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Beyond Food Preparation: Potential of the Field of Food Science and Technology in Tanzania and Beyond

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Abstract

What comes to mind when you hear the phrase "food science and technology" (FST)? One of the authors asked some students who were visiting the Mbeya University of Science and Technology during the Annual Agricultural Exhibition, *Nanenane*, in August 2022. Their responses were unsurprising because they were very similar to how many people perceive the FST field. Most people mistakenly associate FST with other programmes like Hotel Management and Food and Beverage Production and believe it is all about cooking. Of course, someone with experience in food and beverage production is highly likely to pursue further education in the field of food science and technology. The FST is an interdisciplinary field as opposed to a specific discipline. This review aimed to raise awareness of the FST field among the general public. As a result, we have discussed in great detail in this paper how the field of FST relates to other branches of science, technology, economics, and social sciences. A thorough understanding of the FST field is anticipated to raise awareness of how FST knowledge and abilities can be crucial for leveraging the national economy at both the micro and macro levels through food processing, preservation, quality assurance and safety, and business. To support the nation's vision and Sustainable Development Goals, policy amendments are also advised to integrate the FST into various frameworks.

Keywords: *Food, science, technology, awareness, food safety, economy*

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Introduction

During the Annual Agricultural Exhibition, *Nanenane*, in August 2022, one of the authors of this article asked some students who came to visit the Mbeya University of Science and Technology standpoint in Mbeya, Tanzania, "What clicks in your mind when you hear the term Food Science and Technology (FST)?" Their answer did not surprise us because it was not as far as many people think about the field of the FST. Most people think FST is all about cooking; they mix it up with other fields like Hotel Management and Food and Beverage Production. However, someone with a background in Food and Beverage Production has a strong chance of pursuing further education in the field of FST. The lack of awareness and misconceptions about the field of FST is a worldwide problem. For example, in Europe, only a few countries have

established regulated professions in FST, such as Food Engineering in Turkey, Food Technologist in Greece, Iceland, Italy, and Slovenia, and Oenologist (the science and study of wine and winemaking) in Italy, Portugal, and Spain (Costa et al., 2014). Consequently, academia and policymakers must contribute more to this discussion in order to maintain high standards for the quality of education and training for qualified professionals in the food sector.

What is Food Science and Technology?

Most research in the past few decades focused on applying science, scientific reasoning, and scientific methodologies to studying food and cooking, an old trait primarily based on the chemical sciences (Mouritsen & Risbo, 2013). The emphasis was on chemical compounds, chemical reactions, foodstuff transformations, preparation techniques, and culinary precision (Tong, 2016; Mouritsen & Risbo, 2013). However, in the last few decades, FST has become a multidisciplinary field that has significantly impacted our daily lives in various ways, from the types of foods we eat to how they are prepared and distributed. Accordingly, FST covers a wide range of topics, including food chemistry, food microbiology, food processing and preservation, food analysis, food packaging, sensory evaluation, food engineering, and food safety (Tong, 2016). Furthermore, the FST integrates other science, technology, economics, and social sciences disciplines to study food composition and preservation methods. Therefore, FST is an interdisciplinary field rather than a narrow discipline.

According to the Institute of Food Technologists (IFT), Food science is the study of food's physical, biological, and chemical composition, as well as the causes of food deterioration and the concepts underlying food processing (IFT, 2019). Furthermore, food technology is the application of food science to the selection, preservation, processing, packaging, distribution, and use of safe food. Many other related fields, such as analytical chemistry, biotechnology, engineering, nutrition, quality control, and food safety management, are linked to food technology. In general, food scientists and technologists apply scientific disciplines such as chemistry, engineering, microbiology, and nutrition to the study of food to improve food safety, nutrition, wholesomeness, and availability (IFT, 2019).

Therefore, FST is the scientific study of the nature, properties, and behaviour of food materials and the processes used to produce, preserve, and store food. It entails utilising various scientific disciplines such as chemistry, microbiology, physics, and engineering to comprehend the physical, chemical, and biological properties of food and how they can be manipulated to create safe, nutritious, and appealing food products (IFT, 2019; Tong, 2016). Thus, the primary goal of this review is to explore and inform the general public concisely, to serve as a foundational resource for public outreach and education, and to address misconceptions and misinformation about FST. In addition, the current review looks at the history of food science, technological advances, career paths, and exciting future prospects. Through this review, we anticipate that the general public will gain an insight into the broader roles and purposes of various FST applications in the food system, nutrition, health, and human development in general.

Materials and Methods

A comprehensive literature review was conducted using search engines, including Google Scholar, Core, EBSCO, and Europe PMC, to find out the remarkable events of human development in the field of FST, disciplines, applications in our daily lives and the Role of FST in fostering innovation and sustainable development in Tanzania and globe at large.

Results

Human History and the Field of Food Science and Technology

The field of FST has a long and rich history dating back thousands of years. Throughout history, humanity has advanced from a hunter-gatherer lifestyle to agricultural and industrial stages, eventually becoming providers of goods and services (Floros *et al.,* 2010). This progress has been driven by cultural and social evolution and the need to solve societal challenges, such as ensuring adequate nutrition and food

preservation. As a result, FST is closely tied to the development of human civilisation and has played a crucial role in shaping the way we eat and live today (Tong, 2016; Floros *et al.,* 2010). Some notable events and developments in the field of FST are presented in Table 1. Earlier, human survival depended on hunting animals and gathering fruits and herbs in the forest (Floros *et al.,* 2010). The earliest food preparation techniques included cooking and fermentation. Humans thus first learned how to cook food, then how to transform, preserve, and store it safely. Cooking was discovered about 2 million years ago by a distant ancestor after discovering fire (Wrangham, 2009). Later, cooking was improved by fermenting, drying, and preserving with salt and other old food processing forms, allowing communities to survive during the war and natural calamities such as drought (Floros *et al.,* 2010). The advancement in food preservation improved through artisanal practices until the 1800s when scientific studies led to discoveries in canning by Nicolas Appert and the role of microorganisms in food spoilage (Potter & Hotchkiss, 2012; Floros *et al.,* 2010).

Table 1.

Human History and Important Era in the Field of Food Science and Technology

Time	Event	Reference
Prehistoric times	• Collect fruits and vegetables from bushes • Hunt animals • Early humans began experimenting with cooking techniques after discovering fire and found the food more palatable and easier to digest.	Floros *et al.,* 2010; Wrangham, 2009
Ancient civilisations	• Domestication of animals • Plant cultivation • The ancient Egyptians, Greeks, and Romans advanced food preservation technologies, including drying and salting and using fermentation to create products like wine, cheese, and bread.	Floros *et al.,* 2010; Smith, 1998
Middle Ages	• Food preservation techniques, including smoking and pickling, continued to evolve.	Newman, 2018
Industrial Revolution	• In the 19th century, the invention of canning, refrigeration, and pasteurisation revolutionised the food industry and made it possible to transport and store food for extended periods.	Potter and Hotchkiss, 2012; Floros *et al.,* 2010
20th century	• FST advanced in microbiology, chemistry, and engineering, leading to the development of new food products and technologies.	Hardy, 1999
Modern-day	• Food science and technology continue to evolve and innovate, focusing on sustainability, nutrition, and food safety. • The latest trends include plant-based alternatives to meat and dairy, biotechnology to improve crop yields, bioplastic, functional food, and precision agriculture to reduce waste and improve efficiency. • Emerging digital technology offers food traceability solutions to consumers and supply chain partners.	Zeng *et al.,* 2023; Panghal *et al.,* 2022; Hamid and Samy, 2021; Longo *et al.,* 2019; Floros *et al.,* 2010

These early scientific advances improved food safety, quality, productivity, and shelf life, solidifying food science as a modern food industry discipline (Floros *et al.,* 2010). However, despite these advances, foodborne outbreaks were still common in the late 1800s (Hardy, 1999). As a result, microbiology to study specific causal organisms and epidemiology of the illness became an integral part of FST.

FST has recently continued to evolve, and food processing has been raised to a minimally processed and environment-friendly concept, focusing on sustainability, nutrition, and food safety (Akhila *et al.,* 2022). Food Science and Technology are used to improve food processing methods to increase efficiency, reduce waste, and improve the quality of food products (Vaishali *et al.,* 2019; Mendonca & Potter, 2016). In addition, scientists have developed new technologies and processes to improve food safety, extend shelf life, and reduce the use of preservatives and additives (Vaishali *et al.,* 2019). The latest trends include plant-based alternatives to meat and dairy, biotechnology to improve crop yields, bioplastic, functional food, and precision agriculture to reduce waste and improve efficiency (Zeng *et al.,* 2023; Hamid & Samy, 2021; Floros *et al.,* 2010).

Disciplines of Food Science and Technology

Food Science employs a variety of scientific principles to ensure the safety of the food supply. Gastronomy and Food Science have traditionally defined the field as the science that investigates the nature of foods and the natural changes that occur in them due to handling and processing. Food science has evolved over time to become a discipline that addresses current human challenges such as nutrition security, food safety and defence, and sustainability (Potter *et al.,* 1995). Food science employs basic science and engineering principles to create and maintain a safe, abundant, and wholesome food supply. It combines several disciplines to advance our understanding of foods and transform them into safe, convenient, nutritious, healthy, and tasty products. Understanding food science requires the investigation of relevant specialisations such as chemistry, engineering, and food microbiology (Potter *et al.,* 1995; Potter & Hotchkiss, 2012).). Some major scientific disciplines that help to sustain, improve, and advance the field of food science are summarised in Table 2.

Application of Food Science and Technology in our Daily Lives

Food Science and Technology play a vital role in our daily lives, from the farm to the table. Through traditional knowledge, research and new technologies, we can continue to gain new fundamental knowledge to help us develop more efficient processes to reduce waste and natural resource consumption, improve our ability to more consistently produce foods of high product quality and improve shelf life and create new products for a changing and demanding market (Tong, 2016). Some examples of how FST are applied in various stages of the food supply chain in our daily lives are discussed in this section.

Crop cultivation

Generally, food quality starts from agricultural inputs and practices. Thus, food scientists and technologists work hand in hand with other experts such as agronomists and seed breeders. For example, the soil quality in which crops are grown is a crucial determinant of food quality regarding nutritional and sensory qualities (Forsythe *et al.,* 2021). The soil's nutrient content, pH levels, and the presence of contaminants such as heavy metals can all affect the quality and safety of food crops (Kong *et al.,* 2018; Guo *et al.,* 2011). Moreover, the quality of the seeds used during planting can impact the overall quality of the resulting crops. For example, high-quality seeds can result in crops that are more resilient to pests and diseases and have better nutritional profiles.

Furthermore, farm practices, including irrigation, fertilisation, and pest management, can impact food safety and quality. For example, excessive use of fertilisers and pesticides can accumulate contaminants in crops (Kong *et al.,* 2018; *Guo et al.,* 2011). Therefore, Good Agricultural Practices (GAP), a set of guidelines and standards designed to ensure the safety and quality of food products during farming and production, are established (Lepper *et al.,* 2017). As a result, food regulatory bodies and the food industry have set

requirements to trace the application of fertilisers, pesticides, irrigation water and growing condition of food to ensure that the food is either eaten raw or intended for further processing to meet the safety requirements.

Harvesting and postharvest management of food

The knowledge of FST is used to improve the quality and shelf life of harvested crops. Postharvest management covers food handling, transportation and storage before processing or consumption. Good Handling Practices (GHPs) cover postharvest practices encompassing the general procedures that growers, packers and processors of fresh fruits and vegetables should follow to ensure food safety (De *et al.,* 2019). So far, techniques for harvesting crops that minimise physical damage, which may affect food's nutritional and sensory qualities, have been developed. For example, selective harvesting techniques can pick fruits and vegetables at their peak ripeness while minimising bruising and other forms of damage.

Postharvest management is a crucial aspect of the food industry that involves handling, storing, processing, and distributing products after they have been harvested or slaughtered (Potter & Hotchkiss, 2012). In the case of meat, milk, fish, eggs, fruits and vegetables, their postharvest management is especially critical due to their perishable nature. Therefore, postharvest storage techniques are developed to extend the shelf life of fruits, vegetables, and other perishable foods. This is usually done through refrigeration, freezing, and pasteurising milk to eliminate harmful bacteria. Moreover, techniques such as controlled atmosphere storage and new packaging materials, such as modified atmosphere packaging, are designed to help extend the shelf life of fresh produce.

Processing, preservation and packaging of food

Food science and technology are used to develop new food products and improve existing ones. For example, food processors use simple or complex machinery, scientific knowledge, and skills to convert several raw foods into intermediate and finished edible products (Potter & Hotchkiss, 2012). Furthermore, food scientists study the physical and chemical properties of food to determine the best way to process it, which can result in foods that are healthier, more convenient, and more appealing to consumers (Forsythe *et al.,* 2021). For example, to have bread, one has to dehull the wheat grain, mill the grain into flour, and the flour has to be converted to dough, and finally, the dough has to be baked accordingly to have edible bread.

Food preservation is the branch of FST that deals with the practical control of factors that adversely affect the safety, nutritive value, appearance, texture, flavour, and keeping qualities of raw and processed foods (Vaishali *et al.,* 2019; Mendonca & Potter, 2016). This includes fermentation, blanching, canning, freezing, drying techniques and the addition of synthetic preservatives, which can help preserve food for extended periods and make it more convenient for consumers (Potter & Hotchkiss, 2012). Food science is also used to improve the nutritional quality of processed foods, such as fortifying cereals with vitamins and minerals. Advanced processing technologies such as high-pressure processing and irradiation can also improve food safety by reducing harmful microorganisms.

There is a myth that chemicals that may adversely affect our health are used to preserve processed foods. However, biopreservatives have recently been increasingly used in food products due to the growing consumer demand for products recognised as safe. Therefore, the food industry uses naturally produced preservatives such as bacteriocins, essential oils, herbs, spices, vinegar, sugar, and salt to increase the shelf life of products without the addition of synthetic preservatives. Moreover, these preservatives effectively inhibit the growth of microorganisms when added at different concentrations and have been tested in laboratories (Vaishali *et al.,* 2019). Therefore, appropriately processed and preserved food is healthy and may provide safer food. For example, processing such as fermentation and extrusion has been reported to reduce or altogether remove the natural toxins and antinutrients, such as phytate, that limit the bioavailability of nutrients, and foods can be designed to optimise health and reduce the risk of food poisoning (Floros *et al.,* 2010). However, excessive processing can lead to the loss of nutrients, while poor packaging can result in

contamination or spoilage (Potter & Hotchkiss, 2012).

Food packaging plays a critical role in maintaining the quality and safety of food products. Food is packed to help keep food fresh and safe for consumption. In addition, packaging materials are designed to protect food from external factors such as moisture, oxygen, and light, which can cause food spoilage or degradation. Food science and technology are used to develop new packaging materials that can extend shelf life and reduce food waste (Potter & Hotchkiss, 2012). As a result, biodegradable packaging materials and active packaging are developed to help control microbial growth and prevent spoilage (Hamid & Samy, 2021).

Food safety and quality

The quality of food products is determined by physical properties, chemical composition, the level of contaminants and sensory attributes (Mihafu *et al.,* 2020). Food scientists and technologists must ensure that food products meet industry and regulatory standards for quality and nutritional value. Food quality can be compromised, but not food safety. Food safety involves routine hygiene from farm-to-table measures necessary to prevent foodborne illness and other adverse health effects, including allergies. For example, food scientists study the properties of food to determine the best way to process, store and transport it to prevent the growth of harmful bacteria and other microorganisms that can cause foodborne illnesses (Vaishali *et al.,* 2019). This includes testing for contaminants such as microbes, pesticides and heavy metals and implementing quality control measures to ensure that products meet regulatory and industry standards (Mihafu *et al.,* 2020). Therefore, the government sets standards that regulate food safety and quality through its various bodies. The bodies are responsible for determining product standards, defining safety, and inspecting products to determine levels of safety regarding public health.

Food regulation by governments worldwide serves two general purposes: to ensure that the food supply is safe and wholesome, while the second is to prevent economic fraud or deception. These objectives include safety, purity, wholesomeness, and value. Recently, a third objective has emerged, which is to inform consumers about the nutritional content of foods (Potter & Hotchkiss, 2012). Given the complexity of modern society, individual consumers typically lack the specialised knowledge and expertise needed to protect themselves. Therefore, it is the responsibility of both the food industry and the government to ensure protection. In addition, the food industry relies on the government to establish and enforce high standards to protect against unethical competition (Potter & Hotchkiss, 2012). By working together, food industries and government can protect consumers and ensure a safe and reliable food supply. As a result, traceability and transparency became integral to food safety and quality (Potter & Hotchkiss, 2012). For example, technologies such as blockchain have recently been used to create a transparent and secure supply chain that enables consumers to access information about the origin and production of particular food products (Panghal *et al.,* 2022; Longo *et al.,* 2019).

Nevertheless, one of the significant challenges of food processors and manufacturers is to produce products with consistent quality. Therefore, quality control is a part of food quality management, focusing on fulfilling quality requirements. The food quality managers and their technical experts work together to implement quality assurance by setting guidelines that govern processing. Therefore, quality control and assurance ensure that good quality raw materials and appropriate handling and processing meet the final product's quality specifications (Potter & Hotchkiss, 2012). These specifications include the food's colour, flavour, consistency, and nutrient content.

Product development

Product development involves idea conception, design, and creation of entirely new products or improving the existing products in terms of sensorial (colour, flavours, viscosity, etc.), nutrient composition and packaging of food (Raz *et al.,* 2008). Developing new products requires talented personnel, extensive research, facilities, and other resources (Fuller, 2016). Food

technologist integrates several business models during the process of product development to successfully market a product. For example, market mixes such as 4ps and 7ps include product, price, place, and people used as a blueprint for product development (Darmawan & Grenier, 2021; Rathod, 2016). Moreover, FST uses the knowledge and theories of economics to apply them in the food economy and marketing during new food product development. Furthermore, the knowledge of Social Science is essential in FST as it guides Food Scientists and Technologists to understand the drive of certain socioeconomic factors towards acceptance and consumption of several food products. Thus, it is essential to involve the targeted consumers at different stages of the product development process (Hoonhout *et al.,* 2010; Raz *et al.,* 2008).

Environmental sustainability

Thousands of food is wasted daily on farms, roads, and markets in developing countries due to a lack of appropriate handling and processing, especially for fresh products such as fruits and vegetables. For example, surplus fruits can be processed into several products, such as juices, jams, jellies, and concentrates, which may have a longer shelf life (Potter & Hotchkiss, 2012). On the other hand, the increased demand for processed food and food products has led to the development of green packaging made from biopolymers, reducing single-use packaging and minimising waste. Developing green biocomposites can potentially address modern society's sustainability needs (Hamid & Samy, 2021). Bioplastics also have the potential to replace fossil-based plastics in several food packaging applications. Using residual biomass in biocomposites creates value-added by-products and can promote sustainable development in developing countries. Biocomposites also allow for customised, intelligent packaging materials that enhance product quality and safety for longer.

Recently, extraction of residual phytochemicals, such as phenolic compounds in fruit and vegetable wastes, is possible. Phytochemicals are a diverse range of natural antioxidants with numerous health benefits, including anti-inflammatory, anti-ageing, and anti-cancer properties. The potential applications of these compounds in functional food and beverage products, nutraceuticals, and cosmetics are in progress (Zeng *et al.,* 2023).

Career Pathways in the Field of Food Science and Technology

The industrialisation of the food system demanded trained professionals, leading to rapid developments in food science education, research, and professional development in the 20th century. So far, in Tanzania, the career of FST is recognised from an ordinary diploma to a doctoral level. For example, to stream in the field of FST at an ordinary diploma level, one should have an education background in science subjects and at least four principal passes, specifically in Food and Nutrition/Biology, Chemistry/Physics/Engineering Science, Architectural Drafting/Building, Construction, Electrical Engineering Science/Electrical Drafting, Workshop Technology/Mechanical Drafting and Mathematics in the Certificate of Secondary Education Examination (CSEE). Moreover, a person with TRADE TEST GRADE I / NVA LEVEL III issued by Vocational Education and Training Authority (VETA) can start an ordinary diploma given that they possess CSEE with a pass in at least four (4) non-Religious subjects, two must be among Mathematics, Physics, Chemistry and Biology (MUST, 2022).

Graduates find jobs in various positions offered by food manufacturing companies, public and private research centres and quality control laboratories, consultancy in the food sector, and those related to food (e.g. packaging, raw materials production, food service) (Tong, 2016; Costa *et al.,* 2014). Their work is essential to ensuring the safety and quality of our food supply and developing new and innovative food products that meet consumer needs and preferences (Raz *et al.,* 2008). As a result, the field of FST offers a diverse range of career pathways across multiple sectors. Some of the common career pathways in the field of FST are presented in Table 3. Therefore, FST offers many career opportunities to work in various fields and make a meaningful impact on society.

Table 2

Disciplines Involved in the Field of Food Science and Technology

Discipline	Application	Reference
Biology, Cell Biology	Harvested fresh fruits and vegetables are living products. They are characterised by high moisture content, active metabolism, and tender texture; as a consequence, significant losses resulting in senescence, desiccation, physiological disorders, mechanical injuries, and microbial spoilages occur at any point from harvest through utilisation. Application of the knowledge of Biology provides an understanding of postharvest plant physiology, food quality, plant disease control, microbial physiology, food safety etc.	Wu, 2010
Microbiology	Understanding of the nature of bacteria (beneficial, spoilage, and disease-causing microorganisms), parasites, fungi, and viruses, and developments and advances in their detection, identification, quantification, and control (for example, safe thermal processes for commercial sterilisation); hygiene; food safety	Doyle *et al.,* 2020
Biotechnology	Biotechnology is manipulating plant, animal, or microbial cells using physical, chemical, or biological means. These cells are then either grown into whole plants or animals or used in other ways to influence food production, processing, and distribution. Rice with increased content of beta-carotene (vitamin A precursor); enzymes for cheesemaking, breadmaking, fruit wine manufacture, etc.	Goldberg *et al.,* 1991; Thompson *et al.,* 2007
Chemistry	Food chemistry is the study of chemical processes and interactions between all biological and non-biological components of foods. It informs us about changes in foods that occur during processing and storage. Food analysis is essential for implementing many of the applications listed here; improved food quality; extended shelf life; and development of functional foods (foods and food components providing health benefits beyond basic nutrition)	Sivasankar, 2022; Fennema *et al.,* 2017
Nutrition	Foods fortified with vitamins and minerals for health maintenance; functional foods for addressing specific health needs of certain subpopulations; development of diets that match human nutrient requirements; enhanced health and wellness	Campbell-Platt, 2017
Toxicology	Food toxicology can be defined as the science that deals with toxicants in Food. Safety assessment regarding chemical and microbiological contaminants, natural food toxicants, etc.	Omaya, 2004

Discipline	Application	Reference
Physics, Engineering	Food engineering to include Food engineering principles to deal with basic elements of food processing, transformation, conservation (e.g. mechanical processing operations, unit operations, refrigeration, novel methods applied to food such as nanotechnology, electric methods, etc.); Materials science (e.g. properties of food, and other materials coming in contact with food); and Food equipment. Food engineering also deals with plant design and operations of whole food processing units.	Kostaropoulos, 2012
Materials Science	Effective packaging; understanding of how materials properties of foods provide structure for texture, flavour, and nutrient release	Kunzek *et al.,* 1999
Computer Science	Food quality, safety, and authenticity are critical concerns for consumers, governments, and the food industry. As a result, several researchers have attempted to use rapid techniques in the last decade to go beyond traditional microbiological, DNA-based, and other methods. This broad term encompasses a variety of sensors, including hyperspectral and multispectral imaging, vibrational spectroscopy, and biomimetic receptors. Thus, computer science in food science is applicable in food manufacturing process control, data analysis, genomics understanding of plant and animal characteristics, improved control of desirable attributes, and rapid detection and identification of pathogens.	Ropodi *et al.,* 2016; Min *et al.,* 2019
Law	Food is a basic necessity and a fundamental right for all humans: food regulation bodies and consumer protection. FST knowledge is used by regulatory bodies to ensure the safety of food products by developing new food safety standards.	Guo *et al.,* 2019.
Psychology	Sensory food science is a discipline dealing with human sensory perceptions of and affective responses to foods, beverages and their components. Sensory food science is a discipline that is becoming increasingly important in understanding the factors that influence consumer preferences. Sensory evaluation is an important technique for the food industry today and in the future.	Tuorila & Monteleone, 2009
Sociology	Drivers to food consumption such as urbanisation and food industry marketing, trade liberalisation policies and others may affect the food consumers' characteristics.	Kearney, 2010

Table 3

Common Career Pathways in the Field of Food Science and Technology

Title	Responsibilities	Career path
Food Processing	Food processing involves converting raw agricultural products into finished goods such as canned, baked, frozen, and more. A food processing career may involve developing new food and related products, testing and improving existing products, or managing the production process to ensure food safety and quality.	Food Technologists
Food Packaging	Food packaging professionals design and develop materials and methods to protect and preserve food products. They work to ensure that packaging is safe, environmentally friendly, and attractive to consumers.	Food Technologists
Food Quality and Safety	Food quality and safety specialists ensure that food products meet industry and regulatory standards for safety, quality, and nutritional value. They may work in government agencies, as food manufacturers, or as independent consultants or auditors.	Food Safety Officers
Food Research and Development	Food research and development involves developing new food products or improving existing ones. Food scientists in this field may improve the taste, texture, and nutritional value of food products while ensuring their safety and extended shelf life.	Food Researchers / Food Scientists
Food Marketing and Sales	Food marketing and sales professionals work to promote and sell food products to consumers. They may work in food manufacturing companies, retail chains, or advertising agencies.	Food Sales Representatives
Food and Nutrition Education	Food and nutrition educators may work in schools, community organisations, or government agencies to promote healthy eating habits and educate people about the nutritional value of different foods.	Consumer Safety Officers
Food Policy and Regulation	Food policy and regulation professionals work in government agencies or non-profit organisations to develop policies and regulations related to food safety, nutrition, and agricultural practices.	Food Policy Analysts

Discussion

The Role of Food Science and Technology in Fostering Innovation and Sustainable Development

Food is a basic necessity and a fundamental right for all humans. A community is considered food secure when food is readily available, affordable, acceptable, and always safe for consumption (Meenar & Hoover, 2012). Therefore, food processing and preservation ensure that food is available during the off seasons and even natural calamities (Vaishali *et al.,* 2019; Mendonca & Potter, 2016). Furthermore, FST plays a crucial role in fostering innovation and development in the country. Knowledge of FST helps experts to develop new and innovative food products that meet the changing needs and preferences of consumers. Moreover, improving the quality, nutritional value, and safety of food products helps drive innovation and development in the food industry. Modern food manufacturing also

often improves the quality of life for individuals with specific health conditions, offering modified foods to meet their needs. For example, sugar-free foods sweetened with an alternative sweetener for people with diabetes are in the markets (Floros *et al.,* 2010). Furthermore, fortified foods with essential vitamins and minerals can be developed to address micronutrient deficiencies.

Advancing food processing technologies led to the development of new processing technologies, such as high-pressure processing and microwave heating, which have improved the safety and quality of food products while also reducing processing time and costs. In addition, advancements in FST have helped to improve food safety by developing new methods for detecting and controlling foodborne pathogens. It has also enabled the development of systems for tracking and tracing food products throughout the supply chain, which can help to prevent foodborne illness outbreaks and ensure that food products meet regulatory requirements. Promoting the development of new technologies, improving agricultural practices, and ensuring the safety and nutritional value of food products can contribute to economic growth, food security, and public health.

When the citizens are food secure, there is a high chance to improve their nutritional and health status. Furthermore, citizens with good nutrition and health status are in an excellent position to work effectively in their daily income-generating activities, and they can use their income for personal development instead of spending money on hospitalisation costs (Silitonga *et al.*, 2022). Furthermore, FST can facilitate partnerships and collaborations among stakeholders, including academia, government, industry, and civil society. Such collaborations can help to identify research priorities, promote technology transfer, and enhance capacity-building efforts, leading to more sustainable development in the country. Moreover, food processing can help to promote the growth of small and medium-sized enterprises (SMEs) in the food industry, generating employment opportunities, increasing income for local communities and widening the business potential, such as food exportation, which contributes to foreign currencies. Therefore, investing in FST has a great chance to contribute highly to Sustainable Development Goals (SDGs), specifically, zero hunger (SDG 2), good health and well-being (SDG 3), industrial innovation and infrastructure (SDG 9), sustainable consumption and production (SDG 12) and climate action (SDG 13).

Conclusion and recommendations

By applying knowledge from various disciplines, food science and technology have transformed raw food materials into consumable foods that are available year-round. This has reduced nutrient deficiency-related diseases, enhanced food safety and consistent quality, decreased home food preparation time, a wide variety of delicious food choices, reduced food waste, lowered household food costs, and efficient global food distribution. Despite these benefits, there are increasing negative perceptions among the general public, as some scholars in the popular press have wrongly implied that the food industry's motives in manufacturing processed foods are not in the interest of public health. However, the development of processed foods is not responsible for promoting bad eating habits or causing chronic diseases, as personal preferences, choice, willpower, and lifestyle also play a role in deciding what and how much to eat. Further advances in food science and technology are needed to address the challenges in feeding the growing world population, particularly in the areas of greatest need.

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