

Special Edition
"Food Security and Food Sciences"

Mini Review

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Food Product Innovation and Food Safety: Two Vital Elements of the Global Food Security

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INTRODUCTION

Food security is one of the universally accepted and discussed current global issues of the world. Its definition informs how diverse and complicated it can be to solve this problem. It refers physical, social and economic access to sufficient, safe and nutritious food for entire population on our planet, and all the times. This sounds quite challenging task to accomplish. Food security is not merely a question of food availability, but increasingly also a question of access and even distribution of food. Globally food supply is unevenly distributed that leaves a notable proportion of the world population food insecure while others live in abundance of food. Better utilization and stability of food over time are also important aspects of food security. Now it is understandably clear that food security involves multi-disciplines (sociology, economics, political sciences, agriculture, environmental science, food science *etc*) as well as sub-disciplines (for example in case of food science; food nutrition, food microbiology, food biochemistry, food safety *etc*) to work together in order to realize the dream of global food security. Table 1 explains how different branches of food sciences could play a role.

Discipline	Role in food security
Food nutrition	<ul style="list-style-type: none"> Supply of nutritionally balanced diets Development of foods for specific population segments
Food microbiology	<ul style="list-style-type: none"> Improving shelf life of food products through fermentation Enhancement of nutritional value of the foods Foods for active and healthy life style <i>i.e.</i>, probiotics
Food biochemistry	<ul style="list-style-type: none"> Information on food composition and biochemical changes
Food processing	<ul style="list-style-type: none"> Innovative processing technologies to prolong shelf life of foods
Food safety	<ul style="list-style-type: none"> Reduction of microbial contamination Reduction of food wastage Improving shelf life of foods through control of harmful microorganisms
Food quality	<ul style="list-style-type: none"> Reduction of food spoilage and losses
Food technology	<ul style="list-style-type: none"> Innovative food products Better utilization of food ingredients Development of foods with well-defined dietary traits

Table 1: Potential role of different branches of food sciences in global food security.

Both food product innovation and food safety are important sub-disciplines that offer great potential to increase the productivity and the availability of foods. Innovative food products can enhance the shelf life or nutritive value or both of raw food ingredients. Food safety and quality management systems reduce the wastage due to spoilage as well as risk of microbial contamination. Several authors pointed out that efficient implementation and functioning of systems such as Hazard Analysis Critical Control Points (HACCP), Good Manufacturing Practices (GMP) and Risk Management Programmes (RMPs) in food industry were beneficial to save food items being wasted.^{1,2} This short article will highlight the potential role of food product innovation and food safety in future global food security.

FOOD PRODUCT INNOVATION AND FOOD SECURITY

Ensuring the availability of the foods with right nutritional benefits to the consumer is one the basic requirement of the food security. Food product innovation had played, is playing and will play a critical role to improve the bio-utilization of foods and to extend the storage period. Innovative food processing technologies are efficiently increasing the food safety and food quality. For example, High Pressure Processing (HPP) exerts a broad range of effects on different quality and safety aspects of foods and preserving the delicate nutritional elements that may lost otherwise.³ Another example that can be quoted here is the application of Pulsed Electric Field (PEF). PEF had shown efficient destruction of the pathogenic bacteria and maintained the good quality of soya milk.⁴ Some consumers face allergic reactions to specific foods, and there are lots of literature that suggest food processing technologies can help in reducing the food allergies. Iwan et al.⁵ reported that Maillard reaction could affect the immunoreactivity and allergenicity of the hazelnut allergen. From this example, we can see that food processing could increase the food availability towards some people who have food allergies. Lastly, food biotechnology can be useful to manage the production of animals and plants with potential benefits to have increased production for home consumption, more nutritious foods, higher gross revenues from sales, lower exposure to risks and improved natural resource management. Logically when the productivity of food ingredients is increased will influence the productivity of processing positively, hence food availability will be improved.

Food product development is another way how food innovation will play a vital role in the food security. Food product development is a process of creating novel and innovative products to benefit the customers in terms of better product shelf life and nutritional status. In this process an innovative product could be based on an existing product or an entirely new product to target a particular market segment or consumer requirement. Therefore, understanding the consumer needs and expectations will influence on the product success.⁶ Innovation in product development is not only to create new product or redevelop an existing product, but it is also an important process to increase food security. According to the world food programme website, approximately 850 million people in the world do not have enough food to consume and most of them live in developing countries.⁷ Some examples of new and innovative food products and technologies ideas that can positively impact on global food security in coming years are given in table 2.

FOOD SAFETY AND FOOD SECURITY

It is important to have enough food produced and processed to meet the demands of booming world population. However, it is much more important to preserve the soundness and safety of the available food. Otherwise, we will be wasting the hard work, efforts and time of farmers and processors to produce and/or supply food products. Unfortunately, more than third of the total food produced is lost from farm to plate. This is key aspect of food supply and availability that directly comes under food safety. In simple words, food safety is more related to preparation, handling and storage of foods in a way it remains fit for consumption until reaches to the consumer's fork. At farm level, bacterial, fungal, viral or parasitic infections in plants and animals could significantly decrease the food production, this will lead to less availability of foods. Emerging factors such as climate change and environmental pollution are also effecting the food supply through loss of food quality or even will be the major reasons for food insecurity in the future. Therefore, continuous efforts, research and development activities would be required to keep a good control on plant pathogens and zoonotic diseases.

Crops are always at the risk of failure due to a vast number of factors *i.e.*, unexpected changes in weather pattern (drought, floods, pests attack) and plant diseases. An emergent of a plant disease could create a catastrophic situation for the current deficit food supply to 800 million people who are inadequately fed. We should not underestimate the impact of these biotic constraints that have the ability to seriously compromise our food security. Example of potato blight from human history would be enough for us to keep in mind the lessons learned. This single incident of potato disease, caused by *Phytophthora infestans*, struck Europe like "a bolt from the blue" in the 1840's. Food security impact was huge and about a million people died of starvation in Ireland and more than a million attempted to emigrate. The opinion that plant pathogens pose an enormous problem for global food security sounds realistic and scary.¹²

Microbial spoilage causes food deterioration whereas pathogens in food can cause foodborne illnesses.¹³ Food preservation improves food security by inhibiting bacterial activity or eliminating them. Physical, chemical and biological preservation methods such as drying, canning, salting, freezing smoking and fermentation are commonly employed to control microbial contamination and growth and prolong the life of food products. Fermentation is an ancient and a biological preservation method,

Food	Source/technology	Reference
Quorn™ Myco-protein	Alternative source of protein	8
Cultured Meat	<i>In vitro</i> meat production	9
Apples	Natural antimicrobials prolonged the shelf-life of minimally processed apples	10
Nuggets	Ganghwayakssuk extract has good antioxidant potential to improve shelf life	11

Table 2: Examples of innovative food products and technologies that can boost food supply.

which has the ability to extend the product life for unexpectedly longer periods. For example, Archeologists have found the world's oldest cheese in China's Taklamakan Desert and surprisingly the 3,600 years old cheese had no signs of spoilage because of the dry air and salty soil environment.¹⁴ In recent years, the number of food recalls in the US have increased partly due to a renewed focus on food safety and security by the US government. Joint efforts are being made by meat and poultry firms to prevent recalls and share new food safety technologies to ensure the quality of meat and poultry products.¹⁵ It is clear that ensuring the supply of safe food and controlling the pathogens will improve food security situation (Figure 1).



Figure 1: Ways food safety can put more food on consumer's table.

In order to maintain the food safety as a fundamental part of food security, it is required to develop systems throughout food supply chain and have improved storage and transport facilities. Implementation and effective monitoring of the food safety and quality management systems like Good Agriculture Practices (GAPS), HACCP, GMP and RMPs will be highly useful to eliminate hazards in food products. It will strengthen the global efforts to increase the food availability, thus ensuring the food safety has positive implications for food security.

CONCLUSION

Food science and technology need to pay attention toward providing solutions to the issues threatening global food security. Several disciplines within food sciences possess great potential to offer solutions in one or more ways. However, food product innovation and food safety along the food supply chain can help to improve the food security through food availability and supply. To achieve comprehensive food security it is also equally important to improve the understanding of agriculture's vulnerability to climate change, food price dynamics, food waste and consumption patterns as well as monitoring technologies for appropriate responses to food security challenges.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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