International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 3 Issue 6, October 2019 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Food Technology: A Tutorial

Matthew N. O. Sadiku[1], Tolulope J. Ashaolu[2], Sarhan M. Musa[1]

[1]Roy G. Perry College of Engineering, Prairie View A&M University, Prairie View, Texas
[2]College of Food Science, Southwest University, Tiansheng Road Beibei District, Chongqing, P.R. China

ABSTRACT
Food technology is a blanket term for applying food science techniques and principles to the cultivation, production, processing, packaging, labeling, quality management, and distribution of food substances. Much of the food we eat and drink is made using the tools of food technology. The modern food technologies are largely responsible for the successful operation of our supermarkets. This paper provides an introduction to food technology. It covers both new and conventional food technologies.

KEYWORDS: *food technology, food science, food processing, food preservation*

How to cite this paper: Matthew N. O. Sadiku | Tolulope J. Ashaolu | Sarhan M. Musa "Food Technology: A Tutorial" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-3 | Issue-6, October 2019, pp.435-438, URL: https://www.ijtsrd.com/papers/ijtsrd29159.pdf

IJTSRD29159

INTRODUCTION

Food is central to human survival and health. The food we eat can influence physiological processes at all stages of life. Most foods are seasonal. In order to consume them later, they must be preserved using different technologies. Since times immemorial, foods were processed primarily to improve digestibility, palatability, and to ensure a continuous supply. Food processing has evolved to make foods and beverages the basis of a healthy civilization and improve the safety, nutrition, convenience, affordability, and availability of foods. It is worth mentioning that the food processing industry is the largest manufacturing industry in US.

Food technology is a broad term for human endeavors to preserve food. It is a branch of food science, which is the study of the physical, biological, and chemical makeup of food. Food technology involves all aspects of food science. Food technologies apply food science to the production, preservation, processing, packaging, distribution, and use of food. Food technology is related to physics, chemistry, biology, biotechnology, agriculture, engineering, nutrition, quality control, food safety management, statistics, and data analysis. Figure 1 shows how food technology is related to other areas in the food industry [1].

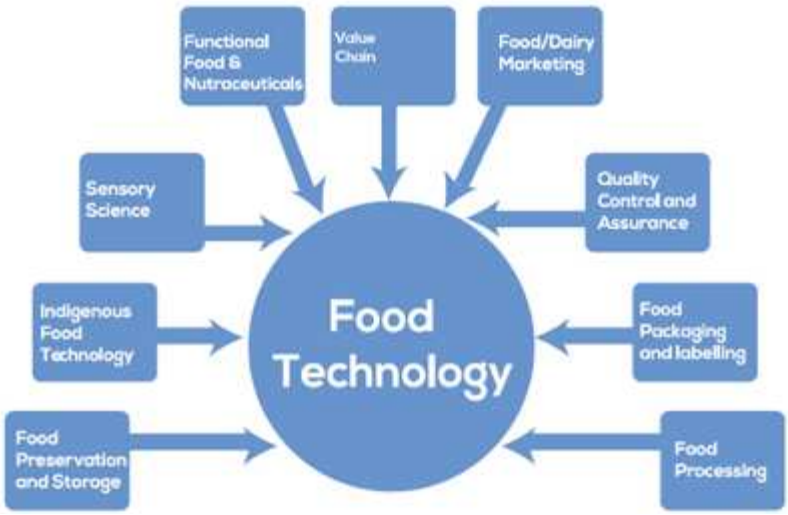

Figure1. How food technology is related to other areas of the food industry [1]

An array of technologies are being used to transform raw food materials into consumer food products. The main purpose of these technologies is to preserve food and ensure food safety. Today, food technologies are diverse and becoming increasingly sophisticated. The technology hill as presented in Figure 2 exemplifies traditional and future food preservation technologies [2]. A typical example of food technology is shown in Figure 3 [3].

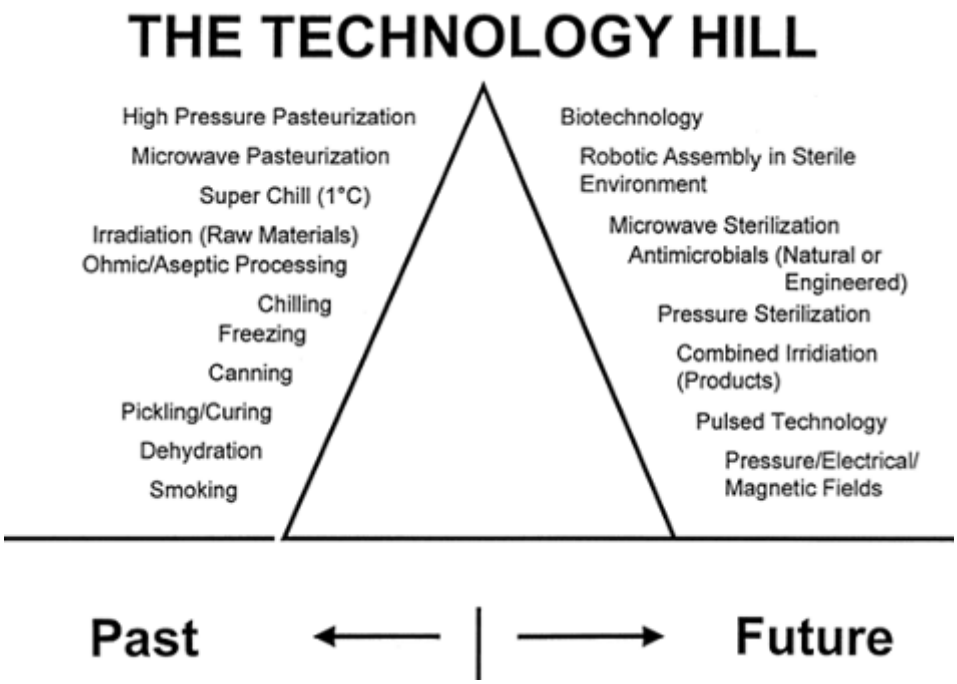

Figure2. The technology hill exemplifying traditional and future preservation technologies [2]

Figure 3 A typical example of food technology [3]

CONVENTIONAL FOOD TECHNOLOGIES

To preserve food, some technologies have been developed over the years. Technologies are used for freezing, drying, heating, canning, chemical preservation, and nutrient conservation. The list of food technologies are too long to exhaustively explore here,

- **Freezing Technology:**

This is the use of low temperatures to extend the shelf life of food. It involves using refrigeration to reduce the temperature of a food product. Freezing foods for preservation has become an important operation in food processing. It both preserves and provides convenience. It is an essential step in the manufacture of certain foods such as ice cream, frozen yogurt, etc.

- **Heating Technology:**

Heating food extends its shelf life. However, any cooking process causes loss of heat-sensitive nutrients, flavors, and colors. Besides cooking, there are basically three types of heat processes that are applied to food: blanching, pasteurization, and canning. Blanching is a mild heat treatment that eliminates or reduces activity of enzymes in the foods that catalyze changes in flavor, texture, or color. Pasteurization is most generally applied to liquids such as milk. Canning is primarily used to inactivate microorganisms that cause food spoilage. Canned food is commercially sterile [4]. An example is ohmic heating, which is also called electrical resistance heating. This is an electrical technique developed for the heating of fluids. Its main advantage is the difference in cost between electricity and other fuels. Microwave heating occurs at radio frequency. Smart ovens will continue to multitask and replace several appliances in the kitchen.

- **Packaging Technology:**

Food is packaged primarily to contain the food product, protect the product from contamination, enable convenience, and provide information. Packaging extends the shelf life of the product by providing a protection from the surrounding. Different kinds of food packages are used for different reasons.

➢ **Ultrasonic Techniques:**

Ultrasonics are elastic waves with a frequency higher than 20 kHz. Since ultrasonic techniques are rapid, non-destructive, easy to automate and relatively inexpensive, the number of applications is rapidly growing in this field. Also, since ultrasound is acoustic energy, it is a non-ionizing, non-invasive, and non-polluting. Low intensity ultrasonics are applied in food technology in numerous ways [5].

Other conventional technologies include pulsed light, high pressure processing, irradiation, cold plasma, and pulsed electric field.

MODERN FOOD TECHNOLOGIES

Just as our society has evolved with time, the food technologies have evolved over centuries. The impact of modern food technologies is evident in today's food supply. Several food technologies have emerged with the goal of faster, less expensive, and more predictive assessment approaches. These food technologies include [6, 7]:

➢ **Robots:**

Robots have been playing an increasingly important role in our daily life. They are indispensable in many industries. They are routinely used in industries to perform tasks that would kill or harm humans. They can help to eliminate safety challenges for dangerous jobs in the food industry. Figure 4 shows an example of using robots in food manufacturing [8].

Figure 4 Automation and robotics in food manufacturing [8].

➢ **3D Printing:**

This is the means of producing three dimensional solid objects from a digital model. It has been regarded as one of the pillars of the third industrial revolution. 3D Food Printing (3DFP) is an emerging technology that allows users to recreate digital models in physical form. There have been several applications of 3D printing food from NASA printing a pizza to creating soft foods for those who cannot chew hard food.

➢ **Drones:**

These are used in precision agriculture (also known as satellite farming). Drones or unmanned aerial vehicles can be easily operated. Drones take high quality images, while satellites capture the bigger picture. They involve using GPS tracking systems and satellite imagery to monitor crop yields and weather patterns to increase efficiency on the farm.

➢ **Internet of Things:**

The Internet of things (IoT) has already come to the farm in the forms of irrigation technologies and crop yield monitoring. The Internet of things is supposed to help farming by introducing more robots and artificial intelligence in farming. IoT has the potential to increase food production transparency.

➢ **Big data:**

Big data is massive volumes of data that can be captured, analyzed, and used for decision-making. Big data is revealing information about the harmful effects of certain ingredients that scientists did not previously understand.

➢ **Biotechnology:**

This is a series of technologies applied to living organisms or their sub cellular components to develop useful products, processes, or services. The new tools of biotechnology hold promise for meeting the needs of our world population more efficiently.

➢ **Nanotechnology:**

Nanotechnology is engineering very small particles, usually defined at a scale of between 1 and 100 nm. This emerging technology has far-reaching implications for science, engineering, and technology in the 21st century. It has the potential to revolutionize agricultural production and food system. Nanotechnology may improve texture, flavor, and utilization of food or food additives. It is anticipated that nanotechnology will transform food safety, food processing, food packaging, and ingredient technologies. Nanotechnology foods and food packaging are already commercialized. It will also improve food package permeability [9].

➢ **Green Technologies:**

The emerging concept of "green technologies" is currently driving the development of new techniques in the food industry. The green technologies are capable of replacing traditional thermal treatment, which negatively affects the physical and nutritional properties of food. They maintain the food safety standards provided by thermal technologies and are more environmentally friendly. Many companies now use technology to help them "go green."

Other modern technologies include block chain technology, high pressure processing, and encapsulation. These new technologies are promoting innovations in the food industry. How these technologies are applied depends on the economic, biological, cultural, and political contexts for each society.

BENEFITS AND CHALLENGES

Technology is helping us to track, analyze, and understand our food system. It is helping researchers to make new discoveries that are changing our understanding of nutrition. It enables food manufacturers to produce more efficiently for a growing world population. It improves food quality, enhances food safety, and minimizes food waste. Today, due to food technologies, our food is largely safe, tasty, nutritious, abundant, diverse, convenient, less costly, and more readily accessible. The application of science and technology to agriculture has dramatically increased productivity and reduced agricultural labor force. There is potential to substantially reduce environmental impacts of food with the use of digital technologies.

No all food technologies are understood and well accepted by the consumers. There has been negative perceptions about "processed foods." Factors contributing to these perceptions include uneasiness with technology, the risks involved, lack of perceived benefits, low level of science literacy, mislabeling, wrong advertising or irresponsible marketing, high level of food availability, and concern that specific ingredients (such as sugar and salt) may have negative impact on their health [4]. Some food technologies raise concerns related to unpredictable effects and uncontrolled use, as well as ethical concerns. There is an urgent need for developing appropriate technology for small farmers [10]. Most of the modern innovative technologies have been proprietary, consolidated, and designed to maximize shareholder interests. In today's connected world, consumers are demanding accountability from the food giants.

CONCLUSION

Today, our food is safe, nutritious, abundant, diverse, less costly, and readily available. Food production and quality have increased in most countries and this increase is largely attributable to advances in food technologies. Technology is a driving force of innovation in modern society today. No industry is impervious to the revolutions caused by technological advances. To stay relevant and increase consumer base, each industry must embrace technological changes. More information on food technology can be found in books [11-28] and the following journals/magazine devoted to food technology:

- Journal of Food Processing and Technology
- International Journal of Food Processing Technology
- International Journal of Food Science and Technology
- Global Journal of Food Science and Technology
- European Journal of Food Science and Technology
- Trends in Food Science & Technology
- Food Technology Magazine

REFERENCES

[1] "Food technology in Nepal," http://nagarikcollege.edu.np/2018/07/04/food-technology-in-nepal/

[2] D. Knorr, "Technology aspects related to microorganisms in functional foods," *Trends in Food Science & Technology*,vol. 9, nos. 8–9, August 1998, pp. 295-306.

[3] "Advanced food technology," http://learnnigeria.org/cases/advanced-food-technology/

[4] *J. D. Floros et al., "Feeding the world today and tomorrow: The importance of food science and technology,"* Comprehensive Reviews in Food Science and Food Safety, *vol.9, 2010, pp. 572-599.*

[5] A. Mulet et al., "Review: Low intensity ultrasonics in food technology." *Food Science and Technology International,* vol. 5, no. 4, August 1999, pp. 285-297.

[6] N. Martin, "How technology is transforming the food industry," April 2019, https://www.forbes.com/sites/nicolemartin1/2019/04/29/how-technology-is-transforming-the-food-industry/#3bb1530220a3

[7] *W. Slikker et al., "Emerging technologies for food and drug safety,"* Regulatory Toxicology and Pharmacology, *vol. 98, October 2018, pp. 115-128.*

[8] "The future of food technology: Automation and robotics in food manufacturing," https://i3l.ac.id/the-future-of-food-technology-automation-and-robotics-in-food-manufacturing/

[9] H. Bai and X. Liu, "Food nanotechnology and nano food safety," *Proceedings of IEEE Nanotechnology Materials and Devices Conference*, 2015.

[10] H. Meliczek, "Food technology as a means of alleviating hunger and poverty," *Food and Nutrition Bulletin*, vol. 7, no. 2, 1985.

[11] *C. Ball and F. C. W. Olson,* Sterilization in Food Technology. Theory, Practice, and Calculations. *New York: McGraw-Hill Book Company, 1957.*

[12] F. D. Gunstone, *Vegetable Oils in Food Technology Composition, Properties, and Uses*. John Wiley & Sons, 2nd edition, 2011.

[13] D. W. Sun (ed.), *Emerging Technologies for Food Processing.* San Diego, CA: Elsevier Academic Press, 2005.

[14] S. A. Matz, *Snack Food Technology*. Westport, CT: The AVI Publishing Co., 2nd edition, 1984.

[15] T. N. Koutchma, L. J. Forney, and C. I. Moraru, *Ultraviolet Light in Food Technology: Principles and Applications*. Boca Raton, FL: CRC Press, 2009.

[16] R. C. Hoseney, *Principles of Cereal Science and Technology*. St. Paul, MN: American Association of Cereal Chemists, 1994.

[17] P. J. Fellows, *Food Processing Technology: Principles and Practice*. Boca Raton, FL: CRC Press, 3rd edition, 2009.

[18] H. Mitchell, *Sweetners and Sugar Alternatives in Food Technology.* Oxford, UK: Blackwell Publishing, 2006.

[19] P. Williams and K. Norris, *Near-infrared Technology in the Agricultural and Food Industries.* St. Paul, MN: American Association of Cereal Chemists, 1987.

[20] A. E. Bender, *Dictionary of Nutrition and Food Technology*. Butterworth Scientific, 5th edition, 1982.

[21] D. R. Tainter and A. T. Grenis, *Spices and Seaonings: A Food Technology Handbook*. New York: John Wiley & Sons, 2nd edition, 2001.

[22] A. I. Ihekoronye and P. O. Ngoddy, *Integrated Food Science and Technology for the Tropics.* London, UK: Macmillan, 1985.

[23] H. Fang, G. V. Barbosa-Canovas, and J. Weiss (eds.), *Ultrasound Technologies for Food and Bioprocessing.* Springer, 2011.

[24] R. Coles, D. McDowell, and M. J. Kirwan, *Food Packaging Technology*. Boca Raton, FL: CRC Press, 2003.

[25] N. W. Desrosier and J. N. Desrosier, *The Technology of Food Preservation.* Westport, CT: The AVI Publishing Co., 1977.

[26] R. Jeantet et al. (eds.), *Handbook of Food Science and Technology 1: Food Alteration and Food Quality*. John Wiley & Sons, 2016.

[27] M. Kuddus (ed.). *Enzymes in Food Technology: Improvements and Innovations*. Singapore: Springer, 2018.

[28] D. R. Heldman, D. B. Lund, and C. M. Sabilov, *Handbook of Food Engineering.*
Boca Raton, FL: CRC Press, 3rd edition, 2019.