evident that in the busy intersections of cities the concentration of CO gets up to 100 ppm. Although carbon monoxide does not absorb heat from the sun, it influences the greenhouse effect by modulating the production of methane and ground-level ozone. This may be the reason why we have been noticing the abnormal amount of these compounds in the atmosphere, post industrial revolution.

Volatile Organic Compounds (VOC): They are considered as greenhouse gases, although their effects are small on Global Warming. Their largest source of emission is from natural vegetation and by-products of automobile exhausts. According to the latest statistics, they are also steadily increasing in the atmosphere and pose a severe threat to the environment in the future.

This subject of the effect of Global- Warming-Climate Change on humanity is dealt, for the sake of simplicity, under the following five different headings:

- a) The effect of global warming - climate change on inducing unfavorable mutations in both the beneficial and harmful micro-organisms, including viruses, causing severe endemics, epidemics, and pandemics, proven through laboratory research experiments.
- b) The adverse effect of global warming- climate change on human health.
- c) The adverse effect of global warming - climate change on agricultural crops and food production.
- d) The effect of global warming- climate change on inducing adverse natural calamities, around the world.
- e) Possible ways and means, and remedial measures to control global warming- climate change to protect humanity.

The effect of global warming-climate change on inducing unfavorable mutations in both the beneficial as well as harmful micro-organisms, including viruses, causing severe endemics, epidemics, and pandemics, proven through laboratory research experiments

These extensive laboratory experiments in this investigation are conducted primarily to study the effects of global warming

on mutations of micro-organisms. All along everybody has been discussing the subject pertaining to the effects of global warming on the environment (natural disasters) only.

Did anybody think of the effect of global warming on the ecosystem involving micro-organisms, such as bacteria, yeast, molds, and viruses etc.?

It is well established that climate change due to abnormally high temperatures affects the health of children, old age people, and people with comorbid diseases etc., (9,10,11).

The major question here is, what are the various physiological and genetic changes which take place in bacteria and other micro-organisms, including viruses, and their devastating effect on humanity due to global warming- climate change?

To answer this question, the following experiments were conducted in a methodical manner, to arrive at a solution and also to sensibly hypothesize the possible causes for the pandemics affecting the humanity throughout the world, due to unforeseen bacterial and viral mutations. It has been well established in science that human beings have more micro-organisms in their body than their own human cells. The total number of human cells is around 10 trillion, whereas the bacteria in the human gastrointestinal tract alone are around 100 trillion. These 100 trillion bacteria are represented by roughly 1000 different genera and species. The total number of bacteria in the GI tract is called Microbiota, and their total genes are termed Microbiome (6). Out of the 100 trillion micro-organisms constituting human Microbiota, roughly 20 percent of them (20 trillion) can be categorized as Probiotics. According to the FAO, WHO (World Health Organization), any live micro-organism when administered in adequate amounts confer a health benefit on host are termed as Probiotics (6,13). Accordingly, several health promoting micro-organisms used to manufacture dairy products come under the definition of probiotics, as per the approved definition by WHO (6,13).

The next obvious question is, how do these probiotic bacteria improve human health?

They improve human health by competing with pathogenic disease-causing bacteria, through production of organic acids, bacteriocins, therapeutic peptides, and other non-specific inhibitory compounds (against the pathogenic bacteria and viruses) etc. In addition, they play an important role in orchestrating the human immune system through immunomodulation, to over-ride the bacterial and viral infections as well as preventing or curing certain cancers (7,17). This is accomplished mainly through production of immunomodulins. Their main impact is predominantly on the adaptive immune system, specifically on the T-cells, such as T-Regulatory cells. Since it is a vast subject readers are referred to the following published journal articles by the author (6,7,8,17).

The other major question is, how do these probiotics differ from other micro-organisms, and are there any genetic determinants in their cells which dictate the production of specific beneficial immunomodulins which can improve the human health through optimizing the immune system?

To answer this question, we have conducted series of experiments using the beneficial probiotic organism, *Lactococcus lactis* var. *lactis* (according to old terminology it is also called *Streptococcus lactis*), which is extensively used to manufacture the dairy products [1,2]. This particular organism produces an abundant amount of lactic acid by utilizing lactose sugar, and also produces bacteriocin Nisin, which inhibits several pathogenic bacteria etc., in addition to producing several therapeutic peptides. This organism grows well at an optimum temperature of 21 C to 32 C. When it is inoculated into sterile 12% reconstituted Non-Fat- Dry milk, and incubated at 21 C for 18 hours, it will coagulate the milk through production of lactic acid.

As early as 1963, the researchers at Oregon State University discovered that at times the organism *Lactococcus lactis* var. *lactis* does mutate and lose its ability to produce lactic acid to coagulate the milk in 18 hrs., when incubated at 21 C [3]. They called the original parent strain Lactose positive (Lac +ve), whereas the mutant evolved of this organism as Lactose negative (Lac -ve). They have also discovered that the Lac -ve mutant also exhibited significantly low degree of proteolysis, to break or digest the milk protein - casein. This was of great significance to the dairy industry, worldwide, since Lac +ve parent strain was intended to produce acid and break the protein to manufacture good functional cheese and other dairy products. Whereas the Lac -ve mutants are nonfunctional and not of much use for making dairy products. In early 1960's the researchers did not know what caused these mutations.

Later in the early 1970's the researchers at the university of Minnesota have discovered that the capacity of the parent Lac +ve organism to produce abundant amount of acid and exhibit proteolysis was due to the presence of extrachromosomal genes, residing in the plasmids [4,5]. These plasmid genes are not part of the chromosome, and they replicate independently during the cell division. Apparently, bacteria synthesized these lactose and casein plasmids due to necessity, over a long period of time. Since these plasmids were not originally there in the bacterial chromosome, and thus they were never allowed to integrate with the chromosome. They are termed extrachromosomal genes. Since these plasmids are not integral part of the chromosome, they can be lost under abnormal circumstances, resulting as Lactose negative (Lac -ve) mutants.

What does it mean and how is it linked to global warming - climate change?

We have conducted a series of experiments in our laboratory to study the effect of higher temperatures (as we have been experiencing due to Global Warming) on the development of Lac -ve mutants. The procedures conducted to study these phenomena are presented in detail in the later part of this presentation. We have figured out that when the parent organism was grown at 21 C it did not generate the Lac -ve mutants. When it was incubated at the higher temperatures i.e., 39 to 40 C, the majority of the population (80 %) turned into Lac -ve mutants, signifying that they lost the lactose utilizing enzyme coding plasmid.

Now let us look into what it means in terms of its capacity to function as a therapeutic probiotic?

The experiments conducted in this investigation, clearly proved (the details are presented in the later part of this publication) that higher temperatures, which we have been experiencing due to global warming, induce mutations, even in the beneficial probiotics, which are the essential components of the human Microbiota and Microbiome [6]. This particular experiment proved that the beneficial micro-organisms present in nature, when exposed to abnormally high temperatures lose their therapeutic beneficial effects by losing their plasmid genes. Consequently, such Lac -ve mutants of *Lactococcus lactis* var. *lactis* when established in the human gastrointestinal tract as part of Microbiota (since most of the nature organisms ultimately may end up part of human Microbiota) cannot function as probiotics, since they lost the capacity to produce immunomodulins such as lactic acid, bacteriocins, and the therapeutic peptides (produced thru proteolysis).

Thus, its role as a probiotic to modulate the immune system is diminished, exposing the human being susceptible to various pathogenic bacterial and viral infections. In addition, due to lack of Lac +ve probiotics, the disaccharide lactose is hard to digest, thus causing Lactose Intolerance. It partly explains why more than one third of the human population in the world has developed Lactose Intolerance. This is just one illustration only. You can imagine how many other probiotics belonging to different genera (stemming from the nature) are affected by the higher global temperatures -

climate change, consequently not able to impart therapeutic effects to protect the human beings from the infections. This explains partly why human beings are susceptible to more diseases lately due to abnormally high temperatures due to Global-Warming-Climate Change. The following experiments were conducted to study the effect of Global Warming-Climate Change on Micro-Organisms, and their effects on humanity and the environment. The experiments were conducted in detail to demonstrate the negative effects of high temperatures on inducing mutations, which negatively affect the therapeutic properties of the selected probiotic organism - *Lactococcus lactis* var. *lactis*.

Materials and Methods

The lactose positive parent *Lactococcus lactis* var. *lactis* was grown in the Tryptic Soy Broth, by incubating at 21 C for 18 to 24 hrs. The acid producing capacity was evaluated on the basis of its capacity to coagulate sterile 12% reconstituted Non-Fat-Dry milk in 18 hours when incubated at 21 C. The coagulation of milk in 18 hours is considered as the organism is being positive, for utilizing lactose, to produce lactic acid, and positive for producing enzymes coded by plasmids to utilize the milk protein- casein. Such an organism has been categorized as Lactose positive (Lac + ve). It was further confirmed by plating on the modified differential agar of Reddy et al. [1,2], to check for the lactose positive character. The composition of the modified differential agar is presented in Table 1.

Table 1: The composition of the differential agar used to differentiate Lac +ve vs. Lac -ve mutants of *Lactococcus lactis* var. *lactis*, probiotic micro-organism.

Ingredients	Amount %
Tryptone	0.5
Yeast extract	0.5
Dipotassium phosphate	0.1
Casamino acids	0.23
Calcium carbonate	0.3
Carboxy methyl cellulose	0.6
Lactose ^a	0.25
BCP (Bromo Cresol Purple) ^b	0.002
Agar	0.15
Distilled water	100 ml

Ph of the medium 6.8 plus or minus 0.1

a- 2 ML of 10 % filter sterilized Lactose solution added to every 100 ML of sterile Agar at the time of pouring..

b- 2 ML of 0.2 % sterile BCP (Bromo Cresol Purple) solution added to every 100 ML of sterile Agar at the time of pouring.

The above medium was poured into petri plates, and after solidification and partial drying, the serially diluted cultures were streaked (surface plated) and incubated at 32 C for 48 hrs. The lactose positive (Lac +ve) cultures appear as intense yellow big colonies, whereas the Lactose negative (Lac -ve) mutants colonies stay colorless and small in size. To study the effect of higher incubation temperature (comparable to Global Warming

Temperatures) on the development of Lactose negative mutants (Lac -ve), the lactose positive parent strain was inoculated into Tryptic Soy Broth and incubated one set at 21 C and the other at 39 C for a period of 24 hours. At the end of incubation, the grown cultures were serially diluted and streaked on to the Lac + ve, Lac -ve differential agar. The plates were incubated at 32 C for 48 hours. The percentage of yellow colonies (Lac+ ve) vs. colorless

colonies (Lac-ve) were determined. Both the yellow color colonies (Lac + ve), and colorless colonies (Lac-ve) were picked and further cultured in Tryptic Soy Broth by incubating at 21C for 18 to 24 hours. At the end of the incubation, they were inoculated separately at 1% level into the sterile 12% reconstituted Non-Fat-Dry milk and incubated at 21 C for 18 hours. The culture that coagulated the milk was considered as Lactose positive (Lac + ve), whereas the culture that did not coagulate the milk was considered as Lactose negative (Lac -ve) mutant. Such milk grown cultures were further streaked on to Lac+ve, Lac -ve differential agar to confirm the parent vs. the mutant.

Results and Discussion

The results of the experiment are presented in Table 2.

Table 2: The percentage of Lac +ve and Lac -ve mutants developed upon the growth at 21C vs. 39 C in Tryptic Soy Broth for 18 to 24 hours incubation, determined by streaking on the differential agar.

Relative percentages of Lac +ve vs. Lac -ve mutants grown at 21 °C		Relative percentages of Lac +ve vs lac -ve mutants grown at 39 to 40 °C	
Lac +ve	Lac -ve	Lac +ve	Lac -ve
98 %	2%	20%	80%

Conclusion of Experiment

The results of this controlled research experiment proved that the abnormal raise of global temperatures due to global warming - climate change will undoubtedly induce mutations in the micro-organisms in the nature in a negative way to eliminate their positive effect on human health. Ultimately such mutated micro- organisms prevalent in the environment when gets into and established in the human system, they can no longer serve as probiotics to improve the immunity and also to produce immunomodulins and neurotransmitters, which are beneficial to human health not only to fight off the pathogens (bacteria, yeasts, molds, and viruses) but also to improve the mental health through production of various neurotransmitters, which will migrate to brain through Vagus nerve [7]. Now I can confidently conclude that global warming - climate change alter the physiological functions of the micro- organisms in the nature, which will ultimately disturb the human health not only thru dysbiosis (unfavorably altered composition of the Microbiota and Microbiome) but also due to abnormalities in the production of immunomodulins and the neurotransmitters [8].

A similar scenario may be happening with the viruses, although unlike bacteria virus can only mutate in the human cell. However, the latest findings point out that the viral naked DNA and / or Naked RNA can infect humans much worse than their intact viruses. The enveloped viruses, such as SARS-CoV-2 Corona Virus and Influenza Viruses, etc., may be vulnerable to the higher global temperatures resulting in the production of the naked genetic materials i.e., Naked RNA/ Naked DNA can also infect, mutate and cause Covid-19 [12,18]. Perhaps the lowered immunity in certain sector of humans due to variance in Microbiota, due to global warming could be another possible factor for the viral pandemics (COVID -19 etc.,). These viral mutations were making even the vaccines and pharmaceutical drugs ineffective. Furthermore, the lowered immunity encourages multiple viral infections leading to the emergence of recombinant

The results presented in Table 2 distinctly proved that higher temperatures incubation produced Lac -ve mutants which could not utilize lactose due to loss of the lactose plasmid. Although we did not check for the proteolysis, it is apparent (due to lack of milk coagulation and the smell) that even the casein plasmid was also lost due to the higher temperature of incubation. Although the number of organisms were lower at high temperature of incubation, the percentage of the Lac -ve mutants were significantly higher, to the tune of 80 %, in comparison to Lac +ve parent trait. Whereas the number of organisms were higher at lower temperature of incubation, yet only 2 % of the Lac -ve mutants were detected, signifying the higher temperatures do induce unfavorable mutations.

(new) viruses with different genomes (compared to the parent) to cause uncontrollable pandemics.

The Effect of Global Warming - Climate Change on Human Health

The sudden abnormal rise in temperature due to global warming in the year 2023, and also in the previous years, caused the following Heath related conditions, especially in the younger and older populations: Asthma, Cardiovascular and respiratory health ailments, and allergies [9-11]. The highest temperature ever registered in the world is in the year 2023, which is 52.2 C (126 F), in Sambo, China. Similarly highest temperatures were registered in Rome, Italy (42.9 C or 109 F), Spain (45.3 C or 115 F), Sicily (46.3 C or 115 F), in addition to the southern parts of the United States, Phoenix, Arizona (43.3 C or 110 F), also in Miami Florida, where the temperature of the sea water was comparable to the temperature of the heated hot tub. This abnormal climate change adversely affects the air quality by increasing the pollutants in the air, including allergens such as Ragweed pollen. The prolonged heat waves due to climate change increase the concentration of the ground level Ozone, which is harmful to the lung tissue through inflammation of trachea, bronchi, bronchioles, and alveoli, thus reducing the lung function significantly.

Global warming increases the concentration of the particulate matter in the atmosphere due to chemical reactions of gases such as sulfur dioxide, nitrogen dioxide, and volatile organic compounds in the air. The inhalation of such particulate matter leads to lung cancer; cardiovascular diseases, chronic obstructive pulmonary diseases (COPD), and myriad of skin diseases [12]. The year of 2023 has been one of the disastrous years for the increase of particulate matter in the air due to wildfires in Canada, Australia, and California in USA. The wildfires coupled with the higher temperatures have been a devastating factor for human health. In my opinion the

prior comorbid lung conditions due to global warming and climate change prone the people to severe SARS-CoV-2 corona viral infections, leading to COVID-19 pandemic [13]. Pollution related cardiovascular diseases is also the cause for the significant rate of viral spread and infections observed during COVID-19 pandemic.

The human Gastrointestinal Microbiota and Microbiome variance (as presented earlier with research data on development of Lac^{-ve} mutants of probiotics) due to global warming and climate change could be another culprit for reducing the efficiency of the immune system, leading to the spread of infectious diseases. This subject was discussed earlier using experimental evidence. According to the World Health Organization, the climate change is expected to cause approximately an additional 200,500 deaths per year between the years 2030 and 2050 due to Malaria (and other insect borne infections), Diarrhea, and heat stress etc. I can hypothesize that the abnormal increase in death rate can be attributed to the Dysbiosis, resulting in significant reduction of Probiotics in the GI tract Microbiota due to higher Global temperatures [6-8].

The Adverse Effect of Global Warming- Climate Change on Agricultural Crops and Food Production

According to the Intergovernmental panel on climate change the rising level of carbon dioxide in the atmosphere significantly reduces the nutritional quality of the agriculture produce or food. More specifically the levels of proteins and essential minerals and vitamins will be reduced causing nutritional deficiencies leading to physical and mental issues in humans, worldwide. Perhaps this can also be due to unfavorable mutations in the soil beneficial micro-organisms, due to loss of Plasmids, leading to the nutrient deficiency in the crops. The underfed mothers, and mothers eating nutritionally inferior foods will give birth to babies who will ultimately be susceptible to unwanted obesity, diabetes, and heart diseases in later part of their life in addition to the significantly lower life span. All over the world, staple crops like Rice, Wheat, and Soybeans are getting harder to grow due to hotter temperatures and unpredictable rain falls. Due to global warming the yield of the food crops and the nutritional quality of the food products are significantly lower. Globally one in five deaths are attributed to poor diets due to low consumption of healthy foods. The following statement is according to the World Health Organization: "Climate change is impacting human lives and health in a variety of ways. It threatens the essential ingredients of good health - clean air and safe shelter - and has the potential to undermine decades of progress in global health".

According to the United Nations Intergovernmental panel 4 in 10 people (40%) live in areas which are highly vulnerable to the devastating effects due to climate change and its effect on crops. According to research conducted at the University of Arizona, global warming undoubtedly has a negative effect on the physical and mental health of the people around the world (9). Once again, it can be attributed to the variance in the Microbiota and Microbiome in addition to the lack of tolerance to heat, especially with the old age population. It has been an established fact that mutated fungal species infected the banana crops and lowered the

yields and production. The orange crops in Florida are also facing severe damage due to unwanted microbial infestations, which can also be attributed to directly or indirectly due to global warming. In addition, pollution and global warming have also significantly reduced the yield of the shrimp and fish, in intense farming arena, due to viral and bacterial infections (14). Most of the problems associated with Agricultural crops can also be attributed to the unfavorable mutations of the soil beneficial micro-organisms due to warmer temperature, like mutations in probiotics, as proven in the earlier experiment using bacterium *Lactococcus Lactis* var. *Lactis*.

The Effect of Global Warming- Climate Change on Inducing Adverse Natural Calamities, Around the World

Global Warming refers to how the increased temperature worldwide might change the weather and climate. Weather is the condition produced by the temperature, humidity, wind, and precipitation at a given minute. Whereas climate refers to weather averaged over several years. Global Warming will have a significant effect on rain, snow, hail, sleet, tornadoes, cyclones, and hurricanes. Global Warming has a significant effect on increasing the tornadoes, hurricanes, and tsunamis creating disastrous effects on humanity around the world.

Tornadoes

The all-time record for the number of tornadoes in the United States was 1,717 in the year 2004. Earlier record in 1998 was 1,424, in 2006, over a period of four days March 9-13, confirmed tornadoes recorded were 105, which was regarded as one of the largest outbreaks in history. These tornadoes do billions of dollars of property damage in addition to death of people and animals. There were 1,072 tornadoes reported in the U.S. alone in 2012. Of which at least 921 have been confirmed. The maximum rated tornado is EF4, which hit Harrisburg, Illinois on February 29 (2012), Henryville Indiana on March 2 (2012), Crittenden, Kentucky on March 2 (2012), and Marquette, Kansas on April 14 (2012). The estimated damage due to tornadoes alone in the U.S. was \$4.8 billion (U.S.) and there were 68 fatalities. Elsewhere in the world, (Poland, Japan, Italy, New Zealand, Indonesia, Turkey, Argentina etc.), tornadoes did enormous amounts of property damage and fatalities in the year 2012. Some of these countries have never heard of tornados. According to the leading environmental scientists, global weather change (global warming) is responsible for these tornado calamities and disasters creating mystery to the humans and animals thus taking away peace in the world. These Tornadoes further increase Global warming by increasing the particulate matter in the atmosphere, thus altering the eco-balance.

Hurricanes

The worst hurricane in the history of United States or for that matter in the world was hurricane Katrina which has affected the Central Gulf Coast i.e., City of New Orleans. It was a category 5 hurricane and caused the biggest property damage amounting close to \$125 billion dollars. Hurricanes are also called typhoons in the Western Pacific and cyclones in the Indian Ocean. Lately the frequency of typhoons and cyclones are increasing significantly due

to Global Warming. In the United States several severe hurricanes have been reported in 2012. They are as follows: Sandy; Isaac; Derby; and Ernesto etc. Out of all the hurricanes, the most intense hurricane, Sandy, was a powerful category 2 hurricane that brought significant damage to the East Coast of the United States in October (2012), causing damage in excess of \$65 billion (U.S.) and fatalities close to 200 or over. Hurricane Isaac hit Florida and the Gulf Coast and caused an estimated \$2.3 billion (U.S.) in damage and 41 deaths. Other hurricanes caused over a billion dollars' worth the damage.

In total in 2012, hurricanes alone killed 328 people in the U.S., causing at least \$68 billion (U.S.) in damages. Hurricane Sandy in New Jersey (2012) destroyed 650,000 homes with additional eight million homes with no electricity and caused an economic loss of 71.5 billion dollars; hurricane Harvey in Houston, Texas (2017) caused 180 billion dollars of damage with loss of several lives, homes and created devastation to thirteen million people in Texas, Mississippi, Tennessee and Kentucky; hurricane Irma (2017), a most powerful Atlantic hurricane in recorded history (a category 5 storm) with winds up to 185 miles/hour continuously for 37 hours (which is longer than any storm recorded in the history) caused an economic loss of \$300 million with severe human devastation including loss of lives, homes etc., hurricane Maria (2017) another category 5 hurricane hit Dominican Republic and Puerto Rico etc. killed over 547 people, damaged abnormal number of homes buildings with a total loss of electricity and caused a severe human mystery with an economic loss of 104 billion dollars.

Recently in January 2018 North American blizzard (historic bomb cyclone) affected New York, New England States, Florida and Georgia (Florida and Georgia never had snow before) killed over 22 people with a power loss in 300,000 homes; northern California had wildfires (2017) with several deaths and over 100 billion dollars' worth of property damage; Southern California in (2018) had wildfires and mudslides with death of several people and property damage at least over 100 billion dollars (exact amount not determined yet); of course such devastations all over the world. Now it is clear in the minds of scientists and people that these natural calamities are due to global warming. Unless we correct the global warming issue, these natural calamities will not be controlled. The peace in the world is not only created by how well human beings and nations get along with each other but also by the significant reduction of misery the natural calamities bring to the world (which will take away peace). Once again, these Hurricanes also contributes to further increase in Global warming, thus disturbing and distorting the eco-balance way beyond our imagination.

Tsunamis

Are the aftermaths of earthquakes (under sea) and are not directly related to Global Warming. However, Global Warming indirectly may increase the chances for tsunamis and other natural disasters. Tsunamis are produced by seismic movements at the bottom of the sea, therefore are produced geologically but not meteorologically. If the sea water temperature is raised due to Global Warming, the chances of such water destroying the land and

humans is significantly greater. The warmer water will rise higher and develop greater speed moving towards the land and cities. A tsunami developed in the Indian Ocean on December 26, 2004, came onto land with enormously great speed, and destroyed the property and killed over 250,000 people in Asia. The tsunami in Japan, March 11, 2011, is an aftermath of an 8.9 magnitude earthquake in the Pacific Ocean. The devastation caused by this tsunami went beyond the imagination of the world. The speed at which the water came into cities (Sendai) was close to 500 miles/hour and the heights of waves were 30 feet (as they approached the land).

If the sea levels were to be slightly lower the devastation might not be as much as we have seen. Overall, the frequency and magnitude of these tsunamis are increasing. Also, the extent of damage they are doing is astronomical. By reducing greenhouse gases, thus reducing Global Warming, ultimately, we may significantly reduce the speed and height of tsunami waves. If Global Warming continues without any check, even the slightest earthquake in the sea may produce violent tsunamis. An increase in tsunamis may happen since changes in temperature of the oceans (due to Global Warming) may affect streams and underwater geophysical masses producing environmental conditions that may precipitate seismic movements at a given place. The sea water levels are rising annually due to excessive melting of glaciers, due to global warming. Once again, these Tsunamis significantly alter the eco-balance through disturbing the associative growth relationships among various micro-organisms in nature, resulting in the domination of the unwanted pathogenic bacteria and viruses. Thus, we strongly feel the magnitude of damage caused by tsunamis can be greatly decreased by controlling Global Warming. At least, it is a step in the right direction.

Possible Ways, Means and Remedial Measures to Control Global Warming- Climate Change to Protect Humanity

It is a vast subject and there is no single answer to curb global warming. The following are some of the ways we can correct global warming and its devastations:

- a) Reduce the emission of greenhouse gases [14-16].
- b) Reduce pollution.
- c) Develop methods to increase the oxygen levels in the air [14].
- d) Although it may take some time to decrease automobile emissions due to the usage of fossil fuels, several other methods to improve the oxygen levels in the atmosphere can be implemented [14].
- e) Develop solar energy systems as alternative energy sources.
- f) Develop microbiological systems to reduce anaerobic fermentations due to anaerobic bacteria which generate greenhouse gases such as carbon dioxide, methane, and ammonia [14-16].

- g) Protect the water bodies from dumping of pollutants.
- h) Take measures to improve the air quality.
- i) Educate people regarding the genesis of global warming and ways to reduce such calamities.
- j) Stress the importance of global warming to the policy makers.
- k) Make the point clear that every human being in the world should cooperate and assist positively to curb global warming.
- l) Reducing global warming is a global affair, and it cannot be attributed to some countries only.
- m) Reduce wildfires due to human negligence.
- n) Control of the ruminant fermentations to reduce the production of methane using proper biological measures. The same should be undertaken with humans also [6-8,17,18].

In concluding remarks, Global warming - climate change cannot be taken lightly since they can devastate the world and eliminate peace in humanity. The topics presented in the research article involve both the research experiments conducted in our laboratory under controlled conditions, and other trivial facts presented by various governmental organizations. Finally, the undue harmful mutations in the micro-organisms present in the environment, due to global warming cannot be ignored, since they can harm human health and devastate the world economy through endemics, epidemics, and pandemics. The classical example is the Pandemic, Covid-19, we have experienced from the year 2020-2023.

Disclosure

The author Dr. Malireddy S. Reddy is a scientist with degrees in Veterinary medicine, MS, and Ph.D. in food technology, microbiology and virology. He has been heavily involved in the microbial and biochemical research (including beneficial bacteria and probiotics) pertaining to the Eco-Systems to reduce the pollution, global warming - climate change, continuously for over 37 years, with a phenomenal success. His pollution reduction systems have been implemented in several parts of the world. He holds over 150 US and international patents and published over 160 research articles. His company (IMAC, Inc.,) does extensive research on Micro-Organisms pertaining to improving the environment and human health, and also manufactures food-grade beneficial microbial cultures and other essential high-tech enzymes fortified functional products that go into manufacturing fermented food products all over the world.

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Conflict of Interest

No conflict of Interest.

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