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Journal of
Nutrition and Food Science Research

ISSN 2770-4475

Research Article

Development and Quality Assessment of Fortified Tofu from Soymilk Incorporated with Almond Milk and Coconut Milk.

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Abstract

Attempts to improve the nutritional value and flavor of conventional tofu have been spurred by the growing demand for plant-based and functional foods. The creation and evaluation of fortified tofu using varying ratios of almond and coconut milk to soy milk (100:0:0, 80:15:5, 70:20:10, and 60:25:15) was the main focus of this study. A 9-point hedonic scale was used to assess the fortified tofu samples' physicochemical characteristics, such as their fat, protein, carbohydrate, ash, moisture, and dietary fiber content, as well as their microbiological quality and organoleptic qualities. The sample containing 70% soy milk, 20% almond milk, and 10% coconut milk (T2) demonstrated the best balance between nutritional value and sensory appeal out of all the treatments. The lipid, fiber, and micronutrient profile was greatly enhanced by the fortification without sacrificing the product's palatability or safety. The results indicate that tofu can be supplemented with almond and coconut milk to make it more nutrient-dense, lactose-free, and sustainable for vegan and health-conscious consumers.

Keywords: Fortified tofu, soy milk, plant-based food, nutritional enhancement, lactose-free, microbiological quality, physicochemical analysis.

INTRODUCTION

Demand for creative, healthy, and environmentally friendly replacements for traditional animal derived foods has grown as an outcome of worldwide trend toward a diet based on plants. Tofu, an unfermented soy product widely consumed in East and South east Asia, has emerged as a popular meat alternative in Western nations due to its high protein content and neutral Flavor (Cao & Chan, 1997; Cao & Chang, 1999). It is traditionally prepared by coagulating hot soy milk with calcium sulphate (CaSO4) or other coagulants, forming a protein gel that is pressed into solid blocks Despite its nutritional advantages, Conventional tofu lacks certain micronutrients such as iron, calcium, and specific vitamins that are critical for human health. This has prompted efforts to fortify tofu using various nutrient-rich plant-based ingredients. Fortified tofu is a novel innovation that seeks to enhance the product's nutritional value without compromising its sensory attributes. Such fortification addresses micro nutrient deficiencies and caters to dietary needs of health conscious and lactose-intolerant individuals (Pal et al., 2021).

Incorporating almond milk and coconut milk into soy-based tofu presents a promising approach to improve both the nutritional and sensory profile of the product. Almond milk, known for its pleasant flavor, is a good source of vitamin E, dietary fiber, and unsaturated fats, making it a preferred plant milk for many consumers (Spiller & Miller, 2003; Lima et al., 2007). On the other hand, coconut milk is rich in medium-chain triglycerides (MCTs) and lauric acid, compounds known for their antimicrobial properties and energy-boosting effects (Narataruska et al., 2010; Sangamitra et al., 2013). These attributes not only enhance the health benefits of tofu but also improves its taste, texture, and market appeal.

Fortified tofu presents an innovative solution to improve the

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Received: 17-July-2025, Manuscript No. JONSFR - 4990 **; Editor Assigned:** 22-July-2025 **; Reviewed:** 05-August-2025, QC No. JONSFR - 4990 **;**
Published: 11-August-2025
Citation: Yuvraj Singh. Development and Quality Assessment of Fortified Tofu from Soymilk Incorporated with Almond Milk and Coconut Milk. Journal of Nutrition and Food Science Research. 2025 August; 12(1).

nutrient density of this traditional food while maintaining its sensory qualities. By incorporating essential minerals and vitamins, fortified tofu can offer enhanced health benefits, including improved bone health, better immunity, and reduced risk of anemia. Moreover, with the growing trend toward plant-based diets and their increasing demand for functional foods, fortified tofu holds significant potential in both consumer markets and public health interventions.

Soybean (Glycinemax)

Soybean is a leguminous plant. Majority of non- vegetarian people do not consume animal products on a daily basis in quantities sufficient to provide the recommended amount of protein. Soybeans are a rich source of good quality protein. Besides nutritional benefits soybeans provide several therapeutic benefits too.

Soybean is one of the very few plants that provide high quality protein. Soybeans contain all the major macronutrients required for good nutrition, as well as fiber, vitamins, minerals. Soybean protein provides all the essential amino acids in the amounts needed for human health Soymilk is a creamy, milk-like product made by soaking and grinding soybeans in water. However, the water absorption of soybeans in soaking is directly related to the changes in textural characteristics and grinding properties of soybeans for processing. Soy bean or soymilk has always been a rich source protein which is inexpensive and abundantly available. (Raja et al., 2014)

Almond (Prunus dulcis)

Almond is chiefly valued due to its balanced composition in protein content and fat (Jenkins et al., 2002), fiber, vitamin and minerals and no lactose content (Spiller and Miller, 2003). This was reported by many almonds peciessuc has Indian almond (Agurbiade et al.,2011), Turkey almond (Omar et al., 2011) and almond exotic. Almond milk is an oil-in-water emulsion with the dispersed phase constituted by complex protein dispersion and oil droplets. (McClements, 2005).

Almond milk showed interesting compositional attributes to investigate. One of the reasons for the popularity of almond milk was its high added-value foodstuff. Almond milk is lighting flavor, so many people find it more palatable than other plant- based milk options. It can be used as an alternative to dairy milk, oatmeal, or baking recipes.

You can make almond milk by soaking, grinding, and straining raw almonds. Commercial versions of almond milk might add nutrients such as calcium, riboflavin, vitamin E, and vitamin D, to boost the drink's nutritional content. (Lima et al., 2007)

Coconut (Cocos nucifera)

Coconut (Cocos nucifera) is one of the most important commercial crop in India and other tropical areas of world. According to Sangamitra et al., (2013), coconut is known as "tree of abundance" and "tree of heaven". It is commonly used as an important source for coconut oil, milk and cream products it is also used in raw as well as in processed form for various medicinal purposes and eating purpose in different variety of cuisines (Alyaqoubi et al., 2015).

Coconut milk is milky-white in color, sweet in taste, natural oil and water emulsion extracted from the endosperm of mature coconut using mechanical force, with addition of water Coconut milk can be used to enrich the fat content of soy milk, improving its texture and taste to be closer to that of real milk. Coconut cream can also be added to soymilk in the production of tofu to enrich its caloric density without affecting its palatability.

Coconut milk, a creamy, nutrient-rich liquid extracted from the grated meat of mature coconuts, has been as taplein many tropical and Asian cuisines for centuries. In recent years, it has gained global attention not only as a flavorful ingredient but also for its potential health benefits. As more people explore plant-based diet sand seek alternatives to dairy products, coconut milk has emerged as a popular option due to its unique composition of healthy fats, vitamins, and minerals. This thesis aims to explore the various health benefits of coconut milk, examining its nutritional value and potential role in promoting overall well- being.

Coconut milk is particularly known for its high content of medium-chain triglycerides (MCTs), which are believed to support weight management, improvement anabolism, and offer quick energy. Additionally, it contains lauric acid, a fatty acid with antibacterial, antiviral, and antifungal properties, which may contribute to immune health. Coconut milk also provides essential nutrients such as iron magnesium and potassium, making it a versatile addition to both food and beverage products. (Narataruska et al., 2010).

MATERIALS AND METHODS

Raw Materials

Fresh Soybean, Almond and Coconut were procured from local vendors of Prayagraj. The entire investigation was carried out in Warner College of Dairy Technology, Department of Food Science and Technology, SHUATS, Prayagraj. By incorporating almond milk and coconut milk in traditional soymilk tofu the research explores the comparison between physio chemical properties and exploring their potential health benefits.

Production of Soy milk, Almond milk and Coconut milk

Figure 1. Flowchart of Preparation of Soy Milk.

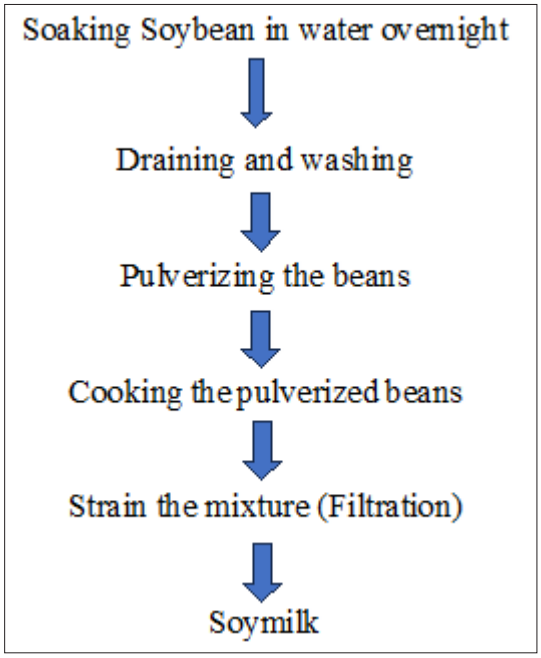


Figure 2. Flowchart of Preparation of Almond Milk

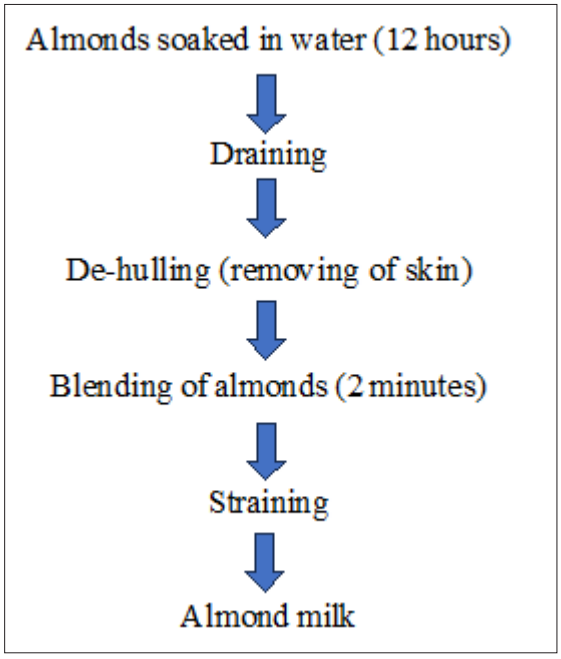
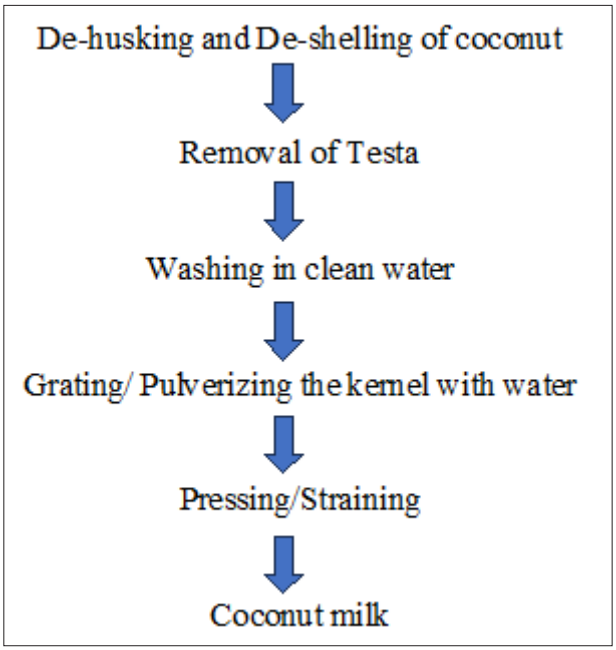


Figure 3. Flowchart of Preparation of Coconut Milk



Production of Experimental Fortified Tofu

Table 1. Treatment table of the combination of milks in experimental fortified tofu.

Treatment	Soy milk (Per 100g)	Almond milk (Per 100g)	Coconut milk (Per 100g)
T0	100	0	0
T1	80	15	5
T2	70	20	10
T3	60	25	15

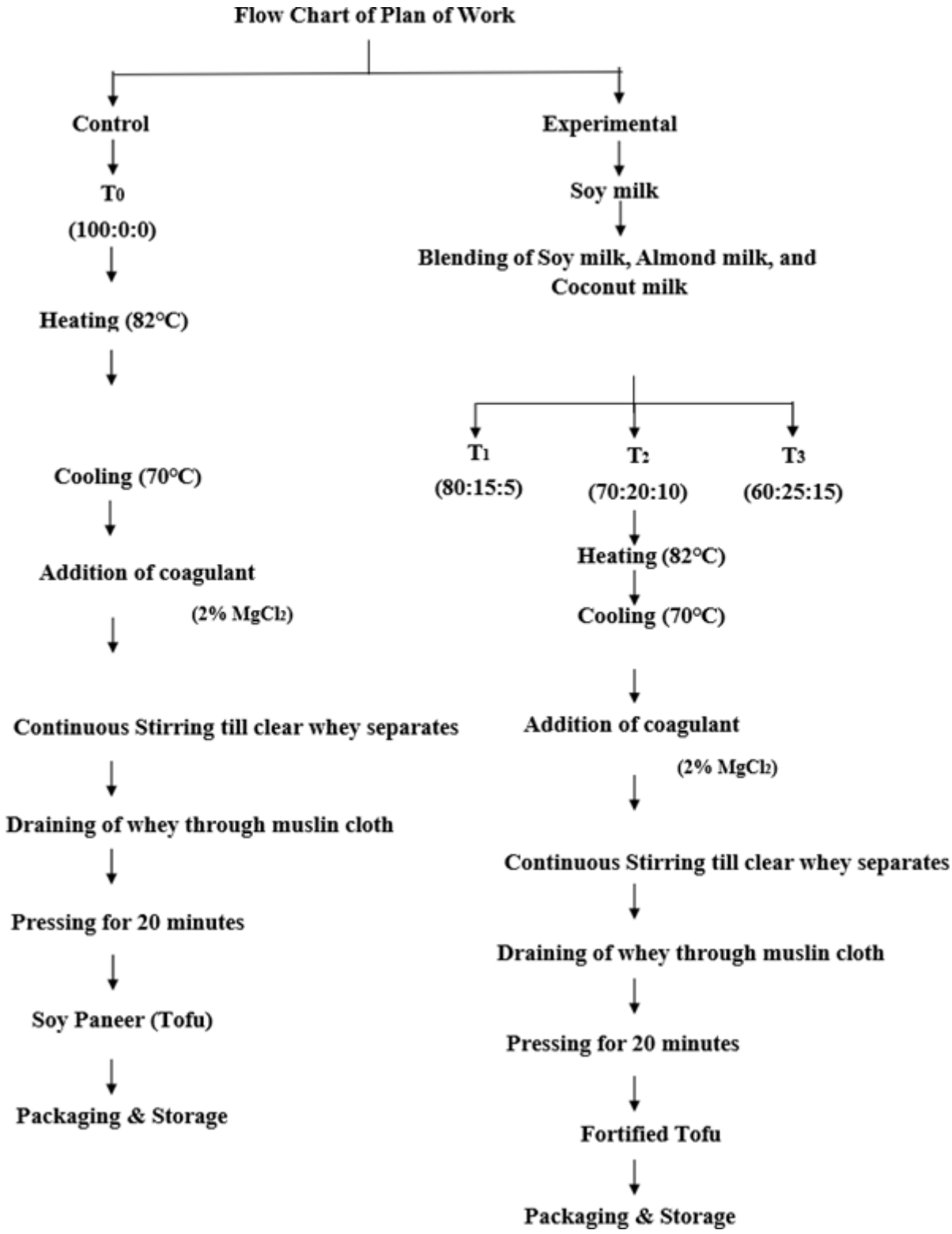
Where, T0 - Tofu will be prepared with Soy milk (100:0:0),

T1 – Fortified tofu was prepared with Soy milk incorporated with almond milk and coconut milk in the ratio (80:15:5),

T2 – Fortified tofu was prepared with Soy milk incorporated with almond milk and coconut milk in the ratio (70:20:10),

T3 – Fortified tofu was prepared with Soy milk incorporated with almond milk and coconut milk in the ratio (60:25:15).

Figure 4. Flowchart of Preparation Experimental Fortified Tofu.



PHYSICO CHEMICAL EVALUATION

The sample of finished product obtained from various treatment combinations were chemically analysed for moisture, fat, protein, carbohydrates, ash and fibre. The fat content was determined as per method described in AOAC 2000, protein content as. AOAC 2000, moisture content as per AOAC 2000, Carbohydrate as per AOAC 2000, fat as per AOAC 2000, and fibre content as per AOAC 2000 and the result is shown in **Table 2**.

Table 2. Chemical composition of the experimental fortified tofu prepared using combination of milks.

Parameters	Treatments				Critical Difference (C.D)
	T0	T1	T2	T3	
Fat (%)	6.63	9.58	12.72	15.86	0.072
Moisture (%)	76.91	74.81	71.63	68.47	0.076
Carbohydrates (%)	2.97	3.40	3.91	4.38	0.055
Protein (%)	10.66	9.14	8.54	7.92	0.063
Ash (%)	1.40	1.54	1.60	1.66	0.023
Fibre (%)	1.43	1.53	1.60	1.71	0.039

Where, T0 - Tofu will be prepared with Soy milk (100:0:0), T1 – Fortified tofu was prepared with Soy milk incorporated with almond milk and coconut milk in the ratio (80:15:5), T2 – Fortified tofu was prepared with Soy milk incorporated with almond milk and coconut milk in the ratio (70:20:10), and T3 – Fortified tofu was prepared with Soy milk incorporated with almond milk and coconut milk in the ratio (60:25:15).

RESULTS AND DISCUSSION

Fat

From the above presented data on Fat Percentage of Fortified Tofu highest mean Fat Percentage was recorded in T3 (15.86%) followed by T2, T1 and then T0 has been mentioned in Table 2.

Moisture

From the above presented data on Moisture Percentage of Fortified Tofu highest mean Moisture Percentage was recorded in T0 (76.91%) followed by T1, T2 and then T3 has been mentioned in Table 2.

Carbohydrates

From the above presented data on Carbohydrate Percentage of Fortified Tofu highest mean Carbohydrate Percentage was recorded in T3 (4.38%) followed by T2, T1 and then T0 has been mentioned in Table 2.

Protein

From above presented data on Protein Percentage of Fortified Tofu highest mean Protein Percentage was recorded in T0 (10.66%) followed by T1, T2 and then T3 has been mentioned in Table 2

Ash

From the above presented data on Ash Percentage of Fortified Tofu highest mean Ash Percentage was recorded in T3 (1.66) followed by T2, T1 and then T0 has been mentioned in Table 2

Fibre

From the above presented data on Fibre Percentage highest mean Dietary Fiber Percentage was recorded in T3 followed by T2, T1 and then T0 has been mentioned in Table 2

CONCLUSION

In conclusion, this dissertation high lights the successful creation of a nutritionally enhanced plant-based product with improved functional properties. Through the incorporation of almond and coconut milk into traditional soy- based tofu, this study demonstrated that it is possible to boost the nutritional profile of tofu by increasing essential nutrients such as healthy fats, dietary fibre as in T3.

In conclusion, this dissertation contributes to the development of fortified functional foods by presenting a novel tofu formulation that not only meets consumer preferences but also addresses the demand for healthier, more nutritious plant-based protein options. The results pave the way for further research and innovation in food fortification, offering potential applications in the global market for sustainable and nutrient-dense food products.

Abbreviations

AOAC - Association of Official Analytical Chemists ANOVA - Analysis of Variance.

REFERENCES

1. Alyaqoubi, S., Abdullah, A., Abdulamir, A. S., & Abas, F. (2015). Identification of bioactive compounds from coconut milk. Journal of Food Science and Technology, 52(10), 6651–6658. https://doi.org/10.1007/s13197-015-1763-2.

2. AOAC International. (2000). Official methods of analysis of AOAC International (17th ed.). Gaithersburg, MD: AOAC International.

3. Cao, W., & Chan, L. J. (1997). Optimization of tofu production from soybean and its quality evaluation. Journal of Food Science, 62(4), 793–796. https://doi.org/10.1111/j.1365-2621.1997.tb15448.x.

4. Cao, W., & Chang, K. C. (1999). Tofu properties affected by soybean varieties, coagulants and processing conditions. Journal of Food Science, 64(5), 906–910. https://doi.org/10.1111/j.1365-2621.1999.tb15936.x.

5. Jenkins, D. J. A., Kendall, C. W. C., Marchie, A., Josse, A. R., & Wong, J. M. W. (2002). Almonds reduce biomarkers of lipid peroxidation in healthy humans. Journal of Nutrition, 132(3), 555–560. https://doi.org/10.1093/jn/132.3.555.

6. Lima, R. L., de Souza, P. M., & Silveira, J. L. M. (2007). Development and quality evaluation of almond milk beverage. Brazilian Archives of Biology and Technology, 50(2), 361–367. https://doi.org/10.1590/S1516-89132007000200019.

7. McClements, D. J. (2005). Food emulsions: Principles, practices, and techniques (2nd ed.). CRC Press.

8. Narataruska, T., Songsermpong, S., & Seesuriyachan, P. (2010). Study of the characteristics and bioactive compounds in coconut milk. Kasetsart Journal - Natural Science, 44(3), 541–547.

9. Omar, K. A., Ahmed, A. R., & Yousif, N. E. (2011). Chemical composition and functional properties of raw and processed almonds. Pakistan Journal of Nutrition, 10(8), 728–732. https://doi.org/10.3923/pjn.2011.728.732.

10. Pal, M., Sagar, V. R., & Prasad, R. (2021). Fortification of tofu with iron and zinc: A review. Indian Journal of Nutrition and Dietetics, 58(1), 91–97. https://doi.org/10.21048/ijnd.2021.58.1.27674.

11. Raja, P. B., Suresh, C., & Sumathi, S. (2014). Quality characteristics of tofu prepared by incorporating natural coagulants. International Journal of Food and Nutritional Sciences, 3(3), 13– 18.

12. Sangamitra, K., Jayashree, S., & Ramesh, B. (2013). Coconut: The tree of abundance – Its uses and benefits. Asian Journal of Pharmaceutical and Clinical Research, 6(1), 8–12.

13. Spiller, G. A., & Miller, A. (2003). Effects of plant-based milks on cardiovascular health. American Journal of Clinical Nutrition, 77(2), 543–550. https://doi.org/10.1093/ajcn/77.2.543.

14. Shah, N. P. (2000). Functional cultures and health benefits. International Dairy Journal, 10(1–2), 127–133. https://doi.org/10.1016/S0958-6946(00)00046-0.

15. Kumar, S., & Chauhan, A. (2020). Functional and nutritional properties of plant-based milk alternatives: A review. Food Reviews International, 38(1), 1–22.https://doi.org/10.1080/87559129.2020.1846060.

16. Elzoghby, A. O., Samy, W. M., & Elgindy, N. A. (2012). Protein-based nanocarriers: A new trend in drug delivery. International Journal of Pharmaceutics,494(1), 1–14. https://doi.org/10.1016/j.ijpharm.2015.08.068.

17. Wu, J., Wang, L., & Li, L. (2021). Recent advances in plant-based milk production and quality evaluation. Critical Reviews in Food Science and Nutrition, 61(10),1672–1687. https://doi.org/10.1080/10408398.2021.1880367