

Review

Certain roles of the Food Scientist in ameliorating food insecurity in developing countries particularly Nigeria

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Food security is highly instrumental to the economic growth and sustainability of any country. Unfortunately, food insecurity has had an adverse effect on people in developing countries of the world, especially in continents of Asia and Africa, most importantly Nigeria. In the midst of food insecurity ravaging these countries, the field of Food Science and Technology has vital roles to play in ameliorating the situation. The Food Scientist, who has obtained sound training in this field, can thus help proffer solutions, making use of technologies that could foster food security in developing countries. While the Food Scientist has important functions to perform in achieving and sustaining food security, it is evident that efforts of other stakeholders are required to ensure success of the exercise. It is important to note that efforts of the Food Scientist could be impaired in the absence of enabling environment and necessary incentives from the government. As in the developed countries, collaborations between the Food Scientist and other professionals alike are also fundamental towards realising the objectives of food security in developing countries particularly Nigeria. In the present review, certain professional inputs by the Food Scientist towards achieving food security are examined.

Key words: Food security, developing countries, Food Scientist, stakeholders, incentives, professional inputs

INTRODUCTION

Progress has been made by mankind, through agricultural and industrial stages, towards provision of goods and services. This progression has been catalyzed by the cultural and social evolution of mankind and the need to solve specific societal issues, such as the need for preservation to free people from foraging for food, and the need for adequate nutrition via consistent food supply year round (Floros et al., 2010). These forces led to the development of the food industry, which has contributed immensely to the basis for a healthy human civilization and helped society prosper and flourish (Lund, 1989).

Food security involves the availability of safe, nutritious and acceptable food for people; this has however posed serious challenges in many countries, especially the

developing countries of Asia and Africa. Along with other professions, the field of food science and technology is directly involved in ensuring food security. One of the many ways by which food insecurity could be ameliorated is in the area of composite flour utilization in the making of baked foods, thereby reducing the cost of such products (Olaoye et al., 2006; Olaoye and Onilude, 2008). The practice makes use of substitution of flours, obtainable from locally available vegetable crops, in wheat flour that is normally imported in many developing countries; this permits reduction in the quantity of wheat flour being used during production of food items. By this process the use of local vegetable crops is encouraged and could lead to increased profit margins. Such

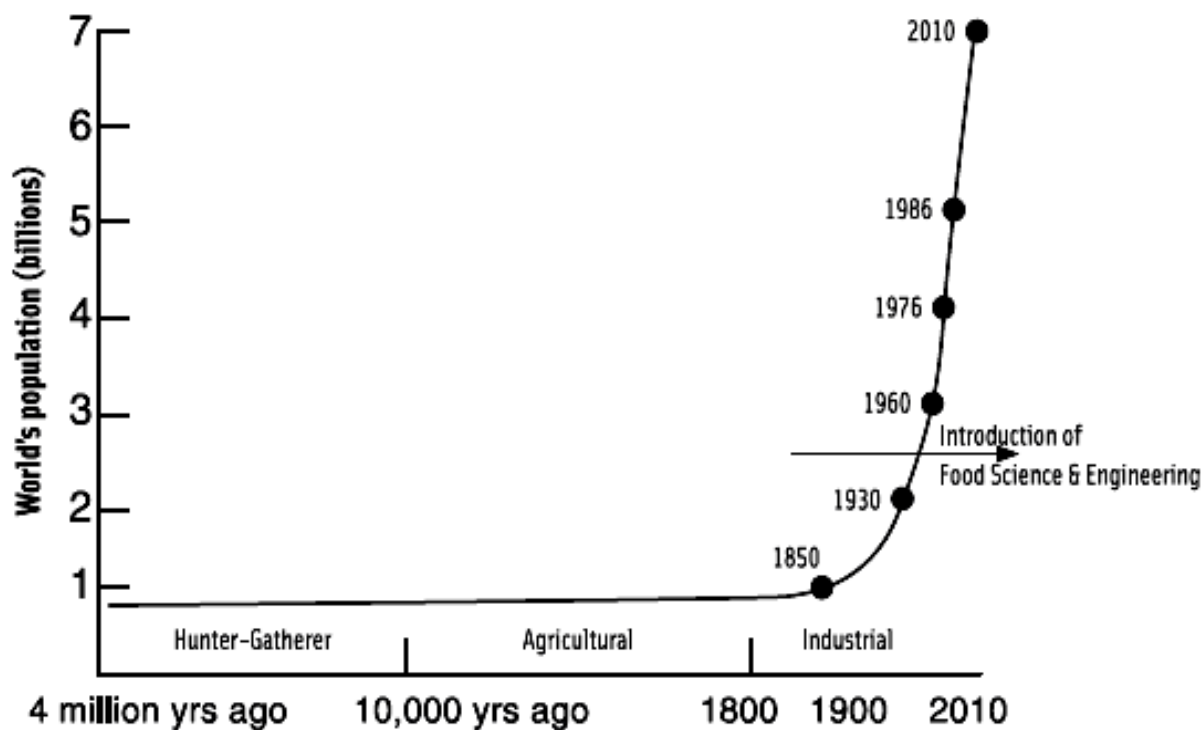


Figure 1. From foraging and farming to Food Science and Engineering (Source: Floros, 2010).

concerted efforts have been made by some researchers in partial substitution of vegetable flours, from soybeans, plantain, tigernut etc, in wheat for successful production of breads and biscuits (Olaoye and Ade-Omowaye, 2011; Udofia et al., 2013).

In this report, some of the roles of the Food Scientist in alleviating food insecurity in the developing countries, with particular reference to Nigeria, are explained. Some of the problems responsible for food insecurity, and probable solutions, are also included.

A GROWING POPULATION: THE NEED FOR FOOD

As a result of improved public health measures and modern medicine, the world population has mushroomed from an estimated 1 to 10 million in 10000 BC to an estimated 600 to 900 million in AD 1750 and an estimated 6.8 billion today. It was predicted around 1803 that population growth would inevitably outpace resource production, and therefore misery (hunger and starvation) would prevail. Undoubtedly, application of science and technology in agriculture and food manufacturing has negated these predictions and fed population growth (Figure 1). The application of science to agriculture has dramatically increased productivity, but until the Green Revolution of the 1960s and 1970s, productivity was not keeping pace with population growth. Large areas of the

world, including the 2 most populous nations, China and India, were experiencing severe food shortages and anticipating worst situations. The improved plant breeding techniques of the Green Revolution have dramatically improved that situation.

PRESERVING THE FOOD SUPPLY

Postharvest losses occur between harvest and consumption as a result of spoilage of raw agricultural commodities, primarily during storage and transportation, before they can be stabilized for longer-term storage. Postharvest losses due to rodents, insects, and microbial spoilage in some areas amount to 30% or more of the harvested crop. This results in wasted seed, water, fertilizer, and labour. Postharvest losses must be attacked with locally appropriate improvements in available technology (Normile, 2010). It is not enough merely to increase and conserve the supply of raw food; it must be conserved against further loss by processing and be packaged, distributed to where it is needed, and guaranteed in its safety, nutritional value, and cultural relevance. That is the role of science and technology and engineering in the processing of foods and beverages.

In general, food processing is applied for one or more of the following reasons: preservation (extending the harvest in a safe and stable form), safety, quality, availa-

bility, convenience, innovation, health and wellness, and sustainability.

WHAT IS FOOD SECURITY?

The word security refers to freedom or protection from danger or worry. It can also refer to measures taken to guarantee safety (Crowther, 1998). Hence, Food security can be defined as freedom or protection of food from danger or worry by the consumers of such food products. Food security can also be simply referred to as measures taken in order to guarantee the safety of foods for consumption. Food security has also been defined in terms of food availability and its accessibility to people (Olaoye and Onilude, 2010). It is believed that there can be no food security without its availability; its safety must however be guaranteed.

According to the World Food Summit organized in Rome in 1996, food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 2001). Food security, therefore, implies the provision of safe, nutritious, and quantitatively and qualitatively adequate food, as well as access to it by all people. Food security has three dimensions:

- (i) Availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports;
- (ii) Access by households and individuals to appropriate foods for a nutritious diet; and
- (iii) Optimal uptake of nourishment, clean water and adequate sanitation, together with healthcare.

Food security can also be explained in terms of the following:

Access to food

It is important to emphasise that more food production does not necessarily mean more food for those who need it. Most experts would agree that the largest part of the production increase has to come from yield increases. Current levels of agricultural productivity and production indicate little about potential levels, because they are simply a response to present levels of demand and price/market conditions. It is, however, important to note that food production is not the same as food availability, and that aggregate availability and the ability to acquire food are very different things. The yield of roots and tubers in Africa is the lowest in comparison to the other regions of the world (McGranahm et al., 1999). Whilst food production undoubtedly influences food entitlements (ability to acquire food), the connections are

complex and there are also other matters involved.

People's access to food depends both on the purchasing power of their income, and on their non-market entitlements, such as rights to land for subsistence farming and foraging purposes. Households seeking to preserve food security levels may resort to a number of coping strategies to gain access to food. These include: maintaining normal income generating patterns; adaptation by means of innovative use of available resources or some divestment of liquid assets; divestment of productive assets, such as stock or land; and out-migration and destitution.

Clearly, food insecurity is basically a problem of poverty, affecting those social groups with the weakest or most fragile food entitlements, both in terms of access to social networks and safety nets or productive assets (capital, land, agricultural inputs).

Adequacy of food supply

Agricultural output in Africa has been lagging behind population growth since the 1960s. Between 1965 and 1990, agricultural production grew at an annual rate of 1.7%, while there was annual population growth average of 2.8%. Food imports including food aid in the African region have increased substantially to offset the deficiencies, and in early 1994 represented about 10% of the food consumed. At the current growth rates, the food gap is projected to increase to more than nine times the present gap by 2020 (Agyare-Kwabi, 2003).

Acceptability of food

As a result of its agro-ecology, trade history, and position most African countries have diverse diets in terms of staple foods. This is a great advantage in terms of food security because many consumers will substitute among the five broad categories of staple - cassava, yams and tubers, plantain, millet, maize and rice - according to national and also tribal taste preferences and changing relative prices. Women have distinctive roles to play in determining the acceptability of food basically because of their traditional role as wives and mothers who cook for their families.

Ascertaining the nutritive values of food, in terms of meeting the dietary requirement of the consumer, is very instrumental to food security. Consumers must be aware of the content in the food they consume. For packaged food items, the nutritional composition must be well stated on their labels. This would afford consumers to regulate their daily dietary intake towards meeting nutritional requirement.

Adulteration of food involves substituting with inferior quality items. Such replacement of part of the food could be very hazardous and could jeopardize the nutritional

expectations of consumers. In addition, such unacceptable practice constitutes an offence to food laws. Therefore, where practicable, the Food Scientist should ensure that the practice is discouraged by taking regular quality control measures. The interest, health and requirement of the consumers must therefore be paramount in the course of implementation of food security programmes.

The Food Scientist and food security

The Food Scientist plays very vital roles in the efficient management of food security. In fact, the Food Scientist must be the first to reckon with during any food security developmental programmes, as his positive contributions towards the success of such programmes cannot be over-emphasized. The Food Scientist play many roles in food security operations and management, some of these include:

Food availability

This is a vital factor in food security, as there can be no food security without making food available. Food must be made available throughout the year, irrespective of whether the raw material for making such food is in season or not. The Food Scientist is actively involved in the processing and preservation of various food items. He adopts necessary processing techniques and preservation methods in ensuring that food is available throughout the year. Some of the methods being adopted include canning, refrigeration, drying, concentration, fermentation and radiation. Many food products have been produced through these methods and this has helped greatly in making food availability possible in Nigeria, and the world at large.

Food safety

Concerns over food safety and quality are increasing worldwide. They are of priority issues in food security for governments, food processors, industry, traders and consumers alike. The burden of food borne diseases (food poisoning, food infection, food intoxication) is significant in all parts of the world. The reported incidence of diseases as food borne hazards has increased over years and this has threatened and endangered consumers' health (Quinlan, 2013); a number of deaths has been recorded as a result (Scallan et al., 2011).

The Food Scientist adopts various measures to prevent the occurrence outbreak of food borne diseases and thus ensures safety and quality of foods. Such measures include good manufacturing practices (GMP), good hygiene practices and good nutritional practices as well as hazard analysis critical control points. When these

measures are exercised and well practiced, the safety and quality of foods will be greatly improved and the customers will be made to enjoy good food security.

Food safety depends on the good manufacturing practices earlier mentioned as well as on identifying and analyzing hazards, setting achievable standards and developing plans to monitor food quality. The Food Scientist needs to strengthen food safety and quality systems in a sustainable way and to improve conditions of food production.

Food quality control

Quality is the ultimate criterion of desirability of any food product. The overall quality of a food depends on the nutritional and other attributes, which are assessed objectively or/and subjectively. It is the duty of the Food Scientist to monitor their nutritional, microbiological, and chemical as well as other hidden qualities. This is necessary to protect the interest of the consumer by stringent controls to assure good food quality and enactment of food laws regarding inspection, grading, packaging and labeling of foods. He thus ensures that there is strict conformance with set standards by food regulatory agencies.

Quality assurance programmes and quality control laboratories are the means by which a manufacturer maintains and improves the quality of his products. Quality assurance sets the policies, standards, methods and specifications for monitoring the quality of production. Quality control is the daily (or hourly) monitoring of production for conformance to the standards and specifications set under the quality assurance systems (Sanni, 1997). The Food Scientist employs this system in ensuring food security for all.

Food nutrition/enrichment

Foods are composed of dozens or even hundreds of different kinds of substances called 'nutrients', which when consumed in adequate amounts, fulfill all the functions of the body. Six general classes or kinds of nutrients found in all foods are carbohydrates, fats, proteins, vitamins, minerals and water.

Carbohydrates make up the bulk of our diet. They are our chief source of energy. About 70% of the energy requirements for all the functions are obtained from carbohydrates. The main sources of carbohydrate in the diet are starch and sugar. Sources of starch are mainly cereal grains (maize, rice etc) or root and tubers. Fats and oils are the most concentrated form of energy in food. They furnish more than twice the number of calories per gram furnished by carbohydrate or proteins. The sources of fats/oils include germs of grains, groundnut,

butter etc.

Proteins are the major source of building material for the body. They play an important role as structural constituents of cellular membranes and function in the maintenance and repair of body tissues. The sources of proteins include meat, fish, poultry, eggs, milk, cheese etc.

Vitamins are 'accessory nutrients'. They are required for the proper utilization of the bulk food of the diet – carbohydrates, fats, and proteins, and for maintenance of good health. They may also be involved in the regulation of body processes. Vegetables and fruits are good sources of vitamins. Minerals also act as catalyst for biological reactions within the body. Their other functions include the building of bones and other structural parts of the body, muscular concentration, transmission of messages through the nervous system and the digestion and utilization of nutrients in food. Minerals are found in foods from animal and plant sources. Water is second only to oxygen in importance for the body. It is an ideal medium for transporting dissolved nutrients and wastes throughout the body.

Food must contain all the basic nutrients in required proportions. Where food is lacking in any of the basic nutrients, there may be the need to enrich such food with the nutrient that is lacking. Hence food enrichment plays an important role in ensuring food security and the Food Scientist takes up this important responsibility when necessary.

Food adulteration

Adulteration of food consists of substituting it, wholly or in part, by any cheaper or inferior substances. It can also be described as the act of removing any of food's constituents, wholly or in part, which affects adversely its quality and nature. This is an important factor in food security management. The Food Scientist can carry out some quality control tests in order to ascertain that no food has been adulterated. In cases where food tests positive to adulteration test, the law should take its full course on the manufacturer of such food product. In entirety, this bad practice should be discouraged among food processors by regulatory agencies, such as the Standard Organization of Nigeria and National Agency for Food Drug Administration and Control in Nigeria.

SOME MAJOR CAUSES OF FOOD INSECURITY

The following important factors are among those responsible for food insecurity in many developing countries, especially Nigeria:

(i) Food spoilage and infection: Spoilage of food constitutes a large percentage of the factors affecting

food security in Nigeria. Food spoils due to many reasons, of which the most important are lack of storage facilities. Where available, the required power to make them functional could be lacking (Olaoye and Ntuen, 2011). Infection of food with pathogenic microorganisms could also threaten public health if such food has not been adequately processed. The government could give necessary assistance in form of credit facilities to small scale food processors to enable them procure storage systems that would prevent food spoilage. Enabling environment should also be provided, especially in terms of power to maintain such storage systems. Food handlers should be encouraged to obtain required training on the need to observe good manufacturing practices and personal hygiene. This would help prevent or reduce possible infection by unwanted microorganisms in food.

(ii) Inadequate processing and preservation techniques: Many forms of processing and preservation methods are available which could help in promoting food security. This ensures the availability of food throughout the year. Unfortunately, due to lack of proper processing methods, the necessary techniques for food processing are not adopted, thereby leading to losses and subsequently food insecurity.

(iii) Poverty: This is a major cause of food insecurity in many developing countries of the world, most especially Nigeria. Incomes of many Nigerians are not enough to cater for their daily dietary requirements. Unfortunately, even the current minimum wage of 18,000 naira (Nigeria) is not enough to guarantee food security for the earners. In the UK, the average minimum pay is £5 per h (~ £40 per day when worked for 8 h). This has been found to be sufficient in meeting the nutritional requirement of the people in this country, even after payment for standard accommodation and other essential domestic bills.

(iv) Lack of education / training of food handlers: Lack of education and/or proper training of many food handlers may also constitute a problem in the management of food security in Nigeria. While reporting on the microbiological quality of sachet packaged water and its public health significance, Olaoye and Onilude (2009) concluded that many of the handlers and processors should be given some training to avoid contacting diseases by consumers.

Suggested ways towards ensuring food security in developing countries

The factors to be considered in order to ensure food security in developing countries, and particularly Nigeria, are inexhaustive; however, the following are suggested

as being important to be addressed:

(i) Research support: Research facilities, grants and staff welfare are of immense importance in the realization of the food security objectives in any country. Food security requires intense research to improve resistance of food crops to microbial infections and infestations by insects, rodents etc. Same is also applicable to processing and preservation of food. All these require functional and up to date research facilities. Staff welfare ranks first in achieving food security developmental plans. Situations where the meager research grants being made available to staff are diverted to personal uses should be avoided; this can only be done through promotion of staff welfare in the various academic institutions. It is unfortunate that the level of research in many countries of Africa and Asia is very poor due to lack of sufficient research support from the government and other non government organizations. As a result, many findings from such countries are not being reckoned with in advanced countries such as UK; it is claim that the findings are unreliable as a result of poor state of research facilities.

(ii) Transformation of research findings into practice: Unlike in developed countries, most research findings in institutions of learning (including the Polytechnic, Universities and Research Institutes) are not forthcoming in terms of transformation into practice in developing countries, including Nigeria. Many research findings that could assist towards ameliorating food insecurity situations have been reported (Olaoye et al., 2006; Olaoye and Onilude, 2008; Olaoye et al., 2008; Olaoye and Ade-Omowaye, 2011); yet such has not been put into any profitable use commercially.

(iii) Education/Training: This is very imperative because the basic hygiene and GMP required in producing safe and nutritious food can only be obtained through training. The training would also assist in minimizing losses commonly experienced during food production, harvesting and processing. It is suggested that people involved in food handling should be encouraged to possess a minimum certificate in the area of food hygiene, processing and/or public health. This would create awareness in terms of the necessary steps towards obtaining food that is free of contamination from unwanted materials that could constitute health hazards to consumers. It would also assist in minimizing losses during food handling operations.

(iv) Poverty: This is of serious concern as many people live below the poverty line of developing countries. A poor man can not afford good food. The government has a vital role to play towards creating enabling environment in alleviating poverty and hence promoting food security for the citizens.

(v) Job creation: Joblessness has left the people concerned with no choice than to eat whatever they find. Good policy formulations that would promote job creation should be the focus of the government in developing countries.

(vi) Good road: Losses of many agricultural produce may be attributed to bad road in developing countries, especially Nigeria. Good road networks, which can only be provided by the government, would promote transportation of food from one location to another, while minimizing losses as well.

(vii) Electricity supply: This is a catalyst to promoting research, and indeed food security. Many research and storage facilities require efficient and regular supply electricity for optimal performance. This is one of the many advantages obtainable in developed countries that assist in achieving food security.

(viii) Policy formulation: Sound policies are vital integral factors that could help in tackling the problem of food insecurity in many countries. Unfortunately, many developing countries don't have good policy formulations on developmental programmes that could foster food security. Policies aimed at encouraging the utilization of local crops and produce should be enacted. This would, overtime, assist in ameliorating the situation of food insufficiencies among the populace. For example, in 2002, Nigeria adopted a policy, compelling flour millers, to implement 10 per cent cassava flour into wheat flour. The policy was backed by improved varieties from the International Institute of Tropical Agriculture (IITA); this raised cassava production by 10 million tons between 2002 and 2008, making the country about the largest producer of cassava.

SOME EFFORTS TOWARDS REDUCING FOOD INSECURITY IN NIGERIA

Certain research efforts are being made towards solving the problem of food insecurity in Nigeria. Such efforts include the use of vegetable flours substitution in wheat as composite in the production of baked food products such as bread, biscuits etc (Olaoye et al., 2006; Olaoye and Onilude, 2008; Olaoye and Ade-Omowaye, 2011). To reduce food insecurity associated with wastages as a result of microbial spoilage of food, the use of biological agents has also been tested on meat and its products (Olaoye and Onilude, 2010; Olaoye and Ntuen, 2011); the findings were reported to enhance quality and reduce spoilage microorganisms in the food products under investigation. In a similar finding, the use of wheat, cassava and soybean composite flours were reported by Udofia et al. (2013) in the production of bread.

These efforts could lead to reduced cost in the produc-

tion of many baked food products in Nigeria, with consequent affordable prices for the masses. Such could also enhance savings in the foreign exchange usually involved in importing wheat from producing temperate countries.

CONCLUSION

The roles of the Food Scientist in ameliorating the food insecurity in developing countries are all encompassing and cannot be over-emphasized. The Food Scientist helps in the realization of the aims and objectives of the food security developmental programmes. Through his sound training, he could also help in the avoidance of major setbacks that are commonly associated with food production, especially losses due to spoilage. It is important to note that working along with other professionals in the field of agriculture, engineering etc would assist greatly in achieving food security in many developing countries such like Nigeria. Moreover, the support of the government is also required in making meaningful progress towards solving the problems of food insecurity.

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