ISSN 2581 – 4346

Available Online at www.ijms.co.in
Innovative Journal of Medical Sciences 2020; 4(2):5-20

RESEARCH ARTICLE

Okra maybe potential cost-effective personalized-biomedicines social-vaccine against COVID-19: Improved immunity food-security green-economy science-and-technology-communication applications

Subhas Chandra Datta[1,2]*

[1]Eco-Club, Kanchannagar D.N. Das High School (HS), Burdwan, West Bengal, India, [2]Department of Zoology, Visva Bharati, Santiniketan, West Bengal, India

Received on: 13 February 2020; Revised on: 15 April 2020; Accepted on: 01 Jun 2020

ABSTRACT

The "human-challenge"–pandemic-coronavirus-COVID-19 effects on human-civilization, health, travel, socioeconomic, education, and clinical research. India emphasis on okra, the most economically-important number-one essential-consumption-nutritious-vegetable as well as traditional-medicine, the "Nature's-Gift to human-disease-free healthy-life," is naturally-infected with different-diseases, significantly reducing food-production. Although pesticides are the most effective means of control, they are not, cost-effective, and environment-friendly. Hence, it has been an urgency to require; new and more efficient solutions, technologies, products to fulfill its food and nutritional requirement, and methods to develop vaccines or social-vaccine against coronavirus-COVID-19. Hence, it is focused on the okra-plant, intercropped with amaranth-plant, to determine the effects on pathogens-infected-diseases; Root-Knot, Yellow-Vein-Mosaic-Virus, and Okra-Enation-Leaf-Curl-Virus in a well-protected-garden. After harvesting, of the two-plant-species, okra received minimum pathogen-infection, forming the "Good-Diseases-Resistant-Eco-Friendly-Highly-Economical-Biomedicinal-Plants," conserving "Biodiversity-Conservations-Sustainable-Climate-Health and Development with Important-Economic-Implications in Agriculture," though both are highly susceptible to diseases, and the farmers would be benefited double; by controlling-diseases, and by buying-selling the okra-amaranth. In biomedicines, highly-trace-tolerance-okra-vegetables or the plant virus; Yellow-Vein-Mosaic-Virus, and Okra-Enation-Leaf-Curl-Virus, which has been developed as antigenic epitopes derived from the vaccine targets COVID-19 infectious epidemic disease agents, and the chimeric virus particles (CVPs), may be used in vaccine formulations or treatments, as one of the most powerful potential-personalized-biomedicine as vaccines or social-vaccine against coronavirus-COVID-19, inducing natural-immunity, enriching food-security green-economy science-and-technology-communication applications-issues. It may be the most; cost-effective, easily-available, safe-edible, prepare-able, and applicable-future-potential-biomedicine, and safe alternative to live replicating COVID-19-"Social Vaccines" which mobilized and united us, hope and opportunity opens new-windows for nations to win the 21st-century pandemic-crisis common-enemy, retaining in the old-form.

Keywords: COVID-19, Improved immunity food security green economy, Intercropped-okra, Potential-cost-effective personalized biomedicines-social-vaccine, Science-and-technology-communication-applications

***Corresponding Author:**
Dr. Subhas Chandra Datta,
E-mail: dattasubhas@rediffmail.com

INTRODUCTION

The recent "human-challenge"[1] pandemic-coronavirus-COVID-19 has presented unique

global-challenges to human civilization, our private and professional life and the social organization-communities,[2] health systems "the invisible patients,"[3] devastating social and economic consequences,[4] truism,[5] and education.[6] And reopening of the educational institutions, could also threaten the surrounding community, and employees will not be permitted to teach or work.[6] Hence, the scientists has been an urgency to develop vaccines against coronavirus[7] or find out the quickest and most efficient effective treatment pathway and prevention strategies, but remain careful regarding scientifically robust and ethically sound clinical research.[8] The fifth endemic coronavirus, leaps from animals, forming humans-health-danger[8] in the future due to very closely related animal-human virus,[9] genetic resistance,[10] divergence, structural and the future evolution, adaptation, and spread,[11] prevails a long time as an asymptomatic patients,[12] and the recent, pandemic situation is analogous to war, the delay of every week in the deployment of a vaccine to the 7 billion humans on earth will cost thousands of lives,[13] and World Health Organization (WHO) develops a blueprint for diagnostics, vaccines, and therapeutics against novel coronavirus.[14]

To face the pandemic-challenge, India emphasis on the most economically important number one consumption-vegetable crop,[15] okra, is badly affected-COVID-19 impact on okra seeds market size.[16] Okra is the oldest widely cultivated-oligo purpose, used as traditional medicine, forming the "Nature's Gift to human disease-free healthy life" multipurpose crop,[17-19] consumed in a variety of ways, fruits rich in vitamins, calcium, folic acid, carbohydrates, phosphorus, magnesium and potassium, iodine, mineral matters, and a good source of superior nutritional quality for human nutrition, and mature fruit and stems contain crude fiber, used in the paper industry and sugarcane industry of India, achieved first in the world.[18] Okra is also known for several potential health beneficial effects on human diseases such as cardiovascular disease, type 2 diabetes, kidney diseases, skin infection, digestive diseases, some cancers, antioxidant, nootropic, eye, body immunity, blood pressure, obesity, asthma, constipation, heart disease, sexual health, and neurological disorders.[19-22]

However, recently, in India, the production in terms of yield as well as fruit quality of okra is hampered adversely by the naturally occurring Root-Knot (RK) diseases caused by the nematode-pathogens, *Meloidogyne incognita* (Kofoid and white, Chitwood, 1949), Yellow Vein Mosaic Virus (YVMV) disease, and Okra Enation Leaf Curl Virus (OELCV) disease, caused by the virus-pathogens which spreads by an insect vector, named whitefly (*Bemisia tabaci* Gen). The use of chemicals is the most effective means of control, but they are expensive and not environment-friendly creating health hazards[23,24] and the genetics-resistance[25] to YVMV and OELCV in okra, and diversity of viruses affect the production, financial losses of okra, and climatic changes impact on the global economy also.[26,27] A number of bio-agents or bio nematicides or biomedicine[28-40] only stand as a suitable and useful against different plants, animals and human diseases caused by pathogens. However, it remains some problems in the rapid depletion of natural resources, biodiversity conservation, and not cost-effective.[41] Then, it is thought that "Homeopathy" may solve all the above-mentioned problems.[42-50] However, it has some cost. Only, intercropping would help in identifying the "Diseases-Resistant-Plants" for possible control of plant diseases caused by different pathogens and it is primarily observed in the okra also.[51-56]

The main aims and objectives are to find out the most suitable solution, a trial was planned to use of okra (*Abelmoschus esculentus* L. Moench) Cv. Ankur – 40 as a "Diseases-Resistant-Biomedicine-Vegetables" intercropped with Amaranth-plant (*Amaranthus viridis* L.) cv. CO-1, to determine the effects on pathogens-infected diseases; Root-Knot, Yellow-Vein-Mosaic-Virus, and Okra-Enation-Leaf-Curl-Virus in a well-protected-garden. Moreover, to overcome the present epidemic COVID-19 disease, it is planned to publish as suggestions, to take measures or treatment opportunities or discover preventive measures, by consumption of the okra based healthy diet as biomedicines, based on healthy diet and greater prevention against SARS-Cov-2, by boosting the human immune system.

MATERIALS AND METHODS

Location and preparation of the field trial

The experiment was carried out in the garden of the Department of Zoology, Visva-Bharati University, Santiniketan – 731235, West Bengal, India, at an ambient temperature of 25 ± 2°C and RH 75 ± 5%.[23,24,51-56] Soil was interchanged to keep the nematode population as uniform as possible with mixing manure (2:1 vol/vol). For uniform distribution, in the three inoculated plots, soil and root samples were taken at random to determine the extent and intensity of *M. incognita* -pathogen infestation by mixing at 255,000 ± 25,338 J2/plot each (*M. incognita* juveniles).[23,24,51-58] These experimental fields were randomized in the infested field using a completely randomized block design. All the data were counted for statistical analysis by analysis of variance ($P \leq 0.05$).

Plantation

Aseptically germinated seeds of Okra (*A. esculentus* L. cv. Ankur-40) and Amaranth (*A. viridis* L. cv. CO-1) were planted alternately with a gap of 25 cm in the first two plots. There were 18 seedlings, nine from each species of plants. The same design was followed in another two plots with amaranth and okra separately.

Since amaranth was a slow-growing plant, it was planted 15 days earlier than the okra plant. The plots were: Uninoculated amaranth-okra, inoculated amaranth-okra, inoculated amaranth, and inoculated okra.[51-56] All the naturally infected-diseases; Root-Knot, Yellow-Vein-Mosaic-Virus, and Okra-Enation-Leaf-Curl-Virus occurred at four-leaf stage of okra plants. All the data were counted for statistical analysis by analysis of variance ($P \leq 0.05$).

Harvesting

Sixty-five days after plantation of okra, all the plants were uprooted and the following parameters of growth and pathogens infection were recorded: Average number of leaves/plant, the average number of disease (Yellow-Vein-Mosaic-Virus and Okra-Enation-Leaf-Curl-Virus) infected leaves/plant (%), the average number of root galls/plant, the average number of nematodes (Root-Knot) per 2 g of root and 200 g soil, average biomass (g) of fresh weight of shoot and root, and average protein % of root and fruits protein content. Three samples of root from each species of plants were taken at random and the total protein fraction in each sample was estimated.[23,24,57-60] All the data were counted for statistical analysis by analysis of variance ($P \leq 0.05$).

Consumption recipe

Okra is a tasty delicacy found in many dishes, making it quite a versatile vegetable, and consumed in a variety of ways like; pods are one of the most widely as vegetables and can be used in salads, soups, stews and sauces, chopped, sliced, fresh or dried, fried, or boiled. It offers mucilaginous consistency after cooking. Okra mucilage has medicinal applications[15,17-22] Okra seed-cooked or ground into a meal and used in making bread or made into "tofu" or "tempeh" and the roasted seed is a coffee substitute.[61,62]

Science and technology communication applications food security economy

The activity of students, researchers, regulators, teachers, staff, community, photographers, visitors, different scientist, academicians, clinicians, administrators, institutions, farmers, NGO named "Burdwan Green Haunter and Students' Goal," and media personnel, campaign or aware or make the news or publication regarding the importance of "Okra Maybe Potential Cost-Effective Personalized-Biomedicines Social-Vaccine against COVID-19: Improved Immunity Food-Security Green-Economy Science-and-Technology-Communication Applications and Nutritious foods, Healthcare-, Defense response and Immunity as well as Biodiversity Conservation Issues" in different audiovisual media (TV channels), social media, web pages, newspapers, and journals, are recorded. It is a platform to promote and discuss different new issues and developments by publishing case

reports in all aspects of Clinical Medicine for all over the globe.[23,24,28-56,63-66]

RESULTS

On root-knot and foliar diseases

Table 1 shows that the use of okra as a "Diseases-Resistant-Biomedicine-Vegetables"-crop against naturally pathogens-infected-diseases; Root-Knot, Yellow-Vein-Mosaic-Virus, and Okra-Enation-Leaf-Curl-Virus in a well-protected-garden intercropped with amaranth plants by analysis of variance ($P \leq 0.05$), though both the amaranth and okra plants were susceptible to root-knot nematodes and foliar diseases. Here, amaranth was more susceptible than okra in terms of root-gall number nematode population in root and root protein content forming "Catch Crop." In the inoculated Amaranth-Okra intercropped field, okra has also the lowest infection in terms of the average number of leaves/plant, the average number of disease (Yellow-Vein-Mosaic-Virus and Okra-Enation-Leaf-Curl-Virus) infected leaves/plant (%), the average number of root galls/plant, the average number of nematodes (Root-Knot) per 2 g of root and 200 g soil, average biomass (g) of fresh weight of root, and average protein % of root protein content, but increased average biomass (g) or fresh weight of shoot and average protein % of fruit-protein content, in comparison to other plots, while *M. incognita* population increased significantly both in the soil and in roots in 65 days in the monoculture. However, okra showed the lowest intensity of nematode infection [Table 1].

Table 1: Study of okra intercropped with amaranth plants infected with Root-Knot, YVMV, and OELCV diseases in a garden

Plots	Average number of leaves/plant	Average number of disease infected leaves/plant (%)		Average number of root galls/ plant	Average number of nematodes (populations)		Average biomass (g)		Average protein %	
		YVMV	OELCV		Soil (200 g)	Root (2 g)	Shoot	Root	Root	Fruits
I. Uninoculated	$87.13^{b}\pm1.11$	Nil	Nil	Nil	Nil	Nil	$186.50^{a}\pm2.02$	$43.00^{a}\pm1.15$	$2.97^{b}\pm0.01$	Nil
Amaranth	$13.58^{a}\pm0.08$	$84.00^{b}\pm2.12\%$	$37.02^{b}\pm0.92\%$	Nil	Nil	Nil	$81.10^{b}\pm1.02$	$12.00^{a}\pm0.10$	$4.01^{a}\pm0.01$	$2.99^{a}\pm0.13$
Okra										
II. Inoculated	$102.28^{c}\pm6.42$	Nil	Nil	$4389.58^{b}\pm22.04$	$99.98^{a}\pm2.42$	$1689.08^{a}\pm12.52$	$98.00^{b}\pm2.20$	$9.80^{b}\pm1.99$	$6.58^{b}\pm0.02$	Nil
Amaranth	$11.94^{a}\pm0.02$	$38.03^{a}\pm0.52\%$	$12.06^{a}\pm0.04\%$	$23.05^{a}\pm10.15$	$99.98^{a}\pm2.42$	$73.75^{a}\pm11.35$	$61.00^{b}\pm1.35$	$13.30^{a}\pm0.16$	$4.29^{a}\pm0.03$	$1.98^{b}\pm0.02$
Okra										
III. Inoculated	$76.02^{b}\pm4.22$	Nil	Nil	$4921.45^{b}\pm29.23$	$48.06^{b}\pm1.04$	$1868.75^{b}\pm10.15$	$96.00^{b}\pm1.02$	$63.95^{a}\pm1.19$	$6.27^{b}\pm0.03$	Nil
Amaranth										
IV. Inoculated	$09.34^{b}\pm0.42$	$94.06^{c}\pm0.12\%$	$56.04^{c}\pm0.18\%$	$1497.80^{b}\pm5.70$	$56.75^{b}\pm1.93$	$973.00^{b}\pm10.01$	$29.98^{c}\pm0.04$	$34.75^{b}\pm1.53$	$5.69^{b}\pm0.02$	$1.07^{c}\pm0.01$
Okra										

^{a,b,c}Significant difference in a column by analysis of variance ($P \leq 0.05$). YVMV: Yellow Vein Mosaic Virus, OELCV: Okra Enation Leaf Curl Virus

In future suggestions in research

The results fulfill the goal of a research suggestions as proposal because the consumption of intercropped cowpea with okra, use as biomedicines, need to justify future research and to present the practical ways, in which the proposed study should be conducted by the future researcher for conducting the research consistent with requirements of the professional or academic field and a statement on anticipated outcomes and or benefits derived from the study's completion.

In science and technology communication applications economy

The students, researchers, teachers, staff, community, photographers, visitors, different scientist, administrators, institutions, farmers, NGOs, and media personnel campaign, aware, discuss, arrange workshops and seminars, make news and publish as abstract regarding the importance of "Okra Maybe Potential Cost-Effective Personalized-Biomedicines Social-Vaccine against COVID-19: Improved Immunity Food-Security Green-Economy Science-and-Technology-Communication Applications and Nutritious foods, and Healthcare, Defense Response, Vaccinations and Immunity as well as Biodiversity Conservation Issues" in different national- and local- audiovisual media (TV channels), different social media, web pages, newspapers, and different national and international Journals as well as Congress Proceedings also.

DISCUSSION

The preventive measures start from the consumption-nutritious-vegetable as well as traditional-medicine, the okra based healthy diet with greater prevention against coronavirus COVID-19. For easy understanding, various different subheadings highlight the many points to deepen and link them to a unidirectional common thread "Nutritious Okra Diet as Potential Cost-Effective Personalized-Biomedicines Social-Vaccine Greater Prevention against COVID-19: Improved Immunity Food-Security Green-Economy Science-and-Technology-Communication Applications Issues" that to make the reader easily understand the link between the various considerations as follows:

Advantages of okra as biomedicine

On susceptibility

It is evident from the observation that intercropped-okra plants were resistant to Root-Knot, Yellow-Vein-Mosaic-Virus, and Okra-Enation-Leaf-Curl-Virus disease. In the contrary, the okra and amaranth are very good hosts of these nematodes as well as foliar pathogens.[66-68] However, root-knot nematodes disliked to feed on okra rather than amaranth when it had a choice, forming the "Disease-Resistant Vegetables Crops." It is due to the relative size as well as biomass of the two root systems that are responsible for the difference in susceptibility between the two plant species. Here, the amaranth root system colonizes and occupies the large area, it is likely that the plant-parasitic nematodes will preferably be found in its roots[51-56] and due to resistance of okra. In other words, amaranth could serve as a good catch crop thereby reducing pathogens infection of other vegetables.

On defense resistance

And the positive effects of the growth of both okra and amaranth plans may be responsible for defense resistance against other plant pathogens[24,28-56] In intercropping, land equivalent ratio, benefit-cost ratio, and monetary advantage index are used to assess the productivity and its economic benefits. The farmers would be benefited double; by controlling root-knot diseases, and by buying and selling the amaranth-okra fruits.[51-56]

On high tolerance to environmental stresses

Okra has high relative productivity, production stability, and high tolerance to environmental stresses like drought. Intercropping systems indicated the advantage of these technologies and their function of socio-economic and bio-physical conditions, the mechanisms and processes associated with soil fertility management, the effect of intensive agriculture on soil degradation, the role of traditional and scientific knowledge, benefits, challenges, and additional human-use impacts on long-term ecological composition and function.[69] The genotypes of okra with a degree of tolerance to drought-water influence in breeding material, segregating populations of this cross are promising.[70] Salinity is a major environmental stress that limits crop production and growth of okra plants as well as its physiological processes such as photosynthesis rate and stomatal conductance worldwide[71] and drought also influence ion accumulation and antioxidative enzymes in okra genotypes[72] with phosphoproteomic response.[73]

On climate change and food security in agriculture

Plants growth directly rate by increasing photosynthesis and stomata activity, conserves solar energy in the glucose, and significantly reduces CO2 in the climate. Hence, we can say that both plants might have induced synthesis of many new proteins which increase photosynthesis has stimulated increased photosynthesis rate, stomata activity, and water retention capacity plants by inducing defense response.[24,28-56,71-73] These results may suggest that plant diseases (such as nematodes, fungus, virus, bacteria, and insects) might be effectively controlled by the okra plant as a "resistance vegetables" and amaranth as a "cover crop." It is a new and more efficient solution, technologies, products and it has to fulfill its food and nutrition requirement[74] for controlling root-knot disease using okra intercropped with amaranth plants, which indirectly influence climate change and resource productive economies enriching quality of midday meal as well as the agricultural sector in food security.

On okra based healthy-diet for greater prevention against epidemiological diseases

Okra is the oldest widely cultivated, nutritional source of power used throughout history for both medicinal and culinary oligo-purpose, used as traditional medicine, forming the "Nature's Gift to human disease-free healthy life" multipurpose crop,[17-20] consumed in a variety of ways, fruits rich in vitamins, calcium, folic acid, carbohydrates, phosphorus, magnesium and potassium, iodine, and other mineral matters, and a good source of superior nutritional quality oil and protein, unsaturated fatty acids such as linoleic acid, which is essential for human nutrition that is responsible for the health benefits. Moreover, mature fruit and stems contain crude fiber, used in the paper industry, and the mucilage of roots and stems is used in the sugarcane industry of India achieved first in the world. Okra is also known for several potential pharmacological properties-health beneficial effects on human diseases, such as cardiovascular disease, type 2 diabetes, kidney diseases, skin infection, digestive diseases, some cancers, antioxidant, nootropic, eye, body immunity, blood pressure, obesity, asthma, constipation, heart disease, obesity, osteoporosis, gastrointestinal health, sexual health, and neurological disorders.[19-22,74]

On food composition, consumption, and digestion

According to the U.S. Department of Agriculture National Nutrient Database, one cup of raw okra, weighing 100 grams (g) contains: 33 calories, 1.9 g of protein, 0.2 g of fat, 7.5 g of carbohydrates, 3.2 g of fiber, 1.5 g of sugar, 31.3 milligrams (mg) of Vitamin K, 299 mg of potassium, 7 mg of sodium, 23 mg of Vitamin C,0.2 mg of thiamin, 57 mg of magnesium, 82 mg of calcium, 0.215 mg of Vitamin B6, 60 micrograms (mcg) of folate, and 36 mcg of Vitamin A, okra also provides some iron, niacin, phosphorus, and copper[17-22,74] and maintains a healthy digestive system with reduced appetite, and it may contribute to weight loss. People can add it to salads, soups, and stews. They can eat it fresh or dried, pickled, fried, sautéed, roasted, or boiled. Tips for choosing and using okra include: Picking okra that is taut and firm to the touch, avoiding pods that are shriveled, soft, or dark on the ends, keeping okra seed dry and storing in the crisper drawer in a paper or plastic bag to stop it from becoming slimy or moldy, avoiding washing it until you are ready to use it and use within 3–4 days.[74] Okra also has economic viability, low environmental impact and contributes to the conservation of natural resources and the sustainability of production systems and it is a safe food, easily available in all regions, and low priced compared to other sources of protein.[74] Based on the analyses performed, it is possible to infer that okra is a strategic culture for the promotion of food security and the health of populations on all continents.[15,69-74] Okra is not only healthy and delicious food but also it is highly versatile and easy to enjoy in a variety of recipes and makes them easier to digest. Okra is a tasty delicacy found in many dishes, making it quite a versatile vegetable, and consumed in a variety of ways like; pods are one of the most widely as vegetables and can be used in salads, soups, stews and sauces, chopped, sliced, fresh or dried, fried, or boiled. It offers mucilaginous consistency after cooking. Often the extract obtained from the fruit is added to different recipes such as stews and sauces to increase the

consistency and it has various uses of the fresh leaves, buds, flowers, pods, stems, and seeds. The pods of okra can be pickled and preserved. The leaves of this vegetable are also edible and they are often utilized raw in salads. Okra mucilage has medicinal applications.[15,17-22] Okra seed cooked or ground into a meal and used in making bread or made into "tofu" or "tempeh" and the roasted seed is a coffee substitute.[61,62] However, they also make a great addition to soups, stews, and salads. However, it is showed that following a low-calorie diet enriched.[17-24,74]

On genetic improvement

Among the diverse wild gene pool of okra, it holds the resistant source of gene for many biotic stresses, diseases and pests infestation, and breeding approach is one of the value-added steps for resistant variety released in the recent past, the advancement in molecular and biotechnological techniques enhances the okra improvement programs by advancing in marker-assisted selection and resistant gene transfer,[75,76] and also on germplasm regeneration, genetic studies and efforts on genetic improvement in West and Central Africa for okra's nutritional and economic potential.[77]

On decreasing, the chemicals' usage

The fertilizers-pesticides, plus improvements in the crop input use efficiency could minimize greenhouse gas emissions while protecting the environment. Sustainable agriculture holds promise for humankind and the planet earth, and it can be successful if all developed and developing nations stand together to seek "our common future" to produce more food while generating less environmental pressure.[78]

Development of suggestions-okra as biomedicine against COVID-19

On genome biology

We are not completely human, at least when it comes to the genetic material inside our cells. We all may harbor, as many as, 145 genes which have jumped from bacteria, other unicellular organisms, and viruses and made themselves at home in the human genome. It is reported-online today in "Genome Biology," that the hundreds of genes that appeared to have been transferred from bacteria, archaea, fungi, other microorganisms, and plants to animals. In the case of humans, they found 145 genes that seemed to have jumped from simpler organisms, including 17 that had been reported in the past as possible horizontal gene transfers.[79] The genomics of plant and animal is a vast area of research for the biological issues covered because it continues to deal with the structure and function of genetic material underpinning all organisms.[80] Approximately, 10% of the human genome is made of bits of virus DNA. Mostly, this viral DNA is not always harmful. In some cases, researchers have found that actually it has a beneficial impact. When viruses infect us, they can embed small chunks of their genetic material in our DNA.[81] The viral content of human genomes is more variable beyond our imagination. Millions of years ago, into the primordial genetic material of our progenitors, parts of human DNA are of viral origin were inserted and have been inherited by successive generations. Thus, the genomes of modern humans are not thought to vary much. Human endogenous retroviruses (HERV) are by far the most common virus-derived sequences in the human genome and mobile DNA shows a mechanism that has introduced more inter-individual variation in HERV content between humans than previously appreciated.[82] Ben L. Calif informs, "The Human Genome Is Full of Viruses and Your body requires viruses, but viruses do not always require a body."[83]

On genetic and immune resistance mechanisms

It is reported in a chapter entitled "Genetic Resistance to Coronavirus Infection – A Review" where researchers have organized their review of genetic resistance to coronaviruses according to those three host resistance mechanisms: genetic control at the level of the, cellular receptors, macrophage and acquired immunity. However, they would like to stress that those "levels" are purely operational boundaries. In reality, a host

can be infected with a virus several times during its lifetime, and thus all available innate and immune resistance mechanisms will be called into play at once. Furthermore, they have included a general outline of the methods used to identify host resistance genes in mouse models of infection.[10] SARS-CoV-2 is the etiological agent responsible for the pandemic COVID-19 outbreak and the main protease (Mpro) of SARS-CoV-2 is a key enzyme that plays an important role in helping in viral replication and transcription which is the structure-based design of antiviral drug candidates targeting the SARS-CoV-2 Mpro.[84] Once the virus infects the host cell, it takes over the host cell's machinery to produce more viruses. The host cell essentially becomes a virus factory. When the human body is attacked by germs, the immune system kicks into gear to fight off the assault. Germ fighting white blood cells in the body are called up to destroy the intruder. These cells target specific sites on the virus, working to destroy the infection. Furthermore, a healthy person's immune system creates a blueprint of the attacking agent. With this blueprint, the body effectively remembers the germ enabling a person to fight for reinfection by the same or similar viruses.[85]

On traditional medicine

In the evolution of human history shows the evidence that people are using traditional medicine for therapeutic purposes. The reports from the WHO claim that 70–80% population is primarily dependent on animals and plant-based medicines because of limited or no access to medical services. The drugs obtained from wild plants and animals are not only used as traditional medicines but also as raw materials in the formulation of modern allopathic and herbal preparations.[14,86] It is reported that as an internal treatment, the innate response of the patient's immune system to the presence of an invading microorganism has been studied, highlighting anti-microbial peptides as the host's own defense molecules which shows a compilation of the most relevant and current antimicrobial peptides that could be used as potential therapeutic agents against microorganisms located in the skin and related to acne disease.[87] The WHO, Africa welcomes innovations around the world including repurposing drugs, traditional medicines, and developing new therapies in the search for potential treatments for COVID-19 and the people of Africa deserve to use medicines tested to the same standards as people in the rest of the world and the therapies are derived from traditional practice and natural, establishing their efficacy and safety through rigorous clinical trials is critical.[88]

On human immunomics initiative (HII)

Vaccination has four components for successful implementations; knowing the vaccine target, what kind of immune response, how to generate that response, and understanding responses in the people who we want to vaccinate. HII aims to decode the underlying mechanisms and rules of how the human immune system fights disease with advances in computing and artificial intelligence, genomics, systems biology, and bioinformatics.[89] And should follow the guideline of the WHO entitled "Vaccine-preventable diseases and vaccines."[90] It is reported that long-stay stress in emergencies can be responsible for this condition in a case study of Tako-Tsubo cardiomyopathy disease which shows that, that is why it is so important to Reduce Wait Time in the emergency as much as possible.[91] Harmonized clinical trials are aimed to accelerate licensure and distribution by the public-private partnership and platform.[92] Because recently, it is known that without effective control measures, strong outbreaks are likely in more humid climates and summer weather will not substantially limit pandemic growth.[93]

On nature of binding

SARS-CoV-2, the coronavirus that causes COVID-19, enters human cells by binding of its viral spike protein to the membrane-bound form of them aminopeptidase angiotensin-converting enzyme 2 (ACE2).[10,11,94] Studies in animals have suggested that angiotensin-converting–enzyme (ACE) inhibitors and angiotensin-receptor blockers (ARBs) may upregulate ACE2 expression,[95] thus increasing the availability of target molecules for SARS-CoV-2. Ultimately, one or more randomized

trials will be needed to answer definitively the question of whether ACE inhibitors or ARBs pose harm to patients with COVID-19.[96] The T cells-immune warriors help us fight some viruses, but their importance for battling SARS-CoV-2, the virus that causes COVID-19 has been unclear and the two studies disclose infected-people harbor T-cells that target the virus – and may help them recover and, both studies also found some people never infected with SARS-CoV-2 have these cellular defenses, most likely because they were previously infected with other coronaviruses.[97]

On epitopes

It is reported that a panel of seven murine monoclonal antibodies was raised against particles of okra leaf curl virus, and serological relationships and epitope profiles of isolates of okra leaf curl geminivirus,[98] which causes the same disease in cassava or tomato in different continents have different epitope profiles but occur in the same geographical area show a general similarity in epitope profile[99] with little diversity.[100]In the cowpea mosaic virus has been evolved as an expression and presentation system to display antigenic epitopes derived from a number of vaccine targets including infectious disease agents and tumors and these CVPs could constitute a cost-effective and safe alternative to live replicating virus and bacterial vaccines which have now been generated and their immunogenicity examined in a number of animal species.[101] In a chapter reports the ability of African medicinal spices and vegetables to tackle malignant diseases. The likely mode of action of reported extracts and compounds included induction of apoptosis, coupled to cell cycle arrest either in G0/G1 or between G0/G1 and S-phases in cancer cells, disruption of the mitochondrial membrane potential, generation of reactive oxygen species as well as activation of caspases enzymes.[102] It is proved to exert various health favorable effects, including blood cholesterol reduction in animal models by cowpea seed β-lignin, a vicilin-like globulin which showed: (i) Differing glycosylation patterns of the two constituent polypeptides, in agreement with amino acid sequence features; (ii) the seed accumulation of a gene product never identified before; and (iii) metal binding capacity of the native protein, a property observed only in few other legume seed visions.[103]

On viral nanobiotechnology

It is an emerging and fascinating field, dealing with the use of virus-based nanoparticles as templates and/or building blocks to display novel molecular moieties with specific properties for a wide range of applications in biology, medicine, and materials science. Plant virus-based nanoparticles (VPNs-VNPs and VLPs derived from plant viruses) have been explored for several years either to express subunit vaccines or as epitope presentation systems. In the recent times, these VPNs are attracting the attention of researchers and clinicians due to their several attractive features such as size range (nanometer), relative structural stability, the high degree of symmetry, polyvalency, monodispersity, noninfectious, and nonhazardous nature when injected to mammals, low cost of production, and biocompatibility. VNPs and VLPs can readily be engineered chemically and genetically to carry targeting ligands, therapeutic antibodies, and imaging agents and drugs on their exterior and interior surfaces. This review aims to summarize important plant virus-based nanomaterials (icosahedral and helical shaped) that have been developed for imaging, drug delivery, and therapeutic applications.[104]

Most applied suggestions-okra as potential biomedicines against COVID-19

Here, the results and discussion fulfill the goal for the research suggestions because the present study needs to justify future research and to present the practical methods, in which the proposed study should be conducted. The plans for conducting research are governed by standards of the results in which the solutions or problems reside, therefore, the guidelines for research proposals are more exacting and less formal than a general project proposals or suggestions.

Suggestion-I

In biomedicines, the plant virus, Okra YVMV, and OELV, may be used in vaccine formulations

to regulate immune function against coronavirus, which has been developed as antigenic epitopes derived from the vaccine targets COVID-19 infectious epidemic disease agents, and the CVPs could represent a cost-effective and safe alternative to live replicating coronavirus vaccines. Moreover, it may be effective by the humoral and cellular immune responses generated by these CVPs following both parenteral and mucosal delivery and highlight the potential of CVPs to elicit protective immunity from COVID-19 infection.[101,102] These plant virus-based nanoparticles are attracting the attention of researchers and clinicians for imaging, drug delivery, and therapeutic applications.[104] Here, vaccination or treatments is the use of remedies against diseases either earlier in an epidemic or given routinely to prevent diseases. When the latter is used it involves mostly the users just like any conventional vaccination, which administers the antigen in an inactive state to gain immunity toward the disease and is given before the onset of disease or disease symptoms in an individual as a prevention rather than cure.[105] It is obligatory that information on ClinicalTrials.gov, a resource provided by the U.S. National Library of Medicine (NLM), to the National Institutes of Health (NIH) or other agencies of the U.S. Federal Government, is provided by study sponsors and investigators, and they are responsible for ensuring that the studies follow all applicable laws and regulations.[89,106,107] It is also studied, the cost-effectiveness of emergency care interventions, in low- and middle-income countries like India.[108] However, it will not only be cost-effective but also easily available and prepare able as well as and safe alternative to live replicating COVID-19 vaccines.

Suggestion-II

The okra fruits (fresh or cooked) may be consumed as biomedicines at 100 g (one cup) twice daily (during taking meal) for at least 6-weeks, against naturally occurring coronavirus infections 45-days before the symptom onset OR illness onset (as a vaccine) OR onset of symptoms (if possible) associated COVID-19 infections have been reported (treatments).[15,74,109] The edible biomedicine-okra may also be directly personal-used for "Clinical trial or as a Vaccine" after getting permission from the; WHO, ClinicalTrials.gov., U.S. NLM, and NIH.[89,106,107] It is the most cost-effective, easily-available, safe-edible, and easily-prepare able as well as and safe alternative to live replicating COVID-19 vaccines.[108]

Planned to publish suggestions

For current outcomes and therapies on coronavirus disease (COVID-19) outbreak that helps the readers as well as a scientific community to take measures or treatment opportunities or discovery of vaccines to avoid new coronavirus. Our main goal is to limit infections. Let us all take this basic information's as proposal and also educate people, help them to fight against this war, the normal life of everyone is on hold due to this escalating coronavirus emergency, which in a way helps all the scientist, readers, authors, and editors to take necessary and respective steps to save or avoid this dangerous disease. I request all to support this initiative and help to reach the targeted audience. Moreover, it also focuses the future "Innovative Journal of Medical Science Globally" which serves as an evidence-based resource covering various experimental disciplines of medicine, innovative case reports in all clinical practices, and acts as an indispensable source to access the pharmacological developments and provides a platform for young/upcoming scientists and future researchers to share/explore their research on Diagnosis and Therapies in Complementary Medicine, Integrative Medicine, and Traditional Medicine.[110-113] Moreover, it also deals with articles related to the translational research or investigations in all medical disciplines, epidemiological studies, and general topics of interest to the biomedical research community.

Suggestions emergency applications

Okra-based healthy diet and greater prevention against COVID-19

Eating okra based healthy diet with Vitamin D is very important during the COVID-19 pandemic because affect our body's ability to prevent,

fight, and recover from coronavirus infections by improving supporting immune systems which is reported in the "Genome Biology and Evolution," these genetic changes may have sharpened the body's defenses against the pathogens.[15-22,108,114-116]

Okra-based vaccines offer several advantages

Conventional vaccines though effective, have high production costs, involve tedious purification processes, and have biosafety issues, requiring time-consuming biosafety tests for commercial production. Plant-based vaccines and antibodies offer several advantages over the conventional systems such as ease of production, storage, higher yields, stability, and safety.[2,14,88,91-93,97,101,102,117-120]

Emergency potential applications of vaccines and antiviral personalized drugs

There is a massive international effort underway to develop diagnostic reagents, vaccines, and antiviral drugs in a bid to slow down the spread of the disease and save lives, with a rapid supply of vaccines and antiviral drugs for the emergency manufacturing and application against COVID-19,[108,121] by inducing a potent immune response through both humoral and cellular components of the immune system.[13,14,122,123]

Okra emergency use as cost-effective personalized-biomedicine social vaccine

Okra should be used as a potential emergency care cost-effective personalized-biomedicine "Social-Vaccine" because it resists and change unhealthy pandemic social and economic structures and useful metaphor for health promotion,[13,14,63,108,122-124] because ancient microbial arms race sharpened our immune system[116] and the SARS-CoV-2 genome with other beta-coronaviruses can provide useful information on how drugs targeting other coronaviruses may improve outcomes for COVID-19 patients.[125] Moreover, the WHO and other international organizations have set up a system to accelerate and equitably distribute vaccines, the COVID-19 vaccines global access (COVAX) Facility[1-7,126,127] for preventing any controversy.

Future approach in research

It will be achieved from typical analysis or justifications of literature review, research articles, specifies hypotheses, backgrounds, problems, brief review of the key literature, reports of clinical research trials or fields, note of any relevant controversies or disagreements in the trials or field, important references and data or conclusions from the work, extensive discussion of relevant literature, as well as present investigation results. Emphasize the new and important aspects of the experimental findings and the conclusions that follow from them which is useful to clarify the main findings, then explore possible mechanisms or explanations for these findings, compare and contrast how the research is different from previous reporting and how the observations will significantly advancement of the current problem or knowledge of the subject, state the limitations of the study. Emphasis on claiming priority of work has not been completed. Then, new hypotheses will arise and clearly label them as such trials for education and prevention are the ultimate keys to extending good health and nutrition globally.[15-25,28-56,66-68] In the future, "Amaranth" may not only be "Economical Catch Crop" against various pathogens in agriculture but also "Potential Cost-Effective Green-Economical Social-Vaccine Biomedicine against COVID-19 with Safe and Elicits Significant Immune Responses", and it resists and change unhealthy pandemic social and economic structures.[1-7,35,65-68,123-127]

CONCLUSIONS

Intercropped okra could serve as a good "Eco-Friendly Resistance Vegetable or Highly Economical Plants as well as Biomedicines" and "Healthy Okra Diet Greater Prevention against COVID-19," thereby reducing different plant diseases. It conserves our biodiversity contributing towards "Sustainable Climate Health and Development" and it has important economic implications in agriculture to fulfill its food and nutrition requirement and improved midday meals by preventing malnutrition. Moreover, highly-trace-tolerance-okra may be

used, in vaccine formulations or treatments, as one of the most powerful potential-biomedicine, improving natural immunity against COVID-19, enriching science and technology communication applications food security economy. It is the most cost-effective, easily-available, safe-edible and prepare able-"Social-Vaccine" as well as and safe alternative to live replicating COVID-19 vaccines which restarts, a window of hope and opportunity opens for nations to green their recovery the 21st-century economy in ways that are clean, green, healthy, safe, and more resilient. In future, "Amaranth" may not only be "Economical Catch Crop" against various pathogens in agriculture but also "Potential Cost-Effective Green-Economical Social-Vaccine Biomedicine against COVID-19 with Safe and Elicits Significant Immune Responses," and it resists and change unhealthy pandemic social and economic structures.

ACKNOWLEDGMENTS

I thank World Vision of India, Burdwan, for making a well-protected nutritious garden and I am thankful to the eminent Senior Consultant Physician and Cardiologist Dr. TusharKantiBatabyal, M.B.B.S., M.D., Ex-Clinical Tutor of the Burdwan Medical College and Hospital, for inspiration and guidance. I express my deep gratitude to Mr. Rakesh Khan, Secretary and Mr. Subhendu Bose, President with all Young Green-Members of the "International NGO named Burdwan Green Haunter and Students' Goal" for arranging several awareness programmed on COVID-19 with "Health Care, Biomedicines, Nutritious Food, Vaccination, Agriculture, Biodiversity Conservation and Enriching Science and Technology Communication Economy Application Issues." Last but not the least; I am thankful to the eminent educationist Sri Tapaprakash Bhattacharya for inspiration and guidance.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest. The idea was conceived by Datta SC.

REFERENCES

1. Cohen J. Controversial human challenge trials for COVID-19 vaccines gain support. In: Science COVID-19 Reporting is Supported by the Pulitzer Center and the Heising-simons Foundation, Posted Health Coronavirus; 2020. Doi: 10.1126/science.abd9203.
2. Filetti S. The COVID-19 Pandemic Requires a Unified Global Response. Berlin, Germany: Springer Science Business Media, LLC; 2020.
3. Prewitt E. Covid-19: Managing the surge. Innov Care Deli 2020;2020:1-97.
4. Cal Y, Zhang J, Xiao T, Peng H, Sterling SM, Walsh RM Jr., *et al*. Distinct conformational states of SARS-CoV-2 spike protein. Science 2020;2020:eabd4251.
5. Blumenthal D, Fowler EJ, Abrams M, Collins SR. Covid-19-implications for the health care system. N Engl J Med 2020. Doi: 10.1056/NEJMsb2021088.
6. Madhusoodanan J. Ethically troubling. University reopening plans put professors, students on edge. Science 2020. Doi: 10.1126/science.caredit.abd9178.
7. Brouwer PJ, Caniels TG, Straten KV, Snitselaa JL, Aldon Y, Bangaru S, *et al*. Potent neutralizing antibodies from COVID-19 patients define multiple targets of vulnerability. Science 2020;2020:1-14.
8. Science Daily. The Genetic Quest to Understand COVID-19: Unlocking the Genetic Code of the Novel Coronavirus Will Help us Prevent Other Diseases. American: Science Daily, Science News, University of Sydney; 2020.
9. Zhang YZ, Holmes EC. A Genomic Perspective on the Origin and Emergence of SARS-CoV-2. Cell 2020;181:223-7.
10. Buschman E, Skamene E. Genetic resistance to coronavirus infection-a review. In: Part of the Advances in Experimental Medicine and Biology Book Series (AEMB). Vol. 380. Switzerland: Springer Nature Switzerland AG, Part of Springer Nature; 2019. p. 1-11.
11. Roujian L, Xiang Z, Juan L, Peihua N, Bo Y, Honglong W, *et al*. Genomic characterization and epidemiology of 2019 novel coronavirus: Implications for virus origins and receptor binding. Lancet 2020;395:565-74.
12. Julka A. Coronavirus India News Live Updates 24 April 2020: COVID-19 Cases Soar Past 24000. Haryana: Grain Mart News; 2020.
13. Cohen J. United States should allow volunteers to be infected with coronavirus to test vaccines, lawmakers argue. Science, posted In: Health Science and Policy Coronavirus. Geneva: World Health Organization; 2020.
14. World Health Organization. Coronavirus Disease (COVID-2019) An International Randomized Trial of Candidate Vaccines Against COVID-19 Version. Geneva: World Health Organization, R&D Blueprint; 2020. Available from: https://www.who.int/blueprint/priority-diseases/key-action/novel-coronavirus/en.

15. Kochlar SI. Okra (lady finger) in tropical crops. In: A Text Book of Economic Botany. New Delhi: ANE Books; 1986. p. 263-4.
16. News Press Release. COVID-19 Impact on Okra Seeds Market Size, Share and In-depth Analysis Research Report Foresight to 2023. Marketers Media via COMTEX. News The Economic Times. Pune, India: News Press Release; 2020. Available from: https://www.marketresearchfuture.com/sample_request/7715.
17. Kumar DS, Tony DE, Kumar AP, Kumar KA, Rao DB, Nadendla R. A review on: *Abelmoschus esculentus* (OKRA). Int Res J Pharm Appl Sci 2013;3:129-32.
18. National Horticulture Board, Ministry of Agriculture, Government of India. Anonymous, Indian Horticulture Database. Gurgaon: National Horticulture Board, Ministry of Agriculture, Government of India; 2015.
19. Gemede HF, Ratta N, Haki GD, Woldegiorgis AZ, Beyene F. Nutritional quality and health benefits of okra (*Abelmoschus esculentus*): A review. J Food Process Technol 2015;6:458.
20. Sindhu RK, Puri V. Phytochemical, nutritional and pharmacological evidences for *Abelmoschus esculentus* (L.). J Phytopharmacol 2016;5:238-41.
21. Lybrate. Benefits of Okra and Its Side Effects; 2020. Available from: https://www.lybrate.com/topic/benefits-of-okra-and-its-side-effects.
22. Savello PA, Martin FW, Hill JM. Nutritional composition of okra seed meal. J Agric Food Chem 1980;28:1163-6.
23. Datta SC. Plant parasitic nematodes-an agricultural problem and its solutions. Visva Bharati Quart 2005a;11:89-100.
24. Datta SC. Bio-nematicides in the Control of Root-knot Nematode, Ph.D. Thesis. India: Visva Bharati; 1999.
25. Jatav PK, Singh K, Mathapati G, Gowda R, Karoriya S, Nalla MK. Breeding for virus resistance in okra. Int J Curr Microbiol Appl Sci 2018;7:3053-65.
26. Valipour M. Handbook of Water Engineering Problems. Foster, CA: OMICS Group; 2014. Available from: https://www.dphu.org/uploads/attachements/books/books_2627_0.pdf.
27. Valipour M. What is the tendency to cultivate plants for designing cropping intensity in irrigated area? Adv Water Sci Tech 2015a;1:1-12.
28. Datta SC, Sinhababu SP, Sukul NC. Improved growth of silkworms from effective treatment of mulberry diseases by *Acacia auriculiformis* extract. Sericologia 1997;37:707-15.
29. Datta SC. Enriched science and technology communication economy in agriculture by use of acacia sides as potential bio-agents against various pathogens. Adv Agric Hortic Entomol 2020a;2:1-13.
30. Datta SC, Datta R. Prevention and control of root-knot disease of mulberry plants using bioagents amaranth plants: Improving sericulture by protecting climate health, health and development. J Environ Sociobiol 2016;13:191-200.
31. Datta SC, Datta R, Sinhababu SP, Sukul NC. Acaciasides and root-knot nematode extract suppress *Melodogyne incognita* infection in lady's finger plants. Proc Natl Sem Environ Biol 1998;98:205-9.
32. Datta SC, Sinhababu SP, Banerjee N, Ghosh K, Sukul NC. Melodogyne incognita extract reduces Melodogyne incognita infestation in tomato. Indian J Nematol 1998;28:1-5.
33. Datta SC, Datta R. Acaciasides use as potential bio-agents against various plant pathogens. In: Khan MM, Abid M, Omer AM, Rani B, editors. New Innovations in Environmental Biotechnology. Ch. 14. New Delhi: Lenin Media Delhi Pvt Ltd.; 2016. p. 20.
34. Datta SC, Datta R. Defence resistance of okra against root-knot disease by bio-nematicides. Proc Zool Soc 2000;59:75-82.
35. Staff Reporter. Corona vaccine will be prepared from the extract of fruits of Aakashmoni plants-opinion of the researcher of Burdwan. Agnirath News, Burdwan, 2020;21:1-3.
36. Datta SC. Discovery of COVID-19 vaccine by using acaciades as a phytomedicine improving science and technology communication applications-an ideas. Open Access J Biogen Sci Res 2020;2:1-30.
37. Datta SC, Datta R. Increased silk production by effective treatment of naturally infected root-knot and black leaf spot diseases of mulberry with acaciasides. J Environ Sociobiol 2007a;4:209-14.
38. Datta SC. Mulberry disease: Problem in sericulture. Seba Newslett Environ Sociobiol 2007;4:7-10.
39. Datta SC, Datta R. Efficacy of pure compound-acaciasides A and B as potential bioagents against various plant pathogens. J Environ Sociobiol 2012c;9:17-26.
40. Sukul NC, Sinhababu SP, Datta SC, Nandi B, Sukul A. Nematotoxic effect of *Acacia auriculiformis* and *Artemisia nilagirica*against root-knot nematodes. Allelopathy J 2001;8:65-72.
41. Datta SC. Improved midday meal by using cowpea as eco-friendly crop controlling root-knot forming global, green, growth and green economy. Int J Adv Res 2019;2020.
42. Datta SC. Effects of cinaon root-knot disease of mulberry. Homeopathy 2006;95:98-102.
43. (a) Datta SC, Datta R. Liquid homeopathic medicine cinaenriches sericulture industry. J Environ Sociobiol 2006;3:55-60; (b) Datta SC, Datta R. Potentized *Artemisia nilagirica* extract Cina increases silk production and effective rate of rearing in a field trial. Hpathy Ezine 2008. Available from: https://hpathy.com/scientific-research/potentized-artemisia-nilagirica-extract-cina-increases-silk-production-and-effective-rate-of-rearing-in-a-field-trial/.
44. Datta SC. The role of Cina in the field of enriched sericulture. Hpathy Ezine 2010. Available from: https://hpathy.com/scientific-research/the-role-of-cina-in-the-field-of-enriched-sericulture/. [Last accessed on 2010 Feb 15].
45. Datta SC, Datta R. Homeopathic medicines protect

environment, health and development by controlling mulberry diseases. J Homeop Ayurv Med 2011b;1:104.
46. Datta SC, Datta R. Homeopathic medicines protect environment, health and development by controlling mulberry diseases. J Tradit Med Clin Naturo 2012a;1:104.
47. Datta SC. Enriched sericulture from effective treatment of mulberry diseases by homeopathic medicines. Adv Biochem Biotechnol 2019b;7:84.
48. Datta SC, Datta R. Homeopathic medicine Aakashmoni 200C control mulberry diseases enriching sericulture. J Curr Chem Pharmacol Sci 2012b;2:37-49.
49. Datta SC, Datta R. Efficacy of homeopathic medicine-Aakashmoni as potential bio-agent against various plant pathogens. J Biochem Pharmacol 2013;2:4.
50. Datta SC, Datta R. Control of root-knot disease of mulberry by homeopathic medicines: Aakashmoni [Mt, 30c, 200c and 1000c] prepared from the funicles of *Acacia auriculiformis*. Available from: https://hpathy.com/agrohomeopathy/control-of-root-knot-disease-of-mulberry-by-homeopathic-medicines-aakashmoni-mt-30c-200c-1000c-prepared-from-the-funicles-of-acacia-auriculiformis/. [Last accessed on 2011 Apr 06].
51. Datta SC, Das R, Chatterjee K, Mondal B, Das R. Amaranth plant: Protects climate, health and development by controlling root-knot disease. J Environ Anal Toxicol 2016;6:341.
52. Datta SC, Datta R, Sukul A, Sukul NC, Sinhababu SP. Relative attractiveness of four species of vegetable crops for *Meloidogyne incognita.* Environ Ecol 2000;18:233-5.
53. Datta SC. Possible use of amaranth as catch crop for root-knot nematodes intercropped with okra. Phytomorphology 2006b;56:113-6.
54. Datta SC, Datta R. Intercropping amaranth with mulberry for managing root-knot nematodes and improving sericulture. Sericologia 2007b;47:297-302.
55. Datta SC. Improved environment by identification of more susceptible plant between cowpea and mulberry for root-knot disease. Open Access J Environ Soil Sci 2019a;2:242-5.
56. Datta SC. Cowpea as biomedicine against COVID-19: Enriching science and technology communication. Diagn Ther Complement Tradit Med 2020d. Available from: https://ospopac.com/journals/All.
57. Christie JR, Perry VG. Removing nematodes from soil. Proc Helm Soc Wash 1951;18:106-8.
58. Sukul NC. Soil and Plant Nematodes. West Bengal: Board Publication Calcutta; 1987. p. 1-271.
59. Lowry OH, Rosebrough NJ, Farr AL, Randall RJ. Protein measurement with the folin-phenol reagent. J Biol Chem 1951;93:265-75.
60. Chatterjee A, Sukul NC. Total protein of galled roots as an index of root-knot nematode infestation of lady finger plants. Phytopathology 1981;71:372-4.
61. Calisir S, Yildiz MU. A study on some physico-chemical properties of Turkey okra (*Hibiscus esculenta*) seeds. J Food Eng 2005;68:73-8.
62. Das S, Nandi G, Ghosh LK. Okra and its various applications in drug delivery, food technology, health care and pharmacological aspects-a review. J Pharm Sci Res 2019;11:2139-47.
63. Datta SC. Improved science and technology communications: Barn owl act as social vaccine against COVID-19. Int J Latest Res Sci Technol 2020c;9:6-13.
64. Datta SC. Enriched school health for the effective healthcare bio-activity of barn owls. Res Rev Health Care Open Access J 2019d;3:269-75.
65. Datta SC. Enriched school environment for the effective bio-activity of barn owls. Int J Hortic Agric Food Sci 2019e;3:119-26.
66. CABI. *Amaranthus viridis* (Slender amaranth). CABI Data sheet, CAB International, Register EU Trademark. United Kingdom: CABI; 2020.
67. Baloch GM, Zafar T, Khan AG. Natural Enemies of *Abutilon*, *Amaranthus*, *Rumex* and *Sorghum* in Pakistan. Trinidad West Indies: Common Wealth institute of Biological Control; 1976. p. 69-70.
68. Srivastava A, Jaidi M, Kumar S, Raj SK, Shukla S. Association of papaya leaf curl virus with the leaf curl disease of grain amaranth (*Amaranthus cruentus* L.) in India. Phytoparasitica 2014;43:1-6.
69. Massawe PI, Mtei KM, Munishi LK, Ndakidemi PA. Existing practices for soil fertility management through cereals-legume intercropping systems Nigeria. World Res J Agric Sci 2016;3:80-91.
70. Naveed A, Khan AA, Khan IA. Generation mean analysis of water stress tolerance in okra (*Abelmoschous esculentus* L.). Pak J Bot 2009;41:195-205.
71. Habib SH, Kausar H, Saud HM. Plant growth-promoting rhizobacteria enhance salinity stress tolerance in okra through ROS-scavenging enzymes. Biomed Res Int 2016;2016:6284547.
72. Kusvuran S. Influence of drought stress on growth, ion accumulation and antioxidative enzymes in okra genotypes. Int J Agric Biol 2012;14:401-6.
73. Yu C, Wu Q, Sun C, Tang M, Sun J, Zhan Y. The phosphoproteomic response of okra (*Abelmoschus esculentus* L.) seedlings to salt stress. Int J Mol Sci 2019;1262:1-18.
74. Ware M. Benefits and Uses of Okra. England: Medical News Today Newsletter; 2019.
75. Kumar S. Okra breeding: Recent approaches and constraints. Ann Biol 2019;35:55-60.
76. Guddadamath S, Mohankumar HD, Salimath PM. Genetic analysis of association studies in segregating population of okra. Karnataka J Agric Sci 2011; 24:432-5.
77. Kumar S, Dagnoko S, Haougui A, Ratnadass A, Pasternak N, Kouamé C. Okra (*Abelmoschus* spp.) in West and central Africa: Potential and progress on its improvement. Afr J Agric Res 2010;5:3590-8.
78. Shah F, Wu W. Soil and crop management strategies to ensure higher crop productivity within sustainable

environments. Sustainability 2019;11:1485.
79. Williams SC. Humans may Harbor More than 100 Genes from Other Organisms. American: Science News; 2015.
80. Appels R, Nystrom J, Webster H, Keeble-Gagnere G. Discoveries and advances in plant and animal genomics. Funct Integr Genom 2015;15:121-9.
81. Science Daily. Our Complicated Relationship with Viruses. Science News, National Institute of General Medical Sciences. Available from: http://www.sciencedaily.com/releases/2016/11/161128151050.htm. [Last accessed on 2016 Nov 28].
82. On Biology. The viral content of human genomes is more variable than we thought. Rebecca Pearce J Dev Manag 2019. Available from: https://blogs.biomedcentral.com/on-biology/2019/01/25/viral-content-human-genomes-variable-thought/. [Last accessed on 2019 Jan 25].
83. Callif BL. The Human Genome Is Full of Viruses. Brazil: Medium, Medical Myths and Models, 2020.
84. Zhang LK, Dai W, Zhang B, Su H, Li J, Zhao Y, *et al*. Structure-based design of antiviral drug candidates targeting the SARS-CoV-2 main protease. Science 2020;2020:abb4489.
85. Burns K. The COVID-19 Disease and Our Genes. United States: A Special Post from Guest Writer Joshua Speiser; 2020.
86. The International Union for Conservation of Nature and Natural Resources, World Health Organization and World Wide Fund for Nature. Guidelines on the Conservation of Medicinal Plants. Gland, Switzerland: The International Union for Conservation of Nature and Natural Resources; 1993.
87. Gómez DM, Lone YC, Salazar LM, Trojan J. Antimicrobial peptides, novel solution for the treatment of precancerous disease acne-a review. Trends Med 2019;19:1-6.
88. World Health Organization. WHO Supports Scientifically-proven Traditional Medicine. Africa, Brazzaville: World Health Organization; 2020.
89. Sweeney C. Human Immunomics Initiative will Decode Immune System, Speed New Vaccines. Massachusetts: Harvard T.H. Chan School of Public Health News; 2020. Available from: https://www.hsph.harvard.edu/news/press-releases/human-immunomics-initiative-will-decode-immune-system-speed-new-vaccines.
90. WHO. Vaccine-preventable diseases and vaccines. Int Travel Health 2020;6:1-61. Available from: https://www.who.int/travel-advice/vaccines.
91. Bougrine R, Hdidou Y, Aissaoui H, Elouafi N, Ismaili N. Emergency stay triggered tako-tsubo syndrome: A case report and review of the literature. Glob J Med Clin Case Rep 2019;6:35-8.
92. Corey L, Mascola JR, Fauci AS, Collins FS. A strategic approach to COVID-19 vaccine R&D. Science 2020;368:948-50.
93. Baker RE, Yang W, Vecchi GA, Metcalf CJ, Grenfell BT. Susceptible supply limits the role of climate in the early SARS-CoV-2 pandemic. *Science* 2020;2020:eabc2535.
94. Hoffmann M, Kleine-Weber H, Schroeder S, Krüger N, Herrler T, Erichsen S, *et al*. SARSCoV-2 cell entry depends on ACE2 and TMPRSS2 and is blocked by a clinically proven protease inhibitor. Cell 2020; 181:271-80.
95. Soler MJ, Barrios C, Oliva R, Batlle D. Pharmacologic modulation of ACE2 expression. Curr Hypertens 2008;10:410-4.
96. John AJ, Julie RI, Beth HM, D'Agostino BR, Harrington PD. Inhibitors of the renin-angiotensin-aldosterone system and covid-19. N Engl J Med 2020;382:2462-4.
97. Leslie M. T cells found in COVID-19 patients bode well for long-term immunity. Science 2020. Doi: 10.1126/science.abc8120.
98. Swanson MM, Harrison BD. Serological relationships and epitope profiles of isolates of okra leaf curl geminivirus from Africa and the Middle East. Biochimie 1993;75:707-11.
99. Harrison BD, Swanson MM, McGrath PF, Fargette D. Patterns of antigenic variation in whitefly transmitted geminiviruses. Plarnt viruses 1997;1:88-90. Available from: https://horizon.documentation.ird.fr/exl-doc/pleins_textes/pleins_textes_7/b_fdi_55-56/010022157.pdf.
100. Hameed S, Robinson DJ. Begomoviruses from mungbeans in Pakistan: Epitope profiles, DNA A sequences and phylogenetic relationships. Arch Virol 2004;149:809-19.
101. Brennan FR, Jones TD, Hamilton WD. Cowpea mosaic virus as a vaccine carrier of heterologous antigens. Mol Biotechnol 2001;17:15-26.
102. Kuete V, Karaosmanoğlu O, Sivas H. Anticancer activities of African medicinal spices and vegetables. In: Medicinal Spices and Vegetables from Africa Therapeutic Potential Against Metabolic, Inflammatory, Infectious and Systemic Diseases. Netherlands: Elsevier Inc.; 2017. p. 271-97.
103. Ferreira FS, Capraro J, Sessa F, Magni C, Demonte A, Consonni A, *et al*. New molecular features of cowpea bean (*Vigna unguiculata*, l. Walp) β-vignin. Biosci Biotechnol Biochem 2018;82:285-91.
104. Hema M, Vardhan GP, Savithri HS, Murthy MR. Emerging trends in the development of plant virus-based nanoparticles and their biomedical applications. In: Recent Developments in Applied Microbiology and Biochemistry. Netherlands: Elsevier Inc.; 2019. p. 61-82.
105. Rajput H. Homeopathic prophylaxis: Just homeopathic vaccination or more. J Homeop Ayurv Med 2012;1:105.
106. Kaiser J. To streamline coronavirus vaccine and drug efforts, NIH and firms join. Science 2020. Doi: 10.1126/science.abc3180.
107. NIH. Clinical Alerts and Advisories/Disclaimer. U.S. National Library of Medicine, Clinical Trials; 2017. Available from: https://clinicaltrials.gov/ct2/about-site/disclaimer.

108. Werner K, Werner K, Risko N, Burkholder T, Munge K. Cost-effectiveness of emergency care interventions in low and middle income countries: A systematic review. Bull World Health Organ 2020;98:341-52.
109. Bio Spectrum. Homeopathy in Managing Viral Infections Like COVID-19. Bangalor: Bio Spectrum News; 2020.
110. Sud S. Poisoning: A perspective through cumulative toxicity. Diagn Ther Complement Tradit Med 2019; 1:1-2.
111. Shankar A, Shankar A, Shankar A. Ayurveda, a hope for diabetics. Diagn Ther Complement Tradit Med 2020; 1:6-18.
112. Paolucci T, Coraci D, Saggini R, Pezzi L, Priori F. Core stability and shoulder injury in overhead athletes: A mini review. Diagn Ther Complement Tradit Med 2019; 1:3-5.
113. Joseph TM, Mahapatra DK. Exploring the 5-lipoxygenase inhibitory potentials of gossypetin 8-glucuronide through *in silico* approach. Innov J Med Sci 2020;4:1-4.
114. Lanham-New SA, Webb AR, Cashman KD, Buttriss JL, Fallowfield JL, Masud T, *et al*. Vitamin D and SARS-CoV-2 virus/COVID-19 disease. BMJ Nutr Prev Health 2020. Doi: 10.1136/bmjnph-2020-000089.
115. World Health Organization. Coronavirus Disease (COVID-19) Advice for the Public. Available from: https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---10-august-2020. [Last accessed on 2020 Aug 10].
116. Gibbons A. Ancient Microbial Arms Race Sharpened our Immune System-but Also Left us Vulnerable. United States: MedicalRF/Science Source; 2020.
117. Parvathy ST. Engineering plants as platforms for production of vaccines. Am J Plant Sci 2020;11:707-35.
118. Science Daily. A Nanomaterial Path Forward for COVID-19 Vaccine Development. San Diego: University of California; 2020. Available from: http://www.sciencedaily.com/releases/2020/07/200715095500.htm.
119. Mani JS, Johnson JB, Steel JC, Broszczak DA, Neilsen PM, Walsh KB, *et al*. Natural product-derived phytochemicals as potential agents against coronaviruses: A review. Virus Res 2020;284:197989.
120. Drug Target Review. COVID-19 Research Hub; 2020. Available from: https://www.drugtargetreview.com/research_hub/covid-19.
121. Capell T, Twyman RM, Armario-Najera V, Ma JK, Schillberg S, Christou P. Potential applications of plant biotechnology against SARS-CoV-2. Trends Plant Sci 2020;25:635-43.
122. Aoust MA, Couture MM, Charland N, Trepanier S, Landry N, Ors F, *et al*. The production of hemagglutinin-based virus-like particles in plants: A rapid, efficient and safe response to pandemic influenza. Plant Biotechnol J 2010;8:607-19.
123. Raw I. Butantan institute: From snakes to vaccines and its destruction. Intern Med Rev 2020;6:1-14.
124. Baumi F, Narayani R, Sanders D, Patel V, Quizhpe A. Social vaccines to resist and change unhealthy social and economic structures: A useful metaphor for health promotion. Health Promot Int 2009;24:428-33.
125. Back S. SARS-CoV-2envelope protein identified as target for antiviral drugs. Front Cell Infect Microbiol 2020. Available from: https://www.scienceboard.net/index.aspx?sec=sup&sub=gen&pag=dis&ItemID=1076. [Last accessed on 2019 Jul 27].
126. Kupferschmidt K. Vaccine nationalism threatens global plan to distribute COVID-19 shots fairly. Science 2020. Doi: 10.1126/science.abe0601.
127. Martin YH. Oxford COVID-19 Vaccine Shows Real Promise. United Kingdom: Newsletter, Medical News Today; 2020.