



Tempe: Indonesian Vegan Protein for the World

Riris Shanti¹, Kemal Komala², Irza Hani Azhar¹, and Fithriyyah Shalihati¹(✉)

¹ School of Business, IPB University, Bogor, Indonesia
oktyshalihati@apps.ipb.ac.id

² Food Science & Technology, IPB University, Bogor, Indonesia

Abstract. Sustainable foods are significantly associated with plant-based foods. Plant-based diets are more sustainable than meat-based diets because they require far fewer natural resources and are less stressful on the environment. In addition, the growing concern for the world's balance and sustainability has increased veganism's appeal and tempeh is a popular as one of the plant-based food and its health advantages, low cost, and long shelf life. By using literature review analysis, this study was performed by accessing the Scopus database. Tempe position in the plant-based protein market is interesting to watch. The plant-based food sector creates a big disruption to the food industry. The demand for vegetarian and vegan foods, such as soy foods like tempeh, has increased as a result of consumer preference for healthier foods. The soy market in many regions is expected to expand dramatically in the next years as a result of consumers being more aware of the health benefits of soy, presenting a special potential for Indonesian tempeh producers. The study in exploring various food technology innovation in tempeh process to support the tempeh business development, which involves the innovation in raw material, the usage of bioactive peptides, and the strain being used in tempeh processing.

Keywords: Food Technology · Sustainable Foods · Tempeh Business · Vegan

1 Introduction

Sustainable foods are those that satisfy three requirements for a healthy diet: (i) low environmental effect (through GHGE); (ii) excellent nutritional quality; and (iii) a reasonable price [1]. Sustainable foods are significantly associated with plant-based foods. Plant-based diets are more sustainable than meat-based diets because they require far fewer natural resources and are less stressful on the environment. Because the production of animal meals emits more greenhouse gases (GHGs) than the production of plant-based foods, reducing meat consumption has been proposed as the key option for considerably reducing world GHG emissions. As a result, diets including fewer animal products may have a lower environmental effect and be healthier. Furthermore, meals with a high environmental impact foods have inferior nutritional quality and cost more per kilogram. When examining the price per kilogram of food, the sustainability parameters appeared to be comparable [2]. Food of plant origin might be less expensive than the higher GHG-emitting UK diet [3].

© The Author(s) 2023

S. Jahroh et al. (Eds.): BIEC 2022, AEBMR 236, pp. 185–195, 2023.

https://doi.org/10.2991/978-94-6463-144-9_18

The growing concern for the world's balance and sustainability has increased veganism's appeal. Veganism is a philosophy and way of life that tries to eliminate, to the greatest extent feasible and practicable, all forms of animal exploitation and cruelty for food, clothing, or any other reason [4]. Veganism has grown in popularity over the previous three years. The number of self-identified "vegans" in the United States increased from 1% in 2012 to 3% in 2018, totalling over 10 million people. Aside from the rise of vegans, 23 percent of Americans report eating less meat, and a third use "plant-based" goods. Flexitarianism is most prevalent among younger generations, accounting for 10% of Millennials and 13% of Gen X and 13% of Gen Z consume meat only sometimes [5]. Vegetarianism has intersected with three main cultural streams throughout history: healthism, environmentalism, and speciesism. Each "ism" was inspired by a distinct moral concern: healthism with food purity, environmentalism with planet conservation, and speciesism with animal compassion [6].

The phrase "plant-based" refers to a current consumer trend that involves eliminating animal-based items in favour of plant-based alternatives, lowering the number of animal-based meals in diets overall, or adhering to dietary programs that include a larger or even sole concentration on plant-based foods. Soy, hemp, linseeds, legumes, seeds, grass, and seaweed are all sources of plant proteins. Protein is a very essential nutritional component. Protein and the amino acids it contain aid in forming muscle fibres and the immune system, as well as to maintain numerous critical activities. The human protein requirement must be supplied mostly by food consumption [7].

In terms of public health and the environment, meat consumption and production have been deemed unsustainable. Tempeh is a popular food source due to its health advantages, low cost, and long shelf life. Tempeh is a traditional meal from Indonesia that has been used as a protein source for more than 300 years. Tempeh is typically prepared from fermented soybeans with *Rhizopus* sp., although it may also be created from a variety of nuts, grains, and beans. Tempeh has long been recognized as a high-protein, vitamin B12, and bioactive chemical source. Studies conducted over the last few decades have revealed that fermentation is critical to the enhanced protein quantity and solubility of tempeh manufactured from soybeans and other legumes. In addition, the fermentation process can reduce antinutrient and allergen levels while increasing important micronutrient content, such as vitamin B12, and health-promoting bioactive substances. The fermentation also encouraged food sensory qualities that are more adaptable for usage as meats while being produced more sustainably and cost-effectively [8].

2 Methods

The systematic literature review analysis in this study were performed by accessing the Scopus database (<https://scopus.com> (accessed on 3 August 2022)). Scopus was chosen since it is one of the largest databases of abstracts and citations, journals, conference papers, and books. The following keywords were inputted into the Scopus web search: Keywords: "Food", "Technology" OR "Sustainable", "Food" OR "Tempe", "Business" OR "Vegan". This query can be written as food AND technology OR sustainable AND food OR tempeh AND business OR vegan AND (LIMIT-TO (PUBYEAR, 2022) OR LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2018)) in the form of Boolean search.

The detailed systematic literature search (Preferred Reporting Items for Systematic Reviews and Meta-Analyses, PRISMA) from the Scopus database. First, when the keyword “Food”, “Technology”, AND “Sustainable”, “Food”, OR “Tempe”, “Business” OR “Vegan” was input, and it was limited by using a time limit of 2018 until 2022, then 364 titles were shown. Then the entry results were reduced to 12 articles when the selection was focused on tempeh business. These papers will be discussed in this article. The interlinked information demonstrated the profile of the Scopus publications on tempeh business in food technology and sustainable food, and also identified the research or publication gap about tempeh business, food technology in grains as part of the sustainable food. Other than that, we also used another database such as Google Scholar, as we get only a few articles from the Scopus database. We also include others theories and concepts that relevant with the topic, such as the diffusion innovation theory regarding the food technology innovation and implementation. Those literatures are used to conclude some research questions as follows:

1. What is the current position of tempeh in the plant-based protein market?
2. Does tempeh disrupt the plant-based protein in the market? How is the disruption?
3. How is tempeh business development in Indonesia and in other regions such as Asia Pacific, Europe, United States, and global market?
4. What appropriate approaches and strategies are needed to develop the innovation in tempeh business?

3 Result and Discussion

3.1 TEMpeh’s Position in the Plant-Based Protein Market

Tempe position in the plant-based protein market is interesting to watch. The demand for vegetarian and vegan foods, such as soy foods like tempeh, has increased as a result of consumer preference for healthier foods. The soy market is expected to expand dramatically in the next years as a result of consumers being more aware of the health benefits of soy, such as the decrease in blood sugar and obesity, and its widespread use in a variety of food products, including baked goods and snacks. The segment of the global tempeh market is divided by Type (Organic and Regular), Distribution Channel (Hypermarket/Supermarket, Convenience Stores, Online Channel, and Others), and Geography (North America, Europe, Asia-Pacific, South America, and Middle-East and Africa).

The region that has a continuous growth in the tempeh market is Asia-Pacific region, due to its lower cost in comparison with other meat substitutes but it also offers many benefits such as increasing antibody production, reduced risk of diabetes, and lower cholesterol levels in the body, which has led to a surge in demand for tempeh. The highest consumption of tempeh is in Indonesia, as this country imports huge amount of soybean (60% of imported soybean) from the United States. The American Soybean Association-International Marketing’s establishment of the Forum Tempeh Indonesia also offers financial and infrastructural support to local tempeh producers in Indonesia for contributing to the potential of the tempeh market in Indonesia.

Additionally, developments in this field have accelerated market expansion. To fulfil the rising demand for non-genetically modified organisms (non-GMO) and high-protein



Fig. 1. Growth sales of several plant-based foods in the market

soybean meals throughout Europe in 2017, ADM (The Archer-Daniels-Midland Company) increased its non-GMO soybean processing capacity in Germany. In order to diversify its product line, the business recently bought Harvest Innovations (US), a pioneer in minimally processed, expeller-pressed soy proteins, oils, and gluten-free components. The United Soybean Board reports that between 2016 and 2021, there will be an increase in the percentage of Americans who consume soy foods (Fig. 1).

A significant number of local and international firms are competing for market dominance in the highly competitive global tempeh industry, and leading players have made product innovation a key component of their overall business strategies. In addition, collaborations with other businesses and mergers, expansions, and acquisitions are frequently used strategies to strengthen a company's position and expand its market. The Future Food Team, Mighty Bean Tempeh, Byron Bay Tempeh, Henry's Tempeh Inc., and Nutrisoy Pty Ltd. are some of the major participants in the tempeh market.

3.2 The Disruption of Plant-Based Protein in the Market

The explosive growth of the plant-based food sector creates a big disruption to the food industry in the last half-century. In a recent analysis, Bloomberg Intelligence predicted that the global market for plant-based foods will increase from US\$30 billion in 2021 to an astounding US\$160 billion by 2030. However, the impact and scope of the plant-based food sector extend far beyond market expansion. The plant-based market is a mega-trend in the food industry today, drawing astounding amounts of investment from private equity groups and international food companies. A perfect system has developed for the plant-based food sector as a result of the worldwide pandemic, climate catastrophe, and health and animal welfare concerns.

In addition, a revolution in food biotechnology is occurring at the precise same time as all of this is happening. One huge opportunity on the global market as a result. The concern is being raised in part due to the rate at which money is pouring into the plant-based business (US\$2.2 billion was spent in this sector alone in 2020, accounting for half of all capital investments made in the sector since 1980). Who is investing, however, is a major worry. Along with private equity firms, corporations and merchants in the food industry, including Nestlé, Danone, McDonald's and Starbucks, Unilever (which offers more than 700 vegan products in Europe), and Cargill, are major investors in the area.

Other concern that triggered the tempeh demand is various meat-related diseases which have influenced people's dietary and culinary preferences for meat products,

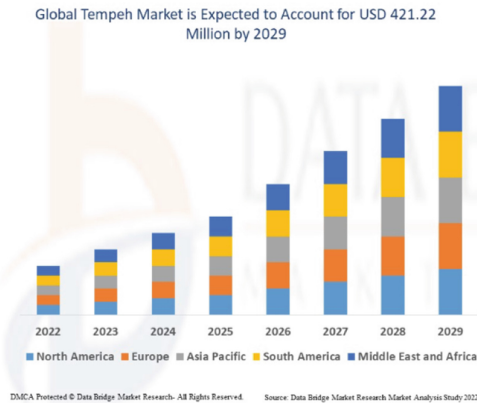


Fig. 2. Global tempeh by 2029

particularly those containing red meat. People's lifestyle which tends to be more care on the health issue also encourage people to shift from meat-based products to the plant-based product. On the contrary, demand for meat substitutes such as tempeh has been steadily increasing in recent years (Fig. 2).

3.3 Current Tempeh Business Development

As a probiotic food with high protein content, tempeh is becoming more and more popular. Tempeh demand is predicted to increase to \$5.8 billion (USD) by 2026, representing a compound annual growth rate of 6.1 percent, per an industry report. A significant portion of that expansion is anticipated in North America, presenting a special potential for Indonesian tempeh producers. This current development of tempeh business become a prospective business for Indonesia. Given that Indonesia is the place where tempeh originated, production and sales of the food items are anticipated to remain stable there and in the other ASEAN nations relative to other parts of the world. In ASEAN nations, tempeh has been consumed by the vast majority of people for hundreds of years. But during the assessment period, North American consumption of tempeh is anticipated to rise significantly.

While the Asia Pacific is anticipated to continue being the largest market through 2030, followed by Europe, the tempeh market in North America is anticipated to rise significantly during the following ten years. In 2019, the value market share for the ASEAN area was greater than 95%. Indonesians have a chance to spread their staple throughout the world as global interest in plant-based proteins increases. For instance, a Jakarta Post article argues that tempeh may become a significant Indonesian export to the United States. In order to offer the cuisine in ways that consumers are more inclined to try, Indonesian producers may even invest in the manufacturing of tempeh in the United States and other nations. Indonesians are working hard to fulfil the rising demand for tempeh, so it's probable that the demand for the U.S. soybeans they prefer to use in the creation of tempeh will rise as well. The global character of the tempeh supply chain will

increase value for all industry groups and give more consumers access to high-protein soy foods [9].

3.4 Exploring Various Types of Tempeh Substrates

The study in exploring various types of substrates in tempeh business is to elaborate on any other innovation in tempeh business to support the tempeh business development. Some literature describes the innovation which involves the raw material of tempeh, the usage of bioactive peptides, and the strain being used in tempeh processing. Wood pellet can be used as the raw material for tempeh and tofu industries so the industry development for wood pellet needs to focus on the improvement and management of the value and supply chains. A potential source of raw material for the processing of wood pellets is feasible to be developed in terms of social, economic, environmental, and policy aspects [10].

As a traditional Indonesian food which high-level vegetable protein, tempeh contains vitamin B, calcium, iron, fiber, antioxidants, and antibiotics. Various names are dedicated to many types of tempeh that indicate the development of tempeh in Indonesia. Tempeh is called with soybean tempe, gembus tempe, koro bean tempe, green bean tempe, red bean tempe, menjes tempe, lamtoro tempe, lupine tempe, seeds munggur tempe, kratok tempe, cassava tempe and bongkreng tempe. The main ingredients used are soybeans, chocolate bars, milk milo powder, green tea powder, and chili powder to add flavors of various processed tempeh. Tempeh is predicted to support community food security due to its processing potency in various forms and flavors into high nutritious food products.

The usage of bioactive peptides from food-grade raw materials have been increased, mainly for functional foods' production. The production of bioactive peptides by combining the fermentation and in vitro papain hydrolysis can generate exhibiting antioxidant properties and facilitate the continuous hydrolysis of tempeh flour-rich in protein under constant flux, thus constant residence time operation [11]. From the industrial perspective, the commercialization of tempeh-based food products is expected to increase by using safer technological approaches (i.e., fermentation and membrane technology).

Fungal-based fermented foods are types of food that are nutritious, environmentally friendly, and sustainable protein sources. Fungal fermented food is developed by using acceptable sensory characteristics; thus, it is important to assess factors that can affect the sensory characteristics of the product. The correlations between the chemical and microbiological characteristics and sensory characteristics of fungal fermented food, and the results contributed to the development of acceptable sensory fungal fermented food and, in particular, the screening of potential starters, are studied here. Soybeans were fermented using local Indonesian strains of the genus *Rhizopus* sp. and one strain of industrial starter to mimic traditional Indonesian tempeh. The fermented products were generated by a correlation between the chemical properties, particularly glutamic acid and aspartic acid, and the overall liking of different types of tempeh. Another strain, *Rhizopus oligosporus*-fermented products had better sensory characteristics than those fermented with *Rhizopus oryzae* and *Rhizopus delemar*, and are comparable to those made with an industrial starter culture with the taste and texture affect the overall liking of the product [12].

3.5 Improving Tempeh Certification for the Global Market

The requirement for clean and healthy label products becomes the consumers' interest that tends to increase nowadays with the fast-growing awareness of health and wellness. Manufacturers are investing in R&D and developing new products to meet the rising demand. This phenomenon also triggered the need of certification to guarantee the product is well produced and health. In order to support the tempeh business development, the producers of tempeh should fulfill all the criteria for the certification. A licensed institution provides the food industry with audit and certification solutions against a variety of standards. Those schemes recognized by the Global Food Safety Initiative (GFSI), who certify against a range of other internationally-acknowledged standards [13].

Usually, the standards for the global certification include:

1. AHA (Allergie, Haut, Asthma – Allergy, Skin, and Asthma, for allergen management)
2. Codex Verified Approval Scheme
3. Hygiene Monitored Approval Scheme
4. IFS Broker (International Featured Standard)
5. ISO 22000 – Food Safety Management
6. ISO 28000 – Supply Chain Security Management
7. ISTA (International Seed Testing Association)
8. Marine Stewardship Council

Tempeh producers in Indonesia should be trained in food certification so they can be accepted in the food value chain. Government or the obtained ministry can inform the audit processes and/or systems against the requirements of the world-class standards. The certification will help the producers to adopt the highest standards in food safety, meet the regulatory requirements and contractual obligations, and gain access to global markets. The certification can be held by international auditors with a multi-lingual network of auditors who are ready to share their expertise and help to raise standards. The certification can also be organized by the tempeh industry association to get food safety solutions and systems which are in line with the latest thinking and best practice so that the quality and safety become synonymous with the tempeh brand image.

3.6 Innovation of the Technology of Tempeh Processing

Current development of the tempeh business in global and domestic markets post a potential business regarding tempeh. There are some solutions that can be done to develop the tempeh business:

3.6.1 Combating Anti-Nutritional Factors

Tempeh has good nutritional and functional quality, but its use may be limited by anti-nutritional factors (ANFs) and protein allergens in the raw material. Soybean is classified as one of the “big eight” food allergens by the Food and Agriculture Organization of the United Nations, and it can cause allergy responses in about 2% of adults and 5% to 8% of

children [14]. Aside from protein-based ANFs and allergens, some carbohydrate-based ANFs, such as flatulence-causing sugars like raffinose and stachyose, can cause flatus in humans and diarrhea in poultry.

The breakdown of ANFs and protein allergens in tempeh was detected throughout fermentation using four fungal strains in solid-state fermentation. *R. oligosporus* had a strong capacity to degrade protein bands and reduce IgE immunoreactivity, but *A. elegans* showed considerable hydrolysis of stachyose and raffinose. *R. oligosporus* was the classic strain that was commonly utilized for tempeh production. According to the findings, *A. elegans* might be considered a viable alternative to *R. oligosporus* for tempeh fermentation. The results demonstrated that co-fermentation of *R. oligosporus* and *A. elegans* produced a high-quality end product and may be preferable for the creation of hypoallergenic tempeh or soy-based products via solid-state fermentation [15].

3.6.2 Shortening Duration for Making Overripe Tempeh

According to recent research, overripe tempeh potencies are the source of umami taste. However, the continued development of overripe tempeh as a culinary ingredient has been hampered by its long manufacturing time compared to tempeh and its commercial unavailability. Rapid tempeh technology was used in the first soaking to decrease the manufacturing period of overripe tempeh by replacing natural lactic acid fermentation with Glucono Delta Lactone (GDL)-chemical acidification. After 72 h of starting inoculation, Tempe GDL turned into overripe tempeh. This is quicker than the other samples in the study, which began to become overripe tempeh after 96 h after starting inoculation [16].

3.6.3 Renewable Gas from Tempeh Wastewater

To boil, soak, and wash the soybean skin for tempeh, a large amount of water is required. The tempeh industry practices inadequate wastewater management, which can cause the quality of tempeh industrial effluent to exceed quality limits and have detrimental effects on the environment and the community living around the industry. The alternative is to transform liquid waste into biogas, which is a renewable energy source. The wastewater from the tempeh manufacturing process contains 99.9% or more water and 0.1 percent solid objects made up of organic and inorganic components. The waste from the soaking of soybeans will include a sufficient amount of nitrogen, around 1.5 percent. Obtaining biogas from organic materials necessitates the use of a biogas digester, which operates on the concept of generating an anaerobic organic material reservoir, from which organic materials can be fermented by methane bacteria to create biogas [17].

3.7 Diffusion of Innovation

The innovation that has been initiated, should be spread out to all tempeh producers. In this stage of dissemination, the Innovation Diffusion concept can be implemented. The first principle in Innovation Diffusion is the quality that makes the innovation spread. In achieving relative advantage, the innovation should be in line with tempeh expectations. The innovations such as new raw material, the strain that is used for fermentation, and

shortening duration process in producing tempeh are considered better ideas than the existing ideas, in terms of economic, social prestige, and producers' satisfaction. The greater the relative profit of innovation, the greater and faster the rate of adoption will be.

Other factors that should be considered in diffusion process is compatibility, complexity, trialability, and observability. Compatibility includes prevalent values, social norms, and existing ideas, from the planting to harvesting process. Some farmers consider that smart farming innovations are inconsistent with existing agricultural management values and are not in line with past experiences. In this case, the potential adopters' opinions will influence market acceptance. Unfortunately, usually the number of potential adopters is very limited because producers' assessment on the compatibility are not published so other producers or in other regions do not know about the result. Complexity is related to the mechanical aspect in new way of producing tempeh, which is difficult to understand by the farmers and user. New ideas that are easier to understand will be adopted more quickly than innovations that require new skills and knowledge because the capabilities of Indonesian farmers on digitalization are very limited.

In trialability, the extent of new approaches that can be tested by producers is limited. New ideas that can be tested by producers, will generally be adopted faster than innovations that cannot be tested. Trialability describes less uncertainty for producers who consider adopting the innovations. Observability intend to assess the results of innovation that can be seen by other producers. The easier other producers see the results, the more likely they are to adopt the innovation. Observability also encourages producers to discuss the idea of innovation with other farmers, but because most of the producers generally have limited understanding, the role of the consultant is needed to explain the product/service.

The second principle of innovation diffusion is the understanding of the producers' needs as the users. For the successful adoption of innovation, it is important to assess the position of the innovations in improving the quality of life of users. The tempeh business development needs to consider the expectation, perception, and behaviour of the user. This position is influenced by the characteristic of the producers, whether they are Innovators who incorporate innovation into the agricultural sector, Early Adopters who validate innovation ideas, Early Majority who intend to adopt innovation, Late Majority who are sceptical of innovation but need or are influenced by the environment to adopt, and Laggards who are wary of innovation.

The last principle of the diffusion of innovation is the importance of peer-to-peer conversation and peer networks in order to understand the characteristics of producers. It is necessary to approach every step of the innovation/entrepreneurial process to understand the characteristics of users or producers.

4 Conclusion

Tempeh's position in the plant-based protein market is interesting as the demand for vegetarian and vegan foods, such as soy foods like tempeh, has increased due to consumer preference for healthier foods. The soy market in many regions is expected to expand dramatically in the next years as a result of consumers being more aware of the health

benefits of soy. Tempeh demand is predicted to increase, representing a compound annual growth rate of 6.1 percent, per an industry report. A significant portion of that expansion is anticipated in North America, presenting a special potential business for Indonesian tempeh producers. While the Asia Pacific is anticipated to continue being the largest market through 2030, followed by Europe, the tempeh market in North America is anticipated to rise significantly during the following ten years.

The study in exploring various types of substrates in tempeh and food technology innovation in tempeh business is elaborating on innovation in tempeh business to support the tempeh business development. Some appropriate approaches and strategies to develop innovation involve the raw material of tempeh, the usage of bioactive peptides, and the strain being used in tempeh processing, the technology for shortening the duration of making overripe tempeh, as well as the Renewable gas process from tempeh wastewater.

Another condition that should be considered is the diffusion of innovation process. Innovation Diffusion involves the quality that makes the innovation spread that consists of compatibility, complexity, trialability, and observability; the understanding of the producers' needs as the users; and the importance of peer-to-peer conversation and peer networks. The greater the relative profit of innovation, the greater and faster the rate of adoption will be.

References

1. Masset G, Vieux F, Darmon N. 2015. Which functional unit to identify sustainable foods?. *Public Health Nutrition*. 18(13):2488–2497.
2. Masset G, Soler LG, Vieux F, Darmon N. 2014. Identifying sustainable foods: the relationship between environmental impact, nutritional quality, and prices of foods representative of the French diet. *Journal of the Academy of Nutrition and Dietetics*. 114(6):862–869.
3. Berners-Lee M, Hoolohan C, Cammack H, Hewitt CN. 2012. The relative greenhouse gas impacts of realistic dietary choices. *Energy Policy*. 43:184–190.
4. Beck V, Ladwig B. 2021. Ethical consumerism: veganism. *Wiley Interdisciplinary Reviews: Climate Change*. 12(1):1–12.
5. Gheihman N. 2021. Veganism as a lifestyle movement. *Sociology Compass*. 15(5):e12877.
6. Miller LJ. 2017. *Building Nature's Market: The Business and Politics of Natural Foods*. Chicago (US): University of Chicago Press.
7. Aschemann-Witzel J, Gantriis RF, Fraga P, Perez-Cueto FJ. 2021. Plant-based food and protein trend from a business perspective: markets, consumers, and the challenges and opportunities in the future. *Critical Reviews in Food Science and Nutrition*. 61(18):3119–3128.
8. Ahnan-Winarno AD, Cordeiro L, Winarno FG, Gibbons J, Xiao H. 2021. Tempeh: A semi-centennial review on its health benefits, fermentation, safety, processing, sustainability, and affordability. *Comprehensive Reviews in Food Science and Food Safety*. 20(2):1717–1767.
9. Mordor Intelligence. 2022. Global Maintenance, Repair, and Operations (MRO) Market – Growth, Trends, Covid-19 Impact, and Forecast (2022–2027). mordor intelligence - Search (bing.com)
10. Siregar AZ, Tulus, Hastuti LDS. 2019. Potential tempe product of Universitas Sumatra Utara in supporting food security in North of Sumatera, Indonesia. *Earth and Environmental Science*. 347(1):1–7

11. Sitanggang AB, Sumitra J, Budijanto S. 2021. Continuous production of tempe-based bioactive peptides using an automated enzymatic membrane reactor. *Innovative Food Science and Emerging Technologies*. 68(2021):1–10.
12. Wikandari R, Kinanti DA, Chairunisa NR, Sardjono. 2021. Correlations between the chemical, microbiological characteristics, and sensory profile of fungal fermented food. *Fermentation*. 7(4):1–14.
13. Société Générale de Surveillance (SGS). Food Certification Services. Our History | SGS
14. Meinschmidt P, Schweiggert-Weisz U, Brode V, Eisner P. 2016. Enzyme-assisted degradation of potential soy protein allergens with special emphasis on the technofunctionality and the avoidance of a bitter taste formation. *LWT-Food Science and Technology*. 68:707–716.
15. Huang L, Wang C, Zhang Y, Chen X, Huang Z, Xing G, Dong M. 2019. Degradation of anti-nutritional factors and reduction of immunoreactivity of tempeh by co-fermentation with *Rhizopus oligosporus* RT-3 and *Actinomucor elegans* DCY-1. *International Journal of Food Science & Technology*. 54(5):1836–1848.
16. Gunawan-Puteri MDPT, Fortunata SA, Mursito E, Wijaya CH. 2019. Application of quick tempe technology for production of overripe tempe. *Earth and Environmental Science*. 292(1):1–6.
17. Puspawati SW, Soesilo TEB, Soemantojo RW. 2019. An overview of biogas utilization from tempeh wastewater. *Earth and Environmental Science*. 306(1):1–6.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

