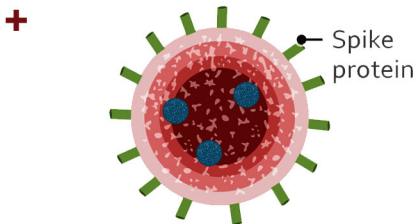
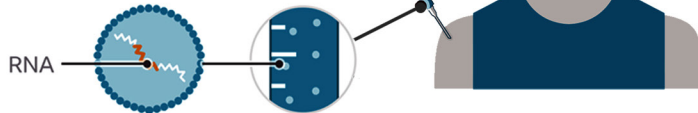


Everyday SCIENCE For Schools

Volume 8, Number 2, 2021

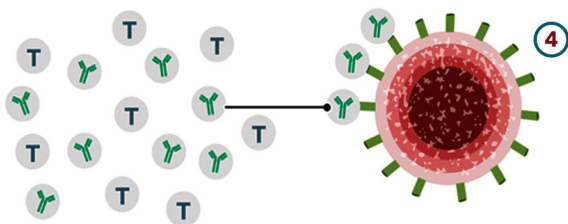
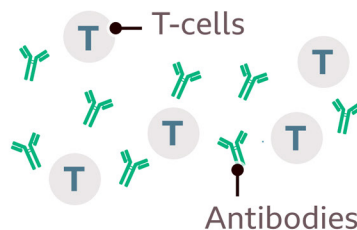
How an **RNA Vaccine** Works

- ① Scientists take part of the virus's genetic code and turn it into a vaccine that is injected into the patient.



- ② The Vaccine enters the cells and tell them to produce the coronavirus spike protein.

- ③ The body's immune system reacts, produces antibodies and activates T-cells to destroy cells with the spike protein.



- ④ If the patient later catches coronavirus, the antibodies and T-cells are triggered to fight the virus.



Why should I take the vaccine?

“Taking the vaccine will ensure that if you get infected, you do not get sick and possibly die from the infection.”

- **Noguchi Emergency Response Team** -

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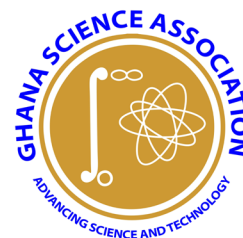
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Ghana Science Association



Introduction

The Ghana Science Association (GSA), a voluntary, non-profit making and multidisciplinary organisation of scientists, technologists and mathematicians was formed in 1959. The Association traces its origin to the West African Science Association (WASA) which was formed in 1953 at the University College of the Gold Coast. WASA was formed to provide West African scientists the forum to advocate the importance of Science and Technology as a necessity and bedrock for national development. The formation of GSA broadened the scope of activities from reading of scientific papers to involvement in national and international affairs. The Association was placed on government subvention under the Ministry of Education as far back as 1961 by a Presidential Fiat. Hence the Association is supported through a budgetary allocation from the Ghana Government. Other sources of income include membership dues and proceeds from workshops and conferences. The GSA was mandated to promote, popularize and demystify science and create a scientific culture in the country. The Association has made tremendous contributions to National Development, Health and Economic Growth through scientific interventions. The Secretariat is a point where scientific and technological information and research findings are

obtained by individuals and corporate bodies.

Membership of the Association is drawn from the Universities, Research Institutes, Industry, Government and Persons interested in the promotion of Science and Technology.

Vision and Mission

Vision

To become a dominant voice in Science and Technology advocacy by promoting and popularizing Science and Technology to meet national developmental needs.

Mission

Advancing Science, Technology, Engineering and Mathematics (STEM) through interaction and cross-fertilization of ideas of all interested people to: -

1. Popularize, promote and disseminate scientific information and technology transfer for national development.
2. Contribute to the development of National Science and Technology policy.
3. Collaborate with industry to set national research agenda.
4. Establish linkages with industry to promote the transfer and application of Science.
5. Seek affiliation and foster

cooperative links with other national and international organizations.

Activities

1. Organization and participation in scientific conferences, workshops, seminars, symposia, public lectures, quizzes and science fairs.
2. Promotion of career development of scientists in Universities and Research Institutes in Ghana and elsewhere.
3. Publication of the scientific journal, magazines and books (e.g. Journal of the Ghana Science Association and Everyday Science for Schools magazine).
4. Training programmes for mathematics and science teachers to improve the teaching and learning of these subjects in schools and colleges of Education

Contribution to National Development

Issues of national importance have been regularly and consistently highlighted at biennial workshops, conferences etc. Communiqués had been submitted to Government and other stakeholders on very topical themes to help shape national policies.

ESS Articles

Biochar and Agroforestry: A Panacea to Mitigate the Climate Crisis

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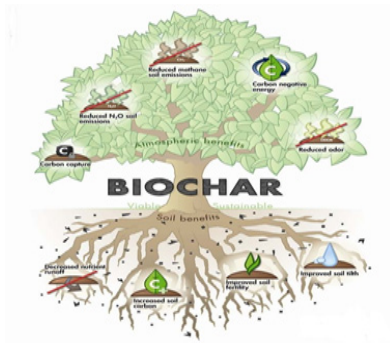


Figure 1: Shows how biochar mitigates climate change

Introduction

Agroforestry is a set of land management techniques involving the combination of multipurpose trees with crops and/or with livestock, in accordance with local traditions.

The International Centre for Research in Agroforestry (ICRAF) is a centre of science and development excellence that harnesses the benefits of trees for people and the environment. It is leveraging the world's largest repository of agroforestry science and information and developing knowledge practices to ensure food security and environmental sustainability.

ICRAF is the only institution that does globally significant agroforestry research in and for all of the developing tropics.

Biochar and agroforestry have beneficial effects on climate

By growing, plants absorb carbon dioxide producing biomass that contains carbon. Rather than allowing unused plants to decompose and emit

carbon dioxide, pyrolysis (heating in oxygen free condition) converts about half of the plants' carbon into solid form. The resulting product called biochar is used as an ecological soil amendment for both soil health and carbon sequestration.

Sustainable biochar systems are carbon negative by transforming the carbon in biomass into stable structures which remain trapped in soils for thousands of years. Biochar therefore acts as a carbon sink allowing a net reduction of carbon dioxide in the atmosphere.

A report from IPCC in 2018 on global warming noted that biochar is credited as a promising negative emission technology for large-scale carbon sequestration (www.ipcc.ch/report/sr15).

Agroforestry has the potential capacity to contribute to climate change mitigation and adaptation by reducing threats and enhancing agricultural landscape resiliency, facilitating species movement to more favourable conditions, sequestering carbon and reducing greenhouse gas emissions. One of the strengths of agroforestry is the opportunity it affords to provide adaptation and mitigation services in an integrated and synergistic manner (Duguma et al., 2014).

When agroforestry is combined with biochar it is possible to maximise the benefits regarding livelihood of the local people together with the conservation of biodiversity.

Thomas and Gale (2015) showed that 41% increase in tree biomass on a mix of temperature and tropical trees with

higher effect on tropical trees where the increase can reach up to 300%.

Biochar and agroforestry have a positive impact on associated crops

Research has shown that the application of biochar between 5 to 10 tonnes per hectare, increases crop productivity from 50% to 200%. Just one application provides and maintains long-lasting soil fertility benefits that enhance carbon sequestration.

Beyond carbon sequestration, biochar offers numerous other benefits:

- i. Soil fertility: Biochar can improve soil fertility, stimulating plant growth, which then absorb more CO₂ in a positive feedback effect. It enhances the soil biological activity, increases the pH of acidic soils, improves nutrient and water retention in soils, and increases organic matter.
- ii. Reduced emissions from feedstocks: Converting agricultural and forestry waste into biochar can avoid CO₂ and

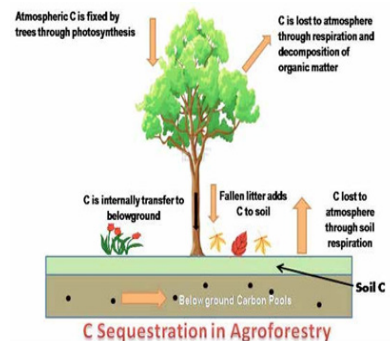


Figure 2: Carbon sequestration in agroforestry

methane emissions otherwise generated by natural decomposition or burning the waste.

- iii. Reduced fertilizer inputs: Biochar can reduce the need for chemical fertilizers, resulting in reduced emissions of greenhouse gases from fertilizer manufacture and use.
- iv. Reduced emissions from agricultural soils: Biochar can reduce emissions of nitrous oxide (N₂O) and methane (CH₄), two potent greenhouse gases released by cultivated soils.

Agroforestry and biochar are contributing greatly to help Reducing Emissions from Deforestation and Forest Degradation (REDD+).

The model also helps optimize the income of the local farming communities by advising them on climate-smart farming with the optimum mix of crops and trees.

One aim is to massively scale up restoration of degraded and destroyed ecosystems as a proven measure to fight the climate crisis and enhance food security, water supply and biodiversity.

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***Parkia biglobosa* and its importance in Northern Ghana**

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Figure 1. *Parkia biglobosa* tree

Introduction

Parkia biglobosa is also known as the African locust bean and it is a deciduous tree with a dense, wide, spreading and umbrella-shaped crown consisting of heavy branches. It can grow from 7 - 20 metres, with exceptional specimens to 30 metres. The usually straight and cylindrical bole is often short, with branches produced low down and can be up to 130 cm in diameter. A taproot is often present, with lateral roots spreading up to 10 metres, occasionally 20

metres, from the bole.

African locust bean is a very important multi-purpose tree in Northern Ghana and they are commonly gathered from the wild for local use as food, medicine and to provide a wide range of commodities. The tree is often planted in and around villages for its many uses, whilst it has also become widely planted in Agroforestry systems throughout the tropics, where it provides shade and shelter for the other crops.

Cultivation details of *Parkia biglobosa*

Parkia biglobosa is found naturally in the drier lowland tropics at elevations below 600 metres and can adapt to a wide ecological range. It grows best at temperatures within the range 28 - 40°C, but then again can tolerate temperatures between 8 - 44°C. It prefers a mean annual rainfall in the range mm, but tolerates mm. It prefers a strongly seasonal climate with a dry

season of 4 - 8 months. It grows best in a sunny location and in well-drained, deep, sandy to loamy cultivated soils, but can also be found on shallow, skeletal soils and thick laterites. They also do well in a pH between 4.5 - 5.5. The plant has a deep taproot system and an ability to restrict transpiration, this gives it the capacity to withstand drought conditions once it is established. Seedlings may reach a height of 1 metre within the first year, and young trees of superior provenances can reach 7 metres tall in 6-year-old plantations. Trees start flowering at 5 - 7 years while still comparatively small. They reach their maximum height after 30 - 50 years, and can reach an age of 100 years.

Parkia biglobosa can be propagated by seed or vegetative propagation

Uses of *Parkia biglobosa* in Northern Ghana

- i. Edible food: The pods contain a sweet, yellow, farinaceous pulp surrounding the seeds. This pulp can be eaten fresh or made into sweetmeats and drinks. It contains up to 29%

crude protein and up to 60% saccharose, is rich in vitamin C and high in oil content. The pulp also yields a flour that is much used in parts of Africa. Seeds are fermented to make dawadawa, a black, strong-smelling, tasty food high in protein. Dawadawa is rich in protein, lipids and vitamin B2. The seeds are roasted and ground into a powder for use as a coffee substitute. Young pods are sometimes roasted on embers and eaten. Leaves are edible but not commonly eaten. They are sometimes eaten as a vegetable, usually after boiling and then mixed with other foods such as cereal flour. Young flower buds are added to mixed salads.

- ii. Medicinal: The bark is used as a mouthwash, vapour inhalant for toothache, or for ear complaints. It is macerated in baths for leprosy and used for bronchitis, pneumonia, skin infections, sores, ulcers, bilharzia, washes for fever, malaria, diarrhoea, violent colic and vomiting, sterility, venereal

diseases, guinea worm, oedema and rickets, and as a poison antidote. Leaves are used in lotions for sore eyes, burns, haemorrhoids and toothache. Seed is taken for tension, and pulp for fevers, as a diuretic and as a mild purgative. Roots are used in a lotion for sore eyes. An alcoholic extract of crude seeds showed anti-hypertensive activity and contractile effect on smooth muscles of the intestine, and increased the tonus and mobility of the uterus. The bark, leaves and pod husks are rich in tannins, which in general have anti-diarrhoeal activities.

- iii. Agroforestry Uses: A useful windbreak and shade tree. Soils under the tree are improved by its leaf fall. It is common practice to grow several crops such as maize, cassava, yams, sorghum and millet under the canopy.

Other Uses of *Parkia biglobosa*

- i. Pods and roots contain fibres and are used as sponges and as strings for musical instruments.
- ii. Twigs are used to clean the teeth

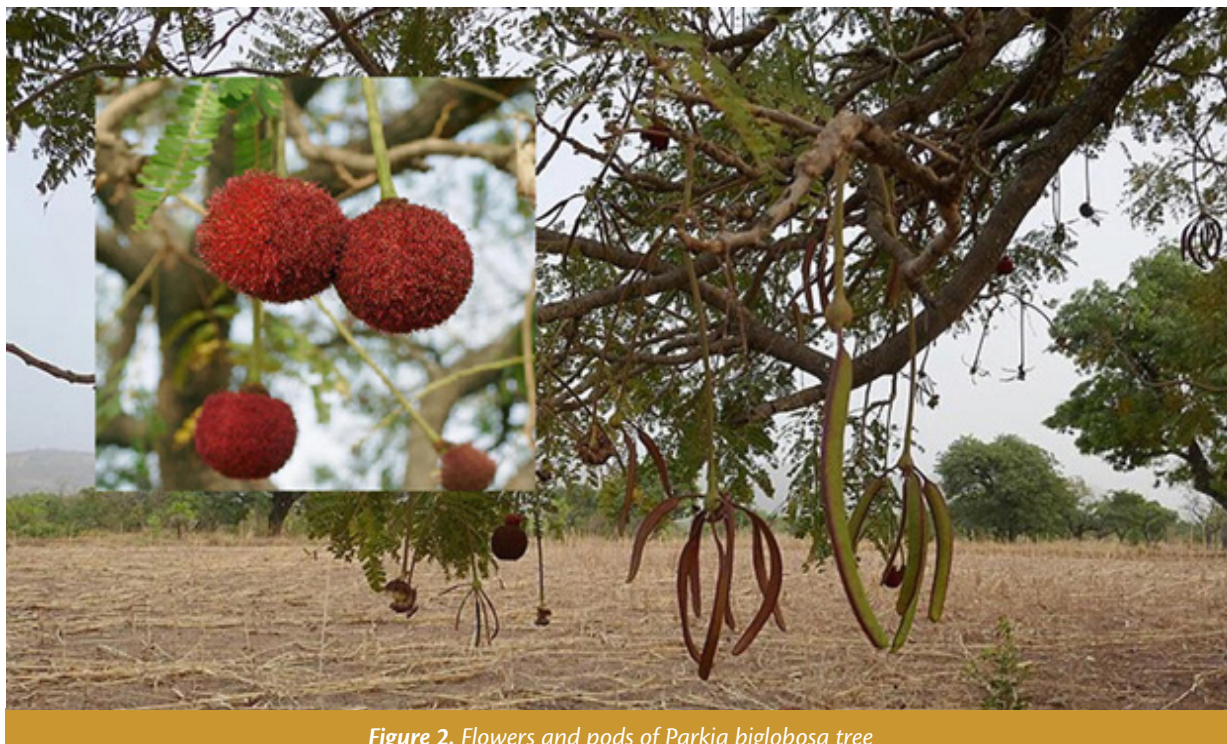


Figure 2. Flowers and pods of *Parkia biglobosa* tree

The bark stains the mouth red and also contains saponins that clean the teeth.

- iii. A mucilage obtained from part of the fruit is made into a fluid and used for hardening earth floors and to give a black glaze in pottery.
- iv. The fruit pods are used to produce an insecticide powder, which is added to water and sprayed on crops.
- v. The husks of pods, mixed with indigo, improve the lustre of dye products.
- vi. The boiled pods are used to dye pottery black.

- vii. The ash is applied as a mordant.
- viii. The seeds and bark are a source of tannins.
- ix. The wood ashes are used as a source of potash in making soap and indigo dye.
- x. The branches are sometimes lopped for firewood.

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Figure 3. Seeds of *Parkia biglobosa*

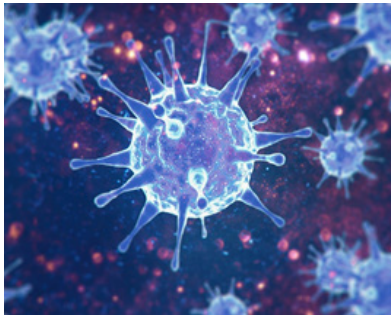


Figure 3. Different uses of Parkia biglobosa (Adopted from Houndonougbo et al., 2020).

The role of Traditional Foods in the Management of COVID-19 Pandemic

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Introduction



Coronavirus disease (COVID-19) is a global pandemic which is being managed through precautionary measures such as washing of hands, social distancing, mask wearing, sanitization of hands and surfaces, and maintenance of good diet or nutrition as recommended by World Health Organization (WHO). Though trials for vaccines are still ongoing and a promising vaccine has been recently found, some parts of the world are experiencing what seems to be a second wave of the disease. The Centre for Disease Control and Prevention (CDC) has reported new variants of the virus that appear to be more contagious in some countries. Due to the novel nature of the coronavirus, more research is required to completely understand the virus. Existing evidence suggests that the only sustainable way to survive in the current situation is to strengthen the immune system.



More than 2,500 years ago, Hippocrates said: "Let food be thy medicine and medicine be thy food". Proper nutrition cannot therefore be underrated in our robust fight against the deadly novel coronavirus, COVID-19. An adequate intake of zinc, iron, and vitamins A, B 12, B6, C, and E is essential for the maintenance of immune function as they help to destroy free radicals, boost white blood cells and support the body's natural immune response.

Traditional foods are nutritious foods prepared from locally produced food ingredients, and are responsible for growth, provision of energy for physiological functions, and protection of the body against diseases. World Health Organization recommends eating lots of fruits and vegetables, reduced fat, sugar and salt intakes, and regular exercise as paramount measures to stay healthy. Consumption of the following traditional fruits, vegetables and spices will provide an individual with the needed vitamin C, zinc and equally important biochemical molecules needed to build strong immunity against this coronavirus disease.

Fruits

Guava



Guavas have a higher vitamin C content

than any other more commonly available citrus fruit. Consumption of just one cup of guavas, you will get 628% of your daily need of vitamin C. Vitamin C has been shown to reduce the duration of disease and increase the rate of recovery in COVID-19 patients.

Avocado



Avocados are good sources of the trace mineral, zinc which is essential for wound healing and reduction in the duration of colds. Zinc is vital for the proper functioning of the immune system.

Orange



Citrus fruits, without any doubt, contain significant amounts of vitamin C. Just one orange can provide you with about 100 mg of vitamin C, which is 130 percent of daily recommended intake. Consuming oranges daily is a good way of building

your immune system against diseases.

Papaya (pawpaw)



One large papaya is packed with 235 mg of vitamin C -- that's two to three times more than the recommended daily allowance -- and is an excellent source of vitamin A, potassium, and calcium.

Mango



Mangoes are rich sources of vitamin A, B6 and C, and copper, potassium and magnesium for the maintenance of the body. One cup of sliced mango provides 60.1 mg of vitamin C. This is most of a person's daily requirement, according to the Dietary Guidelines for Americans.

Watermelon










Eating watermelon regularly boosts one's immune system by supplying vitamin C and A, Calcium, Phosphorus, Magnesium, Potassium and some equally important bioactive compounds. A cup of watermelon balls weighing around 154 grams (g) provides 12.5 milligrams (mg) of vitamin C, or between 14% and 16% of a person's daily needs.

Cashew apple



Cashew apples have been found to contain high amount of vitamin C; about ten (10) times that of citrus crops (orange), and some other minerals like potassium, phosphorus, magnesium, iron and zinc required for maintaining robust immunity against diseases.

Table 1: Health benefits of some other traditional fruits

Traditional Fruit	Nutrients/ Health benefits
Soursop 	Vitamin C, fiber, minerals, antioxidant and anti-inflammatory properties, fights bacteria
Tiger nut 	Calcium, Vitamin C and E, proteins, limits risk of cardiovascular diseases, antioxidant properties
Sugarcane 	sodium, potassium, calcium, magnesium and iron, boost immune system, improves blood flow and digestion, relief stress
banana 	Vitamin C, minerals, aids digestion, promotes skin health
Pumpkin 	Vitamin A, minerals, boost immunity, antioxidant properties
Coconut 	Mn, Fe, Cu, antioxidants, fiber, formation of red blood cells, protect the body against free radicals
Velvet tamarind 	Vitamin C, Calcium, antioxidant properties, cures gastric ulcers

Vegetables

Chili and Bell peppers



Veggies can be great sources of vitamin C, too. One medium red bell pepper has about 152 mg of vitamin C. Green bell peppers don't have quite as much—just 95 mg per one medium pepper, but that's still about 130 percent of your daily recommended intake. Eat them raw or roasted. Chili peppers Can you handle the heat? Well then, chili peppers are another great option. There are 64 mg of vitamin C in one tiny pepper, which is nearly the entire daily recommendation. If you don't mind working up a sweat, eat two to get you past that 75 mg mark.

Tomato



The vitamin C content of 100 g of tomato is about 23 mg, which is about 25% of the daily value. It also has considerable amount of vitamin A, B-vitamins, K and minerals such as iron, potassium, magnesium, zinc, phosphorus and many others for protection against diseases and maintenance of skin integrity.

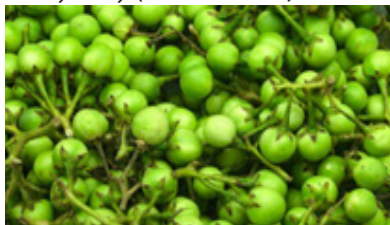
Amaranthus leaves

Amaranthus leaves are popularly called Aleefu in Ghana, and it is reported to be a rich source of beta-carotene, calcium, iron and vitamin C



for the body. These nutrients are very good for mopping free radicals and boosting the immune system.

Turkey berry (kwahu nsusaa)



It contains significant amount of vitamin A and C, iron, calcium and other phytochemicals for protecting the body against diseases.

Cocoyam leaves (Nkontomire)



Nkontomire is one of the immune system booster green leafy vegetables in Ghana. It has vitamins B1, B3 and C, magnesium, potassium, zinc, and phosphorus which will help boost your immune system effectively. One (1) cup of cocoyam leaves contains about 145 mg of Vitamin C, about 86% of our body's daily requirement.

Spices and Herbs

African Locust Bean



Popularly known as 'dawadawa' in the local dialect has shown to have

high amounts of Vitamin C and Zinc (Borquaye et al., 2017) compared with other local spices such as 'Hwentia', Nutmeg, '3soro wisa' and 'Fam wisa'. Regular addition of this traditional spice may contribute to the strengthening of the immune system. These nutrients are essential for the prevention, treatment and management of COVID-19 related symptoms.

Garlic



Garlic has been used for centuries as an immune booster and natural remedy for respiratory disorders. It contains medicinal compounds, including allicin and sulphur-containing compounds that prevent diseases. One systematic review study found that fewer people taking a garlic supplement went on to have a cold when compared to people taking a placebo. Garlic is used quite a lot in cooking, but if you're not keen on the taste, you can also buy it in supplement form.

Ginger



Because ginger is packed with antiviral compounds, it's excellent at preventing as well as treating respiratory ailments as it 'disinfects' the body. Ginger is so easy to add into your diet, as a tea or simply added freshly chopped to your food.

Cloves



Cloves are known as Dadoa Amba or Pepre in Twi, or Mbrego Amba in Fante. Cloves add a burst of flavor to foods while helping in the body's digestion. It protects the liver, prevents mutation, enhances the immune system, and improves oral health. Regular taking of cloves ensures a youthful skin.

Aniseed



Anise Seeds are known as Nkitinkiti in Twi or Osu kon in Ga. The seeds contain certain bioactive compounds such as thymol, terpineol, and anethole, which are good at relieving coughs. Incorporation of these spices can go a long way in promoting overall health and immunity.

Star Aniseed



It has an impressive source of several powerful bioactive compounds such as its shikimic acid content. Shikimic acid is a compound with strong antiviral capabilities. Currently, star anise is the primary source of shikimic acid used for manufacturing of pharmaceutical products. In fact,

it's one of the main active ingredients in Tamiflu, a popular medication for the treatment of influenza. As the influenza pandemic continues to mount as a threat to global health, the demand for star anise is on the rise. Traditionally, star anise is steeped in water to make a tea used to treat respiratory infections. The good news is that this powerful spice is readily available locally.

Eucalyptus



Add a few drops of eucalyptus oil to a bowl of boiling water (place a towel over your head to make a tent to contain steam) then close your eyes and slowly breathe in the vapors for 10 minutes. A study in the Alternative Medicine Review notes this method is effective for easing symptoms of respiratory infections, rhinitis and sinusitis. Its oil has been found to have antibacterial, antiviral and anti-inflammatory properties.

Carrots



Carrot contains considerable amount of beta-carotene; a powerful antioxidant that can reduce inflammation and boost immune function by increasing disease-fighting cells in the body. Other sources of beta-carotene include sweet potatoes and green leafy vegetables.

Seeds and Nuts



Seeds and nuts such as peanuts, cashew nuts, pumpkin seeds, sesame seeds, beans, and lentils are good sources of zinc. One serving of mixed nuts and seeds daily will go a long way in providing adequate amount of zinc intake thus enhancing immune function. The Recommended Daily Allowance for zinc is 10 mg. Zinc helps in boosting white blood cells, which defend against invaders.

Conclusion and Recommendation

Traditional or local fruits, vegetables, herbs and spices are good sources of vitamins, minerals and phytochemicals for maintaining good health and building of strong immunity against infections.

It is therefore recommended to consume our traditional foods to maintain a robust immune system, whilst observing other precautionary measures like wearing of nose mask, hand washing protocols and sanitizing of hands and objects where necessary, as are the surest ways to stay healthy and protected amidst the COVID-19 pandemic.

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Moringa: A Miracle Tree

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Introduction

Moringa oleifera tree is inherent from Asia that has being populous universally. The plant is grown around habitation and in plantation in Africa. Their plant parts such as the leaves are edible and highly nutritious. It is grown within the sub tropic and tropics and was introduced in East-Africa within the starting of the twentieth century (Foidl et al., 2001).

Uses of moringa

1. Nutritive properties: *Moringa oleifera* belonging to the family of *Moringaceae* is an effective remedy for malnutrition. Moringa is rich in nutrition owing to the presence of a variety of essential phytochemicals present in its leaves, pods and seeds. In fact, moringa is said to provide 7 times more vitamin C than oranges, 10 times more



Plate 1. Leaves of moringa



Plate 2. Powdered leaves of moringa

vitamin A than carrots, 17 times more calcium than milk, 9 times

more protein than yoghurt, 15 times more potassium than bananas and 25 times more iron than spinach. The fact that moringa is easily cultivable makes it a sustainable remedy for malnutrition. Countries like Senegal and Benin treat children with moringa. Children deprived of breast milk tend to show symptoms of malnutrition. Lactogogues are generally prescribed to lactating mothers to augment milk production.

2. Medicinal properties: *M. oleifera* is often referred to as a panacea and can be used to cure more than 300 diseases. Indians and Africans have long used Moringa in herbal medicine. The presence of phytochemicals makes it a good medicinal agent. Moringa has been shown to cure both Type 1 and Type 2 diabetes. Type 1 diabetes is one where the patients suffer from non-production of insulin, which is a hormone that maintains the blood glucose level at the required normal value. Type 2 diabetes is one associated with insulin resistance. Type 2 diabetes might also be due to Beta cell dysfunction, which fails to sense glucose levels, hence reduces the signaling to insulin, resulting in high blood glucose levels. Several studies have shown that, moringa can act as an anti-diabetic agent.

3. Renewable energy: The oil of Moringa is known as Ben or Behn oil, is comestible and can be used for cosmetics. Moreover, it is utilized as oil food preparation. Industrially, Moringa oil is a lubricant for machines, especially for fine machinery as used by

watchmakers.

4. Water purification: Moringa seeds can purify water, reducing water turbidity between 92% and 99% (Anwar et al., 2007). The purifying capacity is due to certain coagulant proteins and antimicrobial properties that are present. The coagulation mechanism is most probably by neutralizing charges of particles in the contaminated water and adsorption of these particles, causing flocculation.

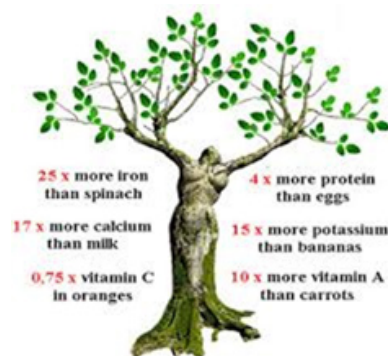


Plate 3. Nutritional value of moringa



Plate 4. Shows leaves, seeds, pod and powdered leaves of moringa

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What is Pyrolysis and its Importance in Science?

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Introduction

Pyrolysis is a thermochemical treatment, which can be applied to any plant materials (carbon-based) product. It can be done on pure products as well as mixtures. In this treatment, material is exposed to high temperature, and in the absence of oxygen goes through chemical and physical separation into different molecules. The decomposition takes place thanks to the limited thermal stability of chemical bonds of materials, which allows them to break down by using the heat.

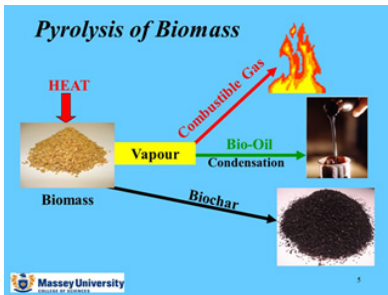


Plate 1. Shows the pyrolysis process

What influences pyrolysis process results?

Treated material composition

– each of the major constituents of biomass and waste feature different temperatures of thermal decomposition, which means they contribute to the results of the process in different ways. Due to high diversity of material compositions, it is always recommended to perform a pilot test to forecast the pyrolysis process performance in more accurately.

Temperature of process – has a major

influence on the treatment results. Higher temperatures of pyrolysis provide greater quantity of non-condensable gases (syngas, synthetic gas), while lower temperatures favor the production of high-quality solid product (charcoal, bio-coal, torrefied fuels). Temperature is a factor fully controllable in Biogreen® process thanks to electrically heated screw conveyor that allows precise setup of treatment conditions.

Residence time of material in the pyrolysis chamber – influences the degree of thermal conversion of received solid product as well as the residence time of the vapor, which influences the composition of vapors (condensable / non-condensable phase). Residence time can be precisely controlled in Biogreen process by changing the rotation speed of screw conveyor (Spirajoule) transporting material along the reactor.

Particle size and physical structure – influences the speed at which material is subjected to pyrolysis. In general, lower particle size materials are more quickly affected by the thermal decomposition, which can result in greater quantities of pyrolysis oil than in the case of larger

Types of pyrolysis

There are three types of pyrolysis: 1) conventional/slow pyrolysis, 2) fast pyrolysis, and 3) ultra-fast/flash pyrolysis.

1. Slow pyrolysis is typically used to modify the solid material, minimizing the oil produced. Fast

pyrolysis and ultra-fast (flash) pyrolysis maximize the gases and oil produced.

2. Fast pyrolysis is a rapid thermal decomposition of carbonaceous materials in the absence of oxygen in moderate to high heating rates. It is the most common of the methods, both in research and in practical use. The major product is bio-oil. Pyrolysis is an endothermic process. The feedstock must be dry; of smaller particles (< 3 mm); and typically done at atmospheric temperature with rapid quenching of the products. The yields of the products are liquid condensates – 30-60%; gases (CO, H₂, CH₄, CO₂, and light hydrocarbons) – 15-35%; and char – 10-15%.
3. Ultra-fast or flash pyrolysis is an extremely rapid thermal decomposition pyrolysis, with a high heating rate. The main products are gases and bio-oil. Heating rates can vary from 100-10,000 °C/s and residence times are short in duration. The yields of the products are liquid condensate ~10-20%; gases – 60-80%; and char – 10-15%.

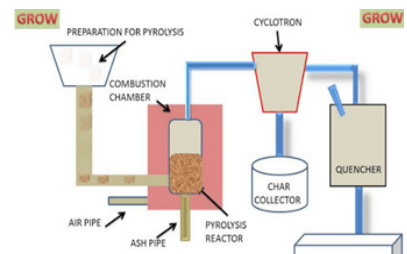


Plate 2. Shows the pyrolysis of plant biomass

Importance of Afforestation

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Plate 1. Shows planting of trees seedlings



Plate 2. Shows tree seedlings

Introduction

Afforestation refers to the process of sowing seeds or planting trees in an area that does not have trees to create a forest. Afforestation is the conversion of bare or cultivated land into forest. However, afforestation should not be confused with reforestation. Reforestation refers to planting trees in a land with a decreasing number of trees

Importance of Afforestation

1. Provide an alternative source of tree products: In today's world, the rate at which trees grow naturally in forests is much slower than the rate at which trees in forests are being cut down for production. The increased demand for tree products has put pressure on forests resulting in deforestation. Afforestation is helping alleviate the pressure on natural forests by providing an alternative source of tree products. It is mostly done for commercial purposes.
2. Increased supply of trees that are in high demand: In the commercial world, the demand is usually high for a specific type of tree. Afforestation allows stakeholders to plant the type of trees in demand, promoting the fast propagation of specific types of trees. The introduction of new supply of trees, for instance, can help to stabilize the cottage industry resulting in stable prices and business reliability.
3. Protection of natural forests: Protecting natural forests without providing alternative sources of tree products is very difficult and unsustainable. Besides, logging is more common in places where there are no alternative sources of tree products. However, when commercial tree users have alternative sources of supply, they can support the administrative and policy efforts in protecting forests, resulting in more sustainable initiatives. Protecting natural forests also leads to other benefits that come with increased tree forest cover like preservation of catchments, wetlands, and riverside zones.
4. Environmental benefits: Planting trees in a barren land is on some occasions more beneficial than planting trees in a depleted or recovering forest. Planting trees in a depleted or recovering forest helps to restore the ecosystem of the area, but planting trees in a barren land helps to create a new ecosystem. Most governments and institutions have used afforestation to help revert the arid and semi-arid areas to productive areas. It also helps improve the appearance of barren lands to picturesque areas.
5. Value addition: An easy way to transform a barren land is by planting trees. Land with trees is more attractive and valuable than barren land. Whether one is seeking to develop or sell property, planting trees is a sure way of increasing the property's value.



Importance and Limitations of Climate Models in Determining Climate Change

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Introduction

Global climate models (GCMs) use mathematical equations to describe the behavior of factors of the earth systems that impact climate. These factors include dynamics of the atmosphere, ocean, land surface, living things and ice plus energy from the sun. Sophisticated climate models include clouds, rainfall, evaporation and sea ice. Scientists extensively use mathematical models of earth's climate, executed on the most powerful computers available to examine hypotheses about past and present-day climate. Thousands of climate researchers use global climate models to better understand the long-term effect of global climate changes such as increasing greenhouse gases or decreasing Arctic sea ice.

Importance of climate models in climate change studies

The Water Cycle

Climate models help us to know how global climate influences the water cycle. Understanding variation in the movement of water through floods and drought in the region of Africa is vital because availability of water is becoming an increasingly important issue.

The ability to predict climate extremes and their impact on the availability of water is essential for implementing water management strategies that will lead to good outcomes. This is done by the comparison of data on the amount of ground water stored over different periods. This is made possible using data from the Gravity Recovery and Climate Experiment (GRACE)

satellite.

Climate and Vegetation

Potential habitats for various plant communities can be computed from the prevailing temperature and precipitation shown are the ten year mean vegetation patterns computed with climate models of different resolution; 500 km (T21), 250 km (T42) and 100 km (T106).

The HIRHAM panel (a regional climate model, version-5) shows the result of a one year simulation with high resolution (50 km) regional model, The required computation times for the comparable simulation regional and times increases as one passes through the model sequence T21, T42, T106 to HIRHAM, (a regional climate model) by a factor of about ten for each model resolution increases.

The Carbon Cycle

About one hundred billion tons of CO₂ are exchanged between the atmosphere and the ocean annually. The ocean contains sixty times as much carbon dioxide as the atmosphere. In the cold high latitudes, the ocean absorbs CO₂ from the atmosphere. The CO₂ is released again by the warm surface water at lower latitude, mainly in the Pacific. The release of CO₂ due to deforestation by burning can be clearly recognized in tropical areas. Together, the oceans and terrestrial plants take up only about half of the CO₂ produced by humans. In the Hamburg carbon model, plant growth is enhanced by an increased CO₂ content of the atmosphere. This so-called CO₂ fertilization effect presupposes, however, a sufficient supply nutrition

and water. If there are lacking, a further increase in atmospheric CO₂ will not be necessarily lead to an increase uptake by terrestrial biomass.

Global Change Research

It must be expected that the problem of climate research will continue to become more closely intertwined in the future with the general problem of global change. The problem of global warming serves as example. The simulation carried out by the DKRZ (German climate computing center) do not represent prediction in the strict sense, but only scenario computation: the climate change is computed under various assumptions about the future emissions of greenhouse gases which are freely chosen and not further justified. The results represent only one line in the chain of assessments needed by policy makers for development of effective climate strategy.

What Are the Limitations in Climate Modelling now?

It is worth reiterating that climate models are not a perfect representation of the earth's climate-and-nor can they be. As the climate is inherently chaotic, it is impossible to simulate with hundred percent accuracy, yet models do a pretty good job at getting climate right. The accuracy of models is also dependent on the quality of forecasts that go into them. For example, scientists do not know if greenhouse gas emission will fall, and so make estimates based on different scenarios of the future socio-economic development. This adds another layer of uncertainty to climate projections.

Similarly, there are aspects of future that would be so rare in earth's history that they're extremely difficult to make projections for example, is the ice sheet stabilized as it melts, accelerating expected global sea level rise. Despite models becoming increasingly more complex and sophisticated, there are still aspects of the climate systems that they struggle to capture as well as scientists would like.

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Climate A Model©Bill Leema

Can We Fix Our Health Without Fixing Our Diet?

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Introduction



According to World Health Organization, Health is a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity.

Diet is a prescribed selection of foods. This prescribed selection of foods either consciously or unconsciously affect your health and wellbeing. The food we eat provides macronutrients (protein, carbohydrate and, fats and oils) and micronutrients (vitamins and minerals) to the body, indicating that human beings are technically made of nutrients.

Basic science informs us about the formation of cells developing into tissue then to organ and organ systems. Protein is needed to build cells and repair worn out tissues. Proteins are also needed in the synthesis of hormones and enzymes. Abnormal production of hormones or enzymes affect physical, mental and social wellbeing. For instance, low production of certain enzymes may lead to food intolerance; low production of insulin may also lead to diabetes. Micronutrients are needed to aid the functioning of these cells, tissues and organs. Most



micronutrients also serve as cofactors in the functioning and production of enzymes.

A diet with inadequate micronutrients is termed “poor diet”. In other words, a poor diet is rich in sugar, salt, saturated fat and has no or low micronutrients. Poor diet influences the body to produce a lot of inflammations or free radicals, which is the genesis of diseases such as cancers, cardiovascular diseases, etc. Poor diet deprives our body of essential micronutrients needed to build a stronger immune system. The root cause of poor health is poor dietary pattern and lifestyle. A systematic review by a Lancet publication showed that poor diet is the leading cause of death and



ill-health. Poor diet is also second to smoking in the causes of cancers. Poor diet robs human potential, devastates a nation's economy and sends many to their early graves.

Prolonged deficiencies of both macronutrients and micronutrients affect cell regeneration and organ functions. As a result, it is either visibly seen as sign(s) or can only be reported by the person experiencing it as symptom(s). These signs and symptoms include dizziness, heart palpitation, diarrhoea, fatigue, loss of smell and taste, depression, irritability, insomnia, numbness, headaches, shortness of breath, anorexia, hair loss, indigestion, etc. These signs and symptoms reported



at health facilities are micronutrients deficiency, which are given ‘titles’ such as diabetes, hypertension, cancers, cardiomyopathy, etc. What do you think should be the strategy to curb and prevent these signs and symptoms?

With the most recent pandemic that hit the world, COVID-19, common complaints of clients were sore throat, tiredness, fever, running nose, loss of taste or smell, etc. Virologists made us understand that a robust immune system can make the virus succumb irrespective of the strain. Healthy immune system is empowered by eating foods rich in anti-oxidants such as vitamin C, vitamin A, zinc and other micronutrients. These micronutrients provide immunity by enhancing differentiation and proliferation of B-cells (produce and secrete antigens to destroy pathogens) and T-cells (kills infected cells and activate other immune cells), aiding the development and functioning of neutrophils and natural killer cells, building mucous barriers to trap infectious agents, and strengthening natural defenses against diseases. Food such as citrus fruits (oranges, tangerine, lemon, grapefruit), pineapple, mango, red palm oil, meat, fish, poultry, etc provide these anti-oxidants. Effective management and prevention of COVID-19 has not been

without a healthy diet.

Current evidence show that vitamin D and chromium deficiency increases risk of diabetes. Both micronutrient deficiencies have impact on insulin secretion, insulin sensitivity and developmental pathway of diabetes. Holo-chromoduline activates insulin receptors. Inability of the body to utilize insulin produced by the pancreas leads to diabetes. Low glycemic index diet and high fibre diet with or without medications have been working favourably for many people plagued with high glucose levels. The low glycemic index diets constituting whole grains, vegetables and nuts are rich in chromium. Vitamin D food sources are mushroom, yeast, fatty fish and fortified milk and milk products. Oral hypoglycemic drugs such as metformin prescribed for most people living with diabetes has been implicated in the depletion of vitamin B12. Vitamin B12 reduces homocysteine to methionine. Vitamin B12 deficiency leads to rise in homocysteine levels and that

contributes to heart disease. Vitamin B12 is abundant and strictly obtained from animal sources of food such as meat, fish, poultry, egg, etc.



People living with hypertension may present signs and symptoms like dizziness, palpitations, fatigue, shortness of breath, etc. Studies have shown that deficiency of magnesium, potassium and calcium affect the heart and blood vessels, a contributory factor to hypertension. Among other roles, these micronutrients also strengthen the heart muscles. Some medications given are potassium and calcium tablets to aid management. Are there food sources rich in these micronutrients? The answer is Yes. It then suggests that the person living

with this condition has deprived him or herself of foods rich in these micronutrients in the long term. As a result, dietary approach to stop hypertension (DASH diet) has been recommended in the management of hypertension, and has proven to be effective and independent in the management of hypertension. The DASH diet is rich in calcium, potassium and magnesium, and low in sodium.

Your current state of health hinges on what you ate yesterday or years back. As you begin to complain of certain signs and symptoms, begin to think of micronutrient deficiencies that present these uncomfortable feelings in your body. Since it is better late than never, it is also not too late to fix your health with your diet. Hippocrates (the father of medicine) said 'let your food be your medicine and your medicine be your food.' Based on the current evidence of disease patterns and management, be intentional about your diet to sustain your health.

The Green Heritage: Illegal Mining “Galamsey” As An Enemy To Our Forest Resources

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Introduction

Forests are so much more than a collection of trees. Forests are home to majority of the world's terrestrial biodiversity and a place for wild animals to breed in a large number (Brockerhoff et al., 2017). The forests, a vital green heritage is a home to many plants and animals. The forest also serves as a source of water. This water can be used for drinking once it is purified or for domestic, agricultural or industrial purposes (Ekhuemelo et al., 2016). Forests provide a habitat for soil microorganisms such as earthworms, millipedes, centipedes, termites as well as microbes- fungi and bacteria. All these living things form a complex chain where larger soil organisms eat organic debris, predators consume prey and microbes feed on the bodies of dead animals. These ecosystems are complex webs of organisms that include plants, animals, fungi and bacteria (Hesammi et al., 2014). Forests take many forms, depending on their latitude, local soil, rainfall and prevailing temperatures control (Gilliam, 2016).

Problem statement

Mining activities in Ghana form a backbone of the growth of the

economy and it is not limited to slopes of highlands and valleys but also occurs close to major rivers and streams. The mining sector is currently invaded by illegal gold and diamond miners (popularly called “galamsey” miners) (Amponsah-Tawiah & Dartey-Baah, 2011). Galamsey is mostly characterized by the illegal felling of trees, land degradation, pollution of our water bodies, mercury pollution and loss of habitats by animals and plants thereby endangering the species. These are the handiwork of individuals who use simple tools such as the pick axe, hoes and shovels. The use of the simple tools does not permit them to undertake deep mining. They thus resort to the destructive surface mining, which destroys trees and vegetation of the high forest (Eduful et al., 2020). Water pollution and destruction of vegetation are the most noticeable effects of mining. Through these activities, galamsey destroys our forest cover and livelihoods. This is due to the fact that a large amount of water is needed to wash the ores (Macháček, 2020).

Justification

Despite all the negative impacts caused by galamsey, a lot of people

are resorting to illegal mining as a source of income (Bansah et al., 2016). There is therefore the need to create awareness on what galamsey is and the risks it poses to humans as well as animals and plants (Emmanuel et al., 2018). Sensitization through the media, our traditional and religious leaders as well as governmental bodies such as the National Communication on Civic Education (NCCE) is needed.

Ecological Services of Forest

1. Soil protection

In various forest ecosystem types all over the world, forests play a critical role in building and maintaining soil fertility. Trees take up nutrients from the soil to enable their growth and return nutrients back to the soil as they decay. Forests also act to promote soil stability. This is because the complex network of tree roots present in a healthy forest, act to hold soil in place, even on steep hillsides or during heavy rainfall when soil would otherwise erode away (Hairiah et al., 2020).

2. Carbon Sequestration

Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide. It is

method of reducing the amount of carbon dioxide in the atmosphere with the goal of reducing global climate change. An enrichment of the reservoir of the sequestration of atmospheric carbon will help to reduce the effects of global warming significantly (Mandal et al., 2007).

4. **Water Purification**

The world's watershed is protected by the forest, healthy forests act as a filter to keep pollution out of water. When forests are disturbed and degraded, sediment flows into streams and pollutes water. In the world, cities and communities often rely on expensive water filtration plants to ensure clean water (Lele, 2009).

5. **Non-Timber Forest Products**

Non-timber Forest Products (NTFPs), also known as non-wood forest products, are useful materials other than timber obtained from forests. These include edible insects, honey, wild meat, medicinal plants and mushroom. Humans mostly depend on the natural forest for their livelihoods through the extraction of NTFPs (Suleiman et al., 2017).

Ecological Services of Forest

1. **Forest Land Reclamation**

Forest land reclamation is the recovery of land that was afforested before mining for the purpose of restoring productive forestry post mining land use. Ideally, it is a process of creating the best possible mine soil for trees and establishing a community of plant species that will develop without further human intervention, into a healthy forest ecosystem. Successful forest land reclamation requires that engineering, economic and regulatory constraints be balanced with biological considerations to accomplish the objectives (Macdonald et al.,

2015).

2. **Education and Sensitization**

The government and other institutions (Eduful et al., 2020) such as the NCCE in partnership with the Council for Scientific and Industrial Research- Forestry Research Institute of Ghana (CSIR-FORIG), Forestry Commission (FC) Ministry of Information but to mention a few should educate the populace through focus group discussion, radio and television announcement, seminars and Schools outreach programs on the effects of illegal mining on biodiversity and humanity.

Conclusion

Illegal mining activities should be controlled to ensure a continuous preservation of our green heritage which provides food, medicine, air, water purification and other ecological services that are vital to our livelihood. When the forest is no more, a lot of species of animals would be endangered because their habitats will be lost.

We must all endeavour to plant more trees today to save lives tomorrow because when the last tree dies, the last man also dies.

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The Impact of Climate Change on Settlement and Society

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Introduction

Climate is the long-term statistical expression of short-term weather. Climate can be defined as “expected weather”. When changes in the expected weather occur, we call this climate change.

Climate may change in different ways over different time scales and at different geographical scales.

In our current times, scientists have become interested in global warming which is causing the change in our climate. The overall state of the global climate determined by the amount of energy stored by the climate system and in particular the balance between energy the earth receives from the sun and the energy the earth releases back to space called the global energy balance.

Some of the major causes of climate change involve any process that can alter the global energy balance, and the energy flow within the climate system. Causes of climate change include changes in the earth's orbit around the sun, changes in the ocean circulation or changes in the composition of the atmosphere.

Throughout the earth's history climate has fluctuated between periods of relative warmth and relative cold. The direct records of temperature and other climatic elements span only a tiny fraction of the earth's climatic history and so provide an inadequate perspective on climatic change and the evolution of the climate today and in the future.

Rapid changes in climate from natural phenomena and anthropogenic activities have made an impact on the

earth. The impact of climate change on our society is the focus of this article.

A settlement or locality is a populated place in a community where people live. The complexity of a settlement can range from a small number of dwellings grouped together to the largest cities with surrounding urbanized areas. Settlements may include hamlets, villages, towns and cities. A settlement conventionally includes its constructed facilities such as; roads, enclosures, field systems, boundary banks and ditches, ponds, parks and woods.

A society is a group of individuals involved in persistent social interaction, or a large social group sharing the same geographical or social territory typically subjected to the same political authority and dominant cultural expectations.

Negative Impacts of Climate Change on Settlements

Climate change is almost certain to affect human settlement, large and small, in a variety of significant ways. Settlements are important because they are where most of the world's population live, often in concentrations that imply vulnerabilities to location specific events and processes and like industry and certain other sectors of concern. They are distinctive in the presence of physical capital that may be slow to change.

- **Extreme weather:** events associated with climate change pose particular challenges to human settlements because assets and populations in both developed and developing

countries are increasingly located in coastal areas, slopes, ravines. Countries where poverty and population pressure force growing numbers of people to live harm's ways on flooded plains and on unstable hillside. Unsafe buildings compound the risk of natural disasters.

- **Food security:** current assessments of the impact of climate change indicate that some regions are likely to benefit from increase in agriculture productivity while others may suffer reduction. Climate changes may increase yield of cereals grains at high and mid latitude but may decrease yield at lower latitude.
- **Air pollution:** the air is full of particles and gases such as pollen, fungal spores, and pollutants from fossil fuel emission that may affect human health. Weather conditions influence air pollution via pollution transport or formation. Exposure to air pollution has serious public health consequences. Climate change, by changing pollen production may affect timing and duration of seasonal allergies.
- **Changing precipitation patterns:** an increase in precipitation may either hurt or help agriculture, depending on when and where it happens. However, some areas may undergo a decrease in temperature, leading to less precipitation. Which may increase the risk of drought and potentially desertification. This can affect productivity in terms of agriculture. Also an increase in precipitation in an area with

poor drainage system may lead to flooding of the area which also will affect agriculture.

- Infectious diseases: insects (example mosquitoes and ticks) that are sensitive to temperature, humidity and rainfall transmit vector borne diseases. Climate change may alter the distribution of imported vector species and the risk of introducing disease into new areas. Temperature can also influence the reproduction and survival of infective agents within the vector, thereby further influencing disease transmission in areas where the vector is

already present.

Positive Impact of Climate Change on Settlements

- Warmer temperatures: the earth's average temperature is increasing. A warming climate can create an extended growing season for farmers in the mid-latitudes. Some areas can grow food species. For example, in the past, farmers in the Canadian prairies were not able to grow corn because the climate was not warm enough, but now with the warmer temperatures and

a longer growing season, many farmers are able to grow new types of crop.

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Composting: A Method for Organic Waste Management in Ghana

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The Solid Waste Situation in Ghana

Increasingly, human activities have resulted in waste generation, which has become a pressing societal problem facing humanity in these modern times. Government and stakeholders are making all possible efforts to curb and manage the waste situation in Ghana through policy implementation and waste management technologies. The municipal solid waste (MSW) generation in Ghana ranges from 0.2 kg/person/day to 0.8 kg/person/day across the geographic zones and a national average generation of waste of 0.51 kg/person/day, bulk of which is generated from households (55-80%), followed by markets and commercial Areas (10-30%) and remaining obtained from institutions, industries, street sweepings, among others. The socio-economic status of an area determines to a large extent the quantity, variety and composition of solid waste produced. Composition of solid waste generated in Ghana shows that organic waste comprises the highest fraction (Miezah et al., 2015).

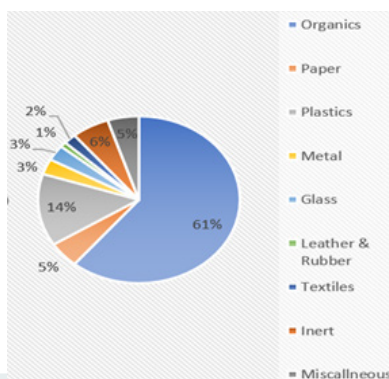


Figure 1: Composition of MSW in Ghana. Source: Miezah et al., 2015

Solid Waste Management Practices in Ghana

Solid waste management is the term used to describe the process of controlling the generation, storage, collection, transport or transfer, processing or treatment and disposal of solid waste materials such that it poses no health and environmental implications. Effective solid waste management reduces pollution considerably, keeps the environment clean as not much waste will be accumulated in the surroundings, creates wide employment opportunities, and protects the biodiversity thus protects the earth. It is preferred that solid wastes once collected be treated to recover energy or materials before final disposal in landfills. The treatment methods used depend on the quantity and composition of the waste as well its physical and chemical properties. The common treatment methods employed are recycling, composting, anaerobic digestion, incineration, pyrolysis, and gasification.

In Ghana, solid wastes are dumped uncontrolled (disposal of in gutters, streets, pits, and nearby bushes) or collected and disposed at uncontrolled dumpsites or landfills. The problems from landfills in Ghana include odour, insufficient covering material, flies and other vermin infestations and smoke from open fires. It is also becoming difficult to find land to use for disposal of solid waste as is the case facing the capital city, Accra. Waste management companies in the major cities and some towns in the country have established solid waste treatment facilities in collaboration

with government to address the many challenges facing disposal of solid waste in the country. Composting is one of the major treatment methods being employed by these companies since organic wastes dominate the waste stream.



Figure 2: Uncontrolled dumping of waste. Source: <https://www.primenewsghana.com/general-news/ama-waste.html>

What is Composting?

Composting is a solid waste treatment process whereby organic materials naturally undergo decomposition by providing the ideal conditions for detritus-eating organisms to thrive. Compost is mainly made with organic waste or animal and plant materials such as food scraps, yard waste leaves, etc. which are converted into valuable fertilizer or nutrient-rich humus that can be used to restore vitality to depleted soil or improve soil structure and provides a wide range of nutrients to support plant growth. Composts commonly contain about 2 percent nitrogen, 0.5–1 percent phosphorus, and about 2 percent potassium and are usually used as the source of fertilizers or manure for organic farming. Compost addition to clayey

and sandy soils makes it easier to plant in such soils and improves the water holding capacity of the soil (University of Illinois, 2021; Hermanova, 2019; Ross, 2018).



Figure 3: A ready compost for planting. Source: <https://www.uaex.edu/yard-garden/vegetables/compost.aspx>

The Science behind Composting

Composting process requires organic matter, moisture, warm temperature, oxygen, and microorganisms as the main components. The organic matter constituent of compost can include both animal and plant materials to supply the needed carbon and nitrogen nutrients needed in the compost. Moisture present in compost makes the organic materials become soft for easy decomposition while techniques such as aeration and turning over the compost pile, supply oxygen which supports and speeds up the breakdown of the organic materials by the actions of the decomposition microorganisms. Regular turning of the compost pile as a technique to help supply oxygen to the compost also helps control odour. In composting, decomposing microorganisms are the real workers of the compost process and in the presence of the ideal conditions of moisture, temperature and oxygen, the microorganisms breakdown the biodegradable compounds of the organic materials and as the decomposition is taking place heat is released as a natural byproduct of the

process. The rate of decomposition of organic waste materials that results in compost increases by providing the ideal environmental conditions for the active sites of bacteria, fungi and other decomposing organisms (such as worms, molds, yeast, pill bugs, centipedes, sowbugs, and nematodes). The organic-matter-decomposing microorganisms called mesophilic microorganisms which mostly function effectively and thrive in temperatures of about 20 oC to 45 oC decompose the organic materials and when temperatures rise to over 40 oC mesophilic microorganisms are replaced by thermophilic microorganisms which thrive in increased temperatures. Composting at high temperatures enables the easy breakdown of proteins, fats and complex carbohydrates and the thermophilic microbes work to breakdown these organic materials into finer pieces. Although temperature is an essential factor in composting, one needs to carefully monitor the compost so it does not get overly hot which can eventually kill off all the helpful microorganisms. Aeration is therefore important for proper decomposition which helps to keep the temperature below about 65 oC, by supplying the needed oxygen. The amount of time needed to produce compost depends on several factors, including the size of the compost pile (breaking materials down into smaller parts chipping, shredding, mulching leaves etc.), the types of organic materials and the number of times the pile is turned.



Figure 4: Worms making compost. Source: <https://www.thespruce.com/worms-escaping-from-my-vermicompost-bin-2539483>

[com/worms-escaping-from-my-vermicompost-bin-2539483](https://www.thespruce.com/worms-escaping-from-my-vermicompost-bin-2539483)

Benefits of Composting

Compost is an essential tool for improving soil structure (better aggregation, pore spacing, and water storage) and crop yield. Instead of relying on synthetic fertilizers that contain harmful chemicals, composting offers a better alternative for providing primary organic nutrients needed by plants: phosphorous, potassium, nitrogen and other traces of elements like zinc, magnesium, iron and calcium. Addition of compost to soils is shown to increase water retaining capacity of soil thereby aiding in water conservation in Agriculture. According to US-EPA, utilizing organic solid wastes to produce compost is an effective way to minimize the amount of waste disposed at landfills which reduces the release of methane gas into the atmosphere, which will also go a long way to appreciatively decrease global warming. This would also help to control odour at landfills (Hermanova, 2019; Petruzzello 2021; Natural Resource Defense Council, 2021).



Figure 5: Plant growing well in a compost. Source: <https://www.sawaal.com/general-science-questions-and-answers/plants-mainly-receive-their-nutrients-from-13110>

Types of Composting

Composting can be of many types such as large-scale composting, small-scale composting, windrow

composting, in-vessel composting, bin composting, composting using insects, and composting without insects.

Vermicomposting is a method of composting that utilizes earthworms. Worms are kept in specialized bins and made to feed on organic scraps and other plant matter. One pound of mature worms (approximately 800-1,000 worms) can eat up to half a pound of organic material per day. (Petruzzello, 2021; United States Environmental Protection Agency, 2016)



Figure 6: Types of Composting- Plant waste vs Animal manure Compost.

Source: <https://www.shutterstock.com/image-photo/pile-fresh-animal-manure-end-plowed-1072687652>

How to Make Compost at Home

Composting is a significant approach to consider for zero waste. Making a compost at home is an easy way to

repurpose kitchen scraps and other organic materials into a nutrient-rich humus that can be used to fertilize flower gardens or plants in your home. Home compost making is as easy as putting together a pile of organic waste in a secured containment in a convenient place in your yard. The organic waste materials must first be shredded into smaller sizes to speed up the composting process. Next is to regularly sprinkle water over the pile so it has a consistent moisture content that will support the effective decomposition activities of microorganisms and regularly turning the pile will provide the pile with enough oxygen to help the microorganisms to decompose organic materials faster. Aeration also prevents the compost from becoming matted down and developing odour. When the compost no longer gives off heat and becomes dry, brown, and crumbly, it is fully cooked or decomposed and ready to be fed to the garden or plants as manure or fertilizer (BH&G Garden Editors, 2020).

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Figure 7: Image of the types of composting: windrow, in-vessel, small scale, and bin composting.

Sources: <https://medium.com/@compostwindrow1/latest-published-composting-technologies-windrow-composting-msw-composting-fish-waste-c2464ec30f5c>, <https://www.prairiehogcountry.com/2019/02/07/in-vessel-composting-a-key-to-biosecurity-in-disposing-of-dead-stock/>, <https://smallfarms.cornell.edu/2012/10/compost-power/>, <https://www.diynetwork.com/how-to/outdoors/gardening/how-to-make-compost>

Symptoms, Signs and Control of Some Plant Diseases

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What is a plant disease?

A plant disease is a disturbance which is caused by some causal agents that result in an abnormal physiological process that disrupts the plant's normal structure, growth, function, or other activities. Plant diseases are broadly classified according to the nature of their primary causal agent, either infectious or noninfectious. A pathogenic organism such as a fungus, bacterium, mycoplasma, virus, viroid, nematode, or parasitic flowering plant causes infectious plant diseases. An infectious agent is capable of reproducing within or on its host and spreading from one susceptible host to another. Noninfectious plant diseases are caused by unfavorable growing conditions, including extremes of temperature, disadvantageous relationships between moisture and oxygen, toxic substances in the soil or atmosphere, and an excess or deficiency of an essential mineral. The study of plant diseases is called plant pathology. Pathology is derived from the two Greek words pathos (suffering, disease) and logos (discourse, study). Plant pathology thus means a study of plant diseases.

Diseases caused by Bacteria



Symptoms and signs

Bacterial diseases can be grouped into four broad categories based on the extent of damage to plant tissue and the symptoms that they cause, which

may include vascular wilt, necrosis, soft rot, and tumours.

Transmission and infection

In order for a bacterium to produce a disease in a plant, the bacterium must first invade the plant tissue and multiply. Bacterial pathogens enter plants through wounds, principally produced by adverse weather conditions, humans, tools and machinery, insects, and nematodes, or through natural openings such as stomata, lenticels, hydathodes, nectar-producing glands, and leaf scars.

Control

- Seed treatment with hot water at about 50 °C (120 °F).
- Use of pathogen-free seed.
- The use of bactericides
- Eradication and exclusion of host plants

Diseases caused by Fungi



Fungi cause the great majority, an estimated two-thirds, of infectious plant diseases. They include all white and true rusts, smuts, needle casts, leaf curls, mildew, sooty molds, and anthracnoses; most leaf, fruit, and flower spots; cankers; blights; scabs, root, stem, fruit, and wood rots; wilts; leaf, shoot, and bud galls; and many others.

Symptoms and signs

In general, a fungal infection can cause

local or extensive necrosis. It can also inhibit normal growth (hypotrophy) or induce excessive abnormal growth (hypertrophy or hyperplasia) in a portion of or throughout an entire plant.

Transmission

Fungi are spread primarily by spores, which are produced in abundance. The spores can be carried and disseminated by wind currents, water (splashing and rain), soil (dust), insects, birds, and the remains of plants that once were infected.

Control

The principal control measures include the use of disease-free seed and propagating stock, the destruction of all plant materials that may harbour pathogenic fungi, crop rotation, the development and use of resistant plant varieties, and the use of chemical and biological fungicides.



Nematodes parasitic on plants are active, slender, unsegmented roundworms (also called nemas or eelworms). The great majority cannot be seen with the unaided eye, because they are very small and translucent. Practically all adult forms fall within the range of 0.25 to 2 millimeters in length. About 1,200 species cause disease in plants.

Symptoms and signs

Common symptoms of nematode injury include stunting, loss of green colour and yellowing; dieback of twigs and shoots; slow general decline; wilting on hot, bright days; and lack of response to water and fertilizer.

Control

Management of nematodes is difficult. The most reliable practices are preventive, including sanitation and choice of plant varieties. You can reduce existing infestations through fallowing, crop rotation, and soil solarization. However, these methods reduce nematodes primarily in the top foot or surface of the soil.

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Nutrition among Adolescents in the Changing Trend of Obesogenic Environments

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Figure 1a



Figure 1b

Figures 1a & b: Energy-dense (junk) foods commonly sold at Ghanaian Fast-Food Outlets

Who is an adolescent?

An adolescent is an individual who falls within the ages of 10 to 19 years according to the World Health Organization. Adolescence is one of the most important stages in the life cycle as it presents a window of opportunity for the formation of lifetime habits or aversion of childhood malnutrition effects. During this stage, there are physical and physiological changes which include an increase in height, onset of puberty, sexual maturation, growth of the nervous system and increase in heart, lungs and viscera size and mass.

Adolescent Nutrition

Nutrition during this period is critical for optimal growth and development and general wellbeing as there is increased energy and nutrients requirement. In the absence of good nutrition, there may be delayed onset of puberty, poor growth and development and loss of potential. Studies have shown that poor dietary habits are usually developed during adolescence due to social interactions, curiosity and the desire to try new

things, body weight and image perception and cultural belief. It has been established that dietary patterns cultivated during adolescence usually continues into adulthood. Low consumption of whole grains, fruits and vegetables, calcium and low-fat dairy foods and high consumption of fast foods and sugar-sweetened beverages are nutritional concerns during adolescence.

Obesogenic Environment

Obesogenic environment refers to conditions of life, opportunities and surroundings which promote the occurrence of obesity (a complex disease involving excessive body fat amounts) among populations and individuals. This comprises both the built and food environments. Where the built environment refers to land use pattern, physical design and transportation systems which tend to influence levels of physical activity. The food environments on the other hand refer to the physical presence of food, accessibility to food, distribution of food and food services and any other means by which food is obtained. This

includes both homes as well as out-of-home food sources.

Adolescent Nutrition in an Obesogenic Environment

Already, the period of adolescence has been documented to be accompanied by poor eating habits such as skipping of breakfast, snacking on processed foods, low consumption of whole grains, fruits and vegetables and high intake of fast foods and sugar-sweetened beverages. Adolescents in Ghana are facing a nutrition transition which compounds this problem. Due to urbanization and its accompanying nutrition transition, there has been infiltration of the Ghanaian market with various fast-food outlets, highly processed and energy-dense foods accompanied by intense marketing. The intense advertisement of energy-dense foods and ease of access to fast food joints affects the dietary choices of adolescents, making them prone to excess energy intake. The healthy nutritious cuisine made from fresh and whole foods which promote satiation, satiety and gut health is gradually being replaced by fast and



Figure 2a



Figure 2b

Figures 2a & 2b: Images depicting a shift from a healthy food environment (right in each image) to obesogenic food environment (left in each image).

highly processed foods (junk foods). These junk foods are characterized by loads of sugar, salt, saturated or trans fats and are low in fibre, fresh and whole foods. These together with lack of physical activity largely influence the occurrence of obesity and all associated complications. These complications include type 2 diabetes, heart disease, high blood pressure, stroke, fatty liver disease, arthritis, infertility, sleeping problems, respiratory disorders and certain cancers (breast, colon and endometrial).

The desire for adventure and social acceptance during adolescence influences most people to make choices they ordinarily wouldn't have made. For instance, during festive seasons like Christmas, a group of adolescents typically dress up and go for an outing. For those in cities, the mall is the first place they head to for fun. During these trips, they eat French fries, pizza, chicken wings along with sugar-sweetened beverages for that is the "ish" on social media which they usually tag "chilling". Frequent intake of these fatty and sugary foods increases one's risk of heart diseases, poor dental health and decreases simple memory which consequently affects learning. Studies have also shown that people who eat a lot of "junk" foods are more likely to be affected by anxiety, depression

and dementia which are all forms of mental disorders.

What is the way forward?

Promoting good health and nutrition among adolescents requires a multi-sectorial approach involving the adolescents themselves, parents and caregivers, teachers, opinion and community leaders, governmental and non-governmental organisations. To attain good nutrition during adolescence in an obesogenic environment, fast food consumption should be occasional and in smaller quantities. Better still, healthy options can be chosen from fast food joints if they are available. Increasing fruit and vegetable consumption increases micronutrient intake and improves gut health. Whole foods such as whole-grain bread, brown rice and minimally processed foods can be chosen over ultra-processed foods during meal times. Keeping banana, orange, apple, mixed nuts, fresh yoghurt or avocado in hand decreases one's tendency to snack on energy-dense foods which are poor in nutrients. Even though the environment may not encourage healthy eating, the choice is yours to eat healthily.



Figure 3: Food Guide for Healthy Eating

Parents and caregivers also have a role to play by providing healthy meals and modelling healthy eating behaviour and attitudes. Healthy eating behaviours can be encouraged by making a variety of healthy foods available at home, encouraging family mealtimes and serving reasonable portion sizes. Furthermore, snacking while watching TV should be discouraged as mindless eating can cause one to overeat. Also, food should not be used as a reward or punishment.

Teachers can help by incorporating physical activity into curricular and extracurricular activities and nutrition education. Physical activity lessons with practical sessions help the students to get an avenue to exercise which is important for a healthy life.

This could be a short break for stretching or a whole hour for a variety of physical activity. Using running or any other form of physical activity as punishment discourages students from performing such activities. Thus, such forms of punishments should be refrained from. Promoting health or nutrition education by incorporating bits of healthy information into lessons for the day can increase awareness of their health, good eating habits and spark ideas about healthy living.

Local governments, community and opinion leaders can use strategies such as policies to create healthy food environments, creating parks and recreational centres and planning

settlement areas to encourage physical activity. Furthermore, effective progressive taxes can be put on energy-dense foods and their advertisement to minimize their patronage. The government may consider introducing compositional standards, tariffs, import restrictions, zoning policies or sales bans on high fat and sugary foods to reduce the volume of such foods available on the markets. Fresh and whole foods can be promoted by intense marketing and advertisement and by providing incentives for farmers to be able to reach the markets early with their goods. Fresh food supermarkets can also be established to serve areas

which do not have ease of access to fresh and wholesome foods.

Non-governmental organizations can also incorporate nutrition education and empowerment into their programmes. These activities will expose a large number of youths to healthy nutrition practices as these organisations are spread all over the country. The private sector providers of the food services should be engaged by the government to establish measures to quantify their portion sizes, drive food reformulation to eliminate trans fats and reduce saturated fats, salts and sugars.



Figures 4: An illustration of how local authorities and governments can ensure healthy eating together with businesses

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Soft Drinks: Health Facts

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Introduction

Soft drink can be defined as a class of non-alcoholic beverages that usually contain carbonated water (but not always carbonated water). They normally contain natural or artificial sweetening agents, edible acids, flavouring agents and juices. Soft drinks were first marketed in the 17th century as a mixture of water, lemon and honey. The average 330 ml can of sweetened soft drink contains about 35 g of sugar which provides 140 kcal of energy. Most of the calories in soft drinks come in the form of corn syrup or refined cane sugar. Soft drinks have little to no fibre, minerals, proteins, vitamins or other nutrients unless they have been fortified. They are available in bottles, cans or dispensing systems (Ashurst, 2009).

Health Benefits of Soft Drinks

- Soft drinks have a high amount of water and by taking soft drinks, one is drinking water which improves kidney function. Water helps the kidney

remove waste from the blood through urine. This prevents urinary tract infections which can lead to kidney damage.

- Soft drinks stimulate digestion by irritating the stomach mucosa which results in increased production of gastric juice which speeds up digestion.
- Soft drinks do not contain alcohol and this exempts one from all the discomfort alcohol brings such as diarrhea and heartburn. It also prevents stomach ulcer and brain shrinkage which are caused by excessive consumption of alcohol (George, 2012).

Potential Health Risk of Soft Drinks

- Soft drinks cause decalcification which can lead to osteoporosis. The edible acids like phosphoric acid added to some soft drinks acidifies the blood. The body in an attempt to neutralize the blood releases calcium and minerals from the bones. Calcium is needed for the absorption

of Vitamin D which provides the bones with strength. A deficiency in calcium affects the absorption of Vitamin D and this is likely to cause osteoporosis.

- They can also cause gastroduodenal ulcer and digestive disorders. Soft drinks cause irritations to the stomach mucosa which increases the production of gastric acid. Gastric acid is a strong acid and increased production of it can cause irritation and inflammation to the stomach lining leading to ulcer and general digestive disorders (George, 2012).
- Excessive consumption can result in type 2 diabetes. Soft drinks contain high levels of sugars which can cause diabetes. High levels of sugar increase the blood sugar level of the body. This puts pressure on the pancreas to produce more insulin causing insulin levels in your body to spike. This causes insulin resistance leading to type 2 diabetes (Vartanian et al., 2007).
- Soft drinks may cause dental caries. The acids and sugars present in soft drinks attack the enamel aggressively causing dental caries over time (Bassiouny and Yang, 2005).
- Soft drinks have the ability to increase the weight of an individual. They are calorie dense and excessive intake without physical exercise can cause obesity. Excess sugar in the body is converted to fats which adds up to the weight of an individual (Gibson, 2008).
- Many of the additives used in soft drinks can cause allergies, which



may manifest in several ways: skin eruptions, stomach pain and digestive disorders, nervous irritability and hyperactivity.

- Regular consumption of cola beverages increases the risk of urinary stones. This is because the beverages foster elimination of calcium and oxalates through the urine as these substances form most of the urinary stones.

Potential Health Risk of Soft Drinks

The nutritional value of soft drinks is mainly the sugar they contain and their water content. It has been reported that regular consumption of sugary drinks is associated with

several health risks. These soft drinks/ beverages cause blood sugar levels to rise rapidly, which may lead to diabetes and adverse effects on brain, kidney, and liver activity.

However, consumption of these sugar-sweetened beverages/ drinks in moderation is unlikely to have a severe effect on health.

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Edible Insects: An Alternative Food for Humans

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Figure 1: a bowl of cricket

Introduction

Entomophagy refers to the consumption of insects. It is not a new phenomenon to humans because archaeological evidence indicates that humans evolved as an entomophagous species (Raubenheimer and Rothman, 2011). For centuries now, humans have been consuming a wide range of insects from different parts of the world (Escudero-Hernández et al., 2017).

The global increase in demand for meat coupled with the limited land area available for farming has led to concerns about the sustainability of meat production. This has prompted a search for alternative protein sources. Apart from being a good protein source for human food, edible insects provide other benefits such as efficient use of land, short harvest cycles, and low greenhouse gas emissions (Van Huis, 2016).

Over 2000 insect species are consumed worldwide by humans (Jongema, 2015) mostly in Asia, Africa, and Latin America as part of their traditional diets (FAO, 2013). In Ghana, a total of 9 species of insects are consumed. These include; larvae of African palm

weevil (*Rhynchophorus phoenicis*), termites (*Macrotermes bellicosus*), ground crickets (*Scapteriscus vicinus*), field crickets (*Gryllus similis*), house cricket (*Acheta domesticus*), grasshoppers (*Zonocerus variegatus*), Locusts (*Locusta migratoria*), shea tree caterpillars (*Cirina butyrospermi*), and larvae of scarab beetle (*Phyllophaga nebulosa*) (Anankware et al., 2016).

Insects can be consumed at various life-stages; (egg, larva, pupa, or adult) and prepared in several ways such as fried, boiled, roasted, or ground. Contrary to the view that they are inferior to other protein sources, insects are a source of energy, protein, fat, minerals, and vitamins comparable



Figure 2: larvae of African palm

to meat, chicken, and beef (Rumpold and Schluter, 2013a) Studies show that crickets (*Acheta domesticus*) offer a superior source of protein than plant proteins such as soy protein (Belluco, 2013). They contain more polyunsaturated fatty acids (PUFAs) than poultry or red meat (Rumpold and Schluter, 2013a) and are also rich in iron and zinc. Protein digestibility for most insects species is between 77% and 98% (Ramos-Elorduy et al., 1997). However, Chitin which is found in the exoskeleton of insects may have anti-nutritional properties and can

negatively affect protein digestibility in some individuals (Belluco, 2013).

In the western world, there is a strong distaste for entomophagy due to factors such as neophobia, attachment to meat, familiarity, and interests in the environment (Gere, 2017). This has contributed to a biased perception that insects are food for the poor and starving (Looy et al., 2014). Studies have shown that, if insects are presented in a convenient, appropriate, and familiar form, more people may be willing to try them (Tan, Verbaan, and Stieger, 2017). Also, more education on the benefits of insect consumption can help diffuse the aversion to entomophagy.

Most insects in tropical countries are collected from their natural habitat which can lead to the destruction of the ecosystem. Examples are the harvesting of larvae of African palm weevil in Cameroon and Kenya which involves the destruction of raffia trees (Muafor, et al., 2015; Kelemu et al., 2016). Also, because most edible insects are scavenged from nature, yields are often subject to seasonal variation and climate fluctuations. Domestication of insects can however ensure a



Figure 2: larvae of African palm

continuous and consistent supply of insects for consumption (Milani et al. 2016) Farmed insects can be fed with organic byproducts such as kitchen scraps, compost, and husks and leaves of crops (FAO 2013). In Thailand, 20 000 domestic cricket farms produce an average of 7500 metric tonnes of insects annually for home consumption and the market (Hanboonsong, Jamjanya, and Durst, 2013).

Insect rearing has the potential of increasing food security as well as creating jobs for the youth in Ghana. It can serve as a cheap and healthy source of protein for all Ghanaians. The government can encourage farmers to rear insects by assisting them with capital and the necessary technologies. More education on the benefits of insects as food can also increase its consumption.

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Mosquitoes Small Bite Big Threat

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Fig 1: (a) *Culex*; (b) *Aedes*; (c) *Anopheles*

Introduction

All mosquitoes undergoes four stages in their life cycle; eggs, larvae, pupae and adult. The egg stage is the most fragile stage of the mosquito life cycle and hatch 1-3 days depending on the availability of optimum conditions. The mosquito larvae moults through four stages, 1st, 2nd, 3rd and 4th instar. After the 4th instar stage, it pupates in the space of 7-14 days at the availability of optimum water temperature and nutrition. The pupae known as tumblers does not feed but rather take oxygen through their trumpets. After a few days the mosquito adult immerge from the pupae having two large compound eyes, a thorax, a pair of scaled wings and six jointed legs. Only the female adult mosquitoes bite animals and humans and suck blood. They need the blood meal to develop their eggs. Male adult mosquitoes do not bite, but feed on nectar of flowers and other sources of sugar [1]. In addition, male mosquitoes are known to be weaker and have a shorter lifespan compared with females [2]. Female mosquitoes can live as long as a week to over a month while male mosquitoes, even in the presence of optimum environmental and nutritional conditions usually live up to a week [3]. As a rule, female mosquitoes mate before taking a first blood meal. Many mosquito species, characteristically, mate in swarms, when males aggregate in sometimes

large numbers, forming nearly-cylindrical swarms of several metres height. Females generally mate once in their lives time [4].

Mosquitoes have been reported to have 34 genera with over 2500 different species world wide of which only about 8 are of public health importance. *Aedes*, *Culex* and *Anopheles* are the three most relevant mosquito genera responsible for medically important diseases [5-7].

Aedes

Of the three mosquitoes, *Aedes* is the only diurnal genera of mosquito [8]. They usually lay their eggs indoors and outdoors in a wide variety of natural and artificial water-holding containers such as plastic tanks, water storage jars, cement tanks, flower vases, rubber tires, and plastic bottles. Destroying the breeding sites of the *Aedes* mosquitoes reduces larval development and adult mosquito population as well. Adult *Aedes* mosquitoes are distinguished from other types of mosquitoes by their narrow and typically black with white patched body, unique patterns of light and dark scales on the abdomen and thorax, and alternating light and dark bands on the legs. They are known to transmit diseases such as dengue fever, yellow fever, West Nile fever, chikungunya, eastern equine encephalitis, as well as the ever famous Zika virus. Symptoms

of Zika virus infection includes joint pain, conjunctivitis (red eyes) and muscle pain among other. Babies infected with Zika virus from their mothers at the point of delivery may present with severe birth defects such abnormally small head and abnormal brain development, vision and hearing problems and other physical deformities. Zika virus infection has not yet been reported in Ghana but in various African countries such as Gabon, Cape Verde, Senegal and Ivory Coast.



Fig 2: A baby with Zika virus infection

Very few numbers of the dengue fever have been confirmed in Ghana, however the risk of exposure remains unclear, especially since the symptoms of dengue may be confused with malaria.

Culex

Culex contains several species which

are both anthropophilic (loving to bite man) and zoophilic (loving to bite animals). *Culex* larvae are extremely ubiquitous and are found in various types of breeding sites including stagnant water pools, gutters, wells, tyre prints, footprints, pit latrine etc. *Culex* mosquitoes can vary in color, typically appearing gray with white, silver, green or iridescent blue scales. They are efficient vector of various diseases, including arbovirus infections. These infections lead to Japanese encephalitis, Western, Eastern and Venezuelan equine encephalitis, St. Louis encephalitis and West Nile virus. It also includes nematode infections which commonly causes filariasis. Protist parasites can also be transmitted by *Culex* leading to malaria in birds [9].



Fig 3: Adult males presenting with lymphatic filariasis

Anopheles

Anophelinae are found worldwide except Antarctica. Abundance and variation of anophelinae can vary over long and short distances; between neighboring continents and regions, countries and towns and breed in clear,

sunlit, temporary water bodies such as swampy areas for agriculture, foot and hoof print, gold mining sites, edges of boreholes, road side puddles, drainage ditches and other man-made shallow water bodies. The breeding site should have presence of algae, chlorophyll A and should not be too deep [10]. The larvae lie parallel to the surface of the water. They usually rest and feed with the body at an angle of 45°-75° to the surface. Diseases transmitted by the *Anopheles* includes lymphatic filariasis and malaria. As pertaining to a particular region and environment, malaria could be transmitted by different species or strains of *Anopheles* [11,12]. Approximately 80 % malaria deaths occur in Africa, where malaria accounts for about 1 in 6 of all childhood deaths [13].

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Fig 4: Various breeding sites of the malaria vector.

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SARS CoV-2 Vaccines

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Introduction

With the discovery of new strains of the virus and the rate of new infections and fatalities still logarithmic, the need for an antidote to halt the damages caused by the corona virus becomes more important every minute. For most viral infections that attained a pandemic status, the way out has dominantly been the development of a vaccine. Thousands of scientists in different laboratories globally are tirelessly working to develop vaccines to salvage the condition. Hopefully, history will once again record another inspired mind whose work will salvage billions. Corona viruses (CoV) are a family of enveloped single-stranded-RNA viruses that cause Severe Acute Respiratory Syndrome (SARS). They are named for the crown like spikes on their surfaces and belong to the family *Coronaviridae*. Corona viruses contain four major structural proteins: the spikes, nucleocapsid, membrane and envelope proteins. There are seven different CoV strains currently known to infect humans. There are also Severe Acute Respiratory Syndrome Corona viruses (SARS -CoV), Middle East Respiratory

Syndrome (MERS - CoV) and newly identified SARS-CoV-2 (for which new strains have also been discovered) which can cause lethal respiratory infections in humans. SARS-CoV-2 is the first corona virus outbreak to be characterized as a pandemic by World Health Organization (WHO).

Stages of vaccine development

As at August last year (2020), 29 candidate vaccines were in clinical evaluation stage and 138 candidate vaccines are in exploratory or preclinical evaluation stages. The Coalition for Epidemic Preparedness Innovations is working with global health authorities and vaccine developers to support the development of more vaccines for COVID-19. An antiviral vaccine helps to boost our natural immune response to an invading virus by priming it to recognize viral antigens. Generally, all the vaccines being developed can be placed under one of the following headings.

1. Inactive/live-attenuated viruses
2. mRNA-based
3. DNA-based
4. Protein-based
5. Virus-Like Particles (VLP)
6. Viral vector

Currently, a number of vaccines have been authorized for use. Among these are:

- Pfizer-BioNTech COVID-19 vaccine
- Moderna's COVID-19 vaccine
- Novavax's COVID-19 vaccine
- AstraZeneca vaccine

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COVID-19 Vaccine – Frequently Asked Questions

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Why should I take the vaccine?

Taking the vaccine will ensure that if you get infected, you do not get sick and possibly die from the infection.

What are the different types of vaccines?

- A1) Pfizer-BioNTech vaccine is a two-dose vaccine that is based on genetic material called messenger ribonucleic acid (mRNA). This genetic material is what your body uses to make the Corona virus' spike protein, which are molecules that stick out like crowns on the virus surface, hence the name "Corona" for this group of viruses.
- A2) Oxford-AstraZeneca vaccine is a two-dose vaccine that is based on genetic material (this time deoxyribonucleic acid or DNA) that makes the spike protein. This Corona virus DNA is inserted in a non-pathogenic virus (modified Chimpanzee adenovirus) for delivery into your body. Your body then uses this information to make the virus spike protein.
- A3) Moderna vaccine is a two-dose vaccine that is based on mRNA that codes for the Corona virus spike protein, similar to the Pfizer-BioNTech vaccine.
- A4) Johnson & Johnson vaccine is a single dose vaccine that is based on DNA of the spike protein, presented by a modified human adenovirus virus-vectored technology, similar to the Astra-Zeneca vaccine.
- A5) Novavax vaccine is a two-dose subunit vaccine that is based on the Corona virus Spike protein, formulated in an ingredient

known as an adjuvant that hypes the immune response to the vaccine protein.

- A6) Sputnik V vaccine is a two-dose vaccine that is based on DNA of the spike protein, presented by a modified human adenovirus virus-vectored technology, similar to the Astra-Zeneca vaccine. This vaccine uses one variant of adenovirus for the primer shot and another adenovirus variant for the booster shot. Both variants contain the same spike protein DNA insert.
- A7) Sinopharm vaccine is a single dose vaccine that is based on a chemically inactivated SARS-CoV-2 virus. This vaccine therefore uses the actually virus, but in a killed form that is not supposed to cause disease.
- A8) Sinovac vaccine is also a single dose vaccine based on the inactivated SARS-CoV-2 virus, similar in design to the Sinopharm vaccine.

Which Vaccines are being procured by Ghana for her citizens?

The Ghana Government is procuring AstraZeneca and Sputnik V vaccines for use in Ghana. These two vaccines have been given emergency use authorization by Ghana's FDA. Other vaccines are likely to also be approved and added to the list for Ghana as and when the FDA gives clearance.

What are the pro's and con's for taking the vaccination?

Pros

Taking the vaccine protects you against getting severe disease

symptoms such as shortness of breath and complications such as pneumonia upon infection. Without the vaccine, you could develop these severe symptoms and sometimes require hospitalization and artificial support to breath.

Cons

You may suffer some side effects, and some of these side effects can interfere with your daily activities for a few days.

What are some of the side-effects of taking the vaccination?

You may have some side effects, including injection site pain, swelling & redness, fatigue, headache, muscle & joint pain, chills, fever, nausea, malaise and swollen lymph nodes. Different persons may suffer some but not all of these side effects, and these are usually more pronounced after a second shot. These are however normal signs that your body is building the necessary protection and will resolve within hours and up to 3 days. These same effects are also normally seen with many other vaccines.

What can I do about the side-effects?

For common side effects such as headache, fever and joint pains, pain relievers such as ibuprofen or acetaminophen can be used to relieve your discomfort. It is however advisable to speak to your doctor for further advise, especially if you have other symptoms.

What are some of the myths concerning taking the vaccination?

Taking the vaccine will ensure that if you get infected, you do not get sick and possibly die from the infection.

- A) That the vaccine will change your DNA or genetic make-up. There is no scientific proof of this. Although the COVID-19 vaccine technologies being used have mostly not been approved for human use till now, they have been tested in both animals and humans for several years, and no such event has been reported in humans.
- B) That the vaccine can give you a COVID-19 infection or you will test positive for COVID-19 after taking the vaccine. This is not possible, once again because the vaccines do not contain the disease-causing virus. The COVID-19 infection tests look for either virus antigen or nucleic acids and therefore require the virus itself to be present in your body. You may however be positive on an antibody test, because your body will make antibodies against the vaccine after the shot.
- C) That you do not need the vaccine after you test positive for COVID-19. After testing positive and recovering from the infection, you may still need vaccination since you can be re-infected. It is not clear for how long being naturally exposed will protect you, but it may not be immediately necessary to have the vaccine for up to about 3 months. After this time, it will be necessary to take the vaccine to protect you against future infections.
- D) That vaccination protects you against being infected by the virus. This is not wholly true, as all the available vaccines have so far

been assessed for the protection they offer you against getting COVID-19 symptoms and dying from them, but not against getting infected. It is possible for you to be re-infected after vaccination and transmit the virus to others, although you may not suffer any significant COVID-19 symptoms. It is therefore important to keep observing the standard preventive protocols even after vaccination.

Visit the Ghana Health Service website for further reading (<https://ghanahealthservice.org/covid19/latest.php>)

Also visit the US CDC website for further information (<https://www.cdc.gov/coronavirus/2019-ncov/vaccines/facts.html>)

For additional information on general COVID-19 myth busters, visit the WHO website (https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/myth-busters?gclid=Cj0KCQiApY6BBhCsARIsAOI_GjapzE4ZeKv7Ay2WoRzW3S6okiC42qWl2bVO-GjutNIlls_-7NeLn8aAtqlEALw_wcB)

Are there any spiritual reasons for not taking the vaccine?

There should be no spiritual reasons why you should not take the vaccines.

What are the holistic steps that can aid the prevention of COVID-19?

- A) Prevent contracting COVID-19 by wearing an appropriate face mask when in the midst of others.
- B) Maintain a safe distance between yourself and others (at least 2 meters) and avoid crowded places.
- C) Effective hand-washing with

soap and water and use of alcohol-based sanitizers will break the cycle of contact-based transmission.

- D) Eat healthy foods and ensure adequate intake of vitamins and minerals, especially vitamins C, D and zinc, to keep your immune system working optimally.
- E) Where available, take the COVID-19 vaccine to protect yourself from falling sick.
- F) Exercise regularly and hydrate by taking water regularly to ensure sound health and an optimally working immune system.
- G) Staying away from other persons when you feel unwell with any of the classic symptoms is important to prevent spreading the infection

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- G) Staying away from other persons when you feel unwell with any of the classic symptoms is important to prevent spreading the infection

Should the holistic steps be taken alone?

It is important to observe all the steps, or multiple steps in order to keep safe. Observing some steps while ignoring others creates avenues to increase your risk of getting infected.

How can I get vaccinated?

In Ghana, four groups of persons have been described and prioritized for receiving the COVID-19 vaccines. These are;

1. Health care givers, top hierarchy of the government machinery (Executive, Parliament, Judiciary), older persons above 60 years, and persons with co-morbid conditions such as diabetes and general cardiovascular diseases who are at increased risk of having severe symptoms or dying from COVID-19 following virus infection.
2. Various groups of persons including the Ghana Armed Forces and other security services, teachers, and personnel of the media.
3. The remaining general population, except for pregnant women and children under 16 years.
4. Pregnant women and children under 16 years will only be vaccinated in the event of these or any other COVID-19 vaccines being deemed safe for them.

Who can I speak with about the vaccination?

You can speak with your GP/family doctor or any community/public health specialist about vaccination. You can also speak with any health authorities in your area.

Where can I get further information?

Further information on vaccination and related news can be obtained from the following sources

- A) WHO ([https://www.who.int/news-room/q-a-detail/coronavirus-disease-\(covid-19\)-vaccines?adgroupsurvey={adgroupsurvey}&gclid=Cj0KCQjApY6BBhCsARIsAOI_GjaHflGbkulDpHEVN5QTI3pRJBcr1RZhhg-b8ThwH-l0EWsmT_u27loaAnK5EALw_wcB](https://www.who.int/news-room/q-a-detail/coronavirus-disease-(covid-19)-vaccines?adgroupsurvey={adgroupsurvey}&gclid=Cj0KCQjApY6BBhCsARIsAOI_GjaHflGbkulDpHEVN5QTI3pRJBcr1RZhhg-b8ThwH-l0EWsmT_u27loaAnK5EALw_wcB))
- B) US CDC (<https://www.cdc.gov/coronavirus/2019-ncov/index.html>)

What if I don't take the vaccination?

Taking the vaccine is not mandatory, but it protects you and those around you from getting the infection and suffering the disease symptoms. You are therefore strongly encouraged to take the vaccine.

Can I mix the various types of vaccines?

Because of the differences in doses, the number of shots required and the vaccination schedules, it is advisable at this stage to get one type of vaccine and not mix them. Mixing of these vaccines can only be recommended after clinical trials have shown that they are safe to mix and to be given in specific quantities, a specific order and at specific times.

What if I am pregnant or breast-feeding?

Almost all the vaccines that currently have emergency use authorization have been trialled in adults 16 years and older, and did not deliberately include pregnant women and breastfeeding mothers. Although there is no data that shows that these vaccines can have any negative effects on pregnant women and breastfeeding mothers, pregnant women are not included in the current vaccination schedule in Ghana.

Will I be given a Vaccination Card?

Yes, you will receive a vaccination card, which helps you to keep track of which vaccine you have been given and when and where to get your second vaccine dose (if necessary). The card will also serve as proof of you having been vaccinated.

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