

Utilization of jackfruit seed milk as a natural source of micronutrients for health: Literature review

Yusni Naelis Sa'adah¹, Arum Meiranny²

*Sultan Agung Islamic University Semarang
naelisyus@gmail.com*

ABSTRACT

Food waste is a global issue aligned with the Sustainable Development Goals (SDGs). In Indonesia, jackfruit (*Artocarpus heterophyllus*) seeds are often discarded as waste despite their high nutritional content. Processing the seeds into plant-based milk is a promising food diversification option. Objective: This study aimed to review the literature on the processing, nutritional content, and health benefits of jackfruit seed milk. Methods: A literature review was conducted by analyzing secondary data from Google Scholar, PubMed, and Garuda published between 2015 and 2025. Results: Jackfruit seed milk contains high protein (12.19 g/100 g), carbohydrates, phosphorus, calcium, and vitamin C. Reported health benefits include increased hemoglobin levels in third-trimester pregnant women, support for digestive health (as a source of prebiotics and fiber), control of blood glucose and cholesterol, and potential anti-aging and anticancer properties. Conclusion: Jackfruit seed milk is an economical and nutritious food alternative that supports public health, including reproductive and metabolic health.

Keywords: jackfruit seed milk; food waste; nutrition; micronutrients; health

INTRODUCTION

Indonesia's Sustainable Development Goals (SDGs) roadmap towards 2030 includes Goal 2 (Zero Hunger) and Goal 12 (Responsible Consumption and Production). Both goals emphasize the urgency of food diversification and natural resource efficiency to minimize food waste (Ministry of National Development Planning/Bappenas, 2021). In line with this commitment, Indonesia, as a tropical country, has a significant opportunity to optimize its previously neglected local biodiversity. One potential that has not been fully utilized is jackfruit seeds, or "beton." Jackfruit (*Artocarpus heterophyllus*) is very common in Indonesia (Nisrina & Gusnadi, 2023). Often, only the fruit is consumed or processed, while the seeds are simply discarded and become food waste. However, jackfruit seeds contain many beneficial substances (Celestial et al., 2023; Septiarin et al., 2025). Jackfruit seeds are round to oval and bilobed; the average number of seeds per jackfruit is 30 to 50, with a seed-to-fruit ratio of about one-third, with the remainder being skin and flesh (Sulastri et al., 2018). Utilizing jackfruit seed waste into economically valuable products is one solution to reduce environmental pollution while supporting food security.

One potential food diversification option is processing jackfruit seeds into jackfruit seed juice or milk. Plant-based milk has recently become a popular consumption trend, especially among vegetarians or those with lactose intolerance (the inability to digest lactose in cow's milk). However, comprehensive information on the specific benefits of jackfruit seed milk remains scattered across various studies. A literature review is needed to summarize the scientific evidence regarding the nutritional content and health benefits of jackfruit seed milk to provide a scientific basis for its development in the community.

This article aims to review the literature related to the manufacturing process, nutritional content, and health benefits of jackfruit seed milk as a nutritious food alternative that is economical and easily accessible to the general public.

METHODS

Research design

The method used in writing this article is a literature review. The research design focused on collecting and analyzing secondary data from various scientific articles, national and international journals, and research findings relevant to the topic of jackfruit seed milk and other jackfruit seed waste processing.

Search strategy and inclusion criteria

Data sources were obtained through searches on Google Scholar, PubMed, and Garuda databases with the search keywords "Jackfruit seed milk", "concrete milk", "Jackfruit seed milk", "Nutritional value of *Artocarpus heterophyllus* seeds", and "Benefits of jackfruit seeds". The inclusion criteria for the literature used were articles published within the last 10 years (2015–2025), available in full text, and specifically discussing the nutritional content, processing, or health benefit tests of processed jackfruit seeds.

Data analysis

The collected data was then analyzed descriptively and qualitatively to draw conclusions about the potential and benefits of jackfruit seed milk without using statistical procedures. The data analysis procedure was carried out by summarizing key findings, comparing results between studies, and organizing them systematically.

RESULTS

Jackfruit seed milk processing process

Based on the results of a literature review, the processing of jackfruit seed milk generally includes cleaning the seeds, boiling, peeling the seed coat, grinding with water, filtering the jackfruit seed extract, and re-boiling the jackfruit seed extract (Daniela et al., 2025). Several studies have also developed innovations by adding other components, such as moringa leaf extract (Daniela et al., 2025) and palm sugar, to improve the sensory characteristics and functional value of the product. Jackfruit seed milk can also be further processed into a probiotic drink (Nirmalasari et al., 2023).

Processing jackfruit seeds into flour has been reported to meet the quality requirements of the Indonesian National Standard (SNI) 3751:2009 (Rakhmawati & Musdholifah, 2019). This finding demonstrates that jackfruit seeds can be processed into various food products with standard quality.

Nutritional profile of jackfruit seed milk

Based on analysis, jackfruit seed milk has nutritional content comparable to other plant-based milks (Sulastri et al., 2018). Jackfruit seeds contain protein and carbohydrates, which are beneficial for muscle growth and repair of damaged cells.(Mustaghfiroh & Asiyah, 2019)Jackfruit seeds contain 12.19 g of protein per 100 g, which is reportedly higher than wheat flour (Diningrum & Antika, 2024). Jackfruit seeds also contain 165 kcal of energy, as well as phosphate, fat, and potassium (Arpit & John, 2015). Potassium is an important electrolyte for the body, especially in regulating blood pressure; electrolyte balance, such as sodium and potassium, is associated with blood pressure in adolescents (Polii et al., 2016).

In addition to macronutrients, jackfruit seed milk contains micronutrients, namely vitamin C at 13.8274 mg/100 g, phosphorus at 38.9844 mg/100 g, and calcium at 39.2461 mg/100 g (Meiranny et al., 2024). Jackfruit seeds are also a source of minerals because they contain magnesium, oleic acid, and linoleic acid (Hajj et al., 2022). Minerals play a role in regulating inflammation and optimizing the immune system (Shah & Ershler, 2007). Jackfruit seeds also contain vitamin A which is beneficial for eye health and contributes to the balance of T cell differentiation and inflammatory diseases throughout the body, in addition to thiamine and riboflavin (Swami & Kalse, 2019; Thirunavukarasu et al., 2022). Thiamine is a water-soluble

vitamin that plays a crucial role as a coenzyme in carbohydrate metabolism, and its deficiency can lead to the accumulation of pyruvic and lactic acids in body tissues (“Requirements of Vitamin A,” 1967). Riboflavin is an essential micronutrient that plays a role in oxidation-reduction processes and cellular energy metabolism and is an indicator for assessing development, growth, and nutritional status (Levit et al., 2021; “Requirements of Vitamin A,” 1967).

In terms of fiber, the crude fiber test in jackfruit seed milk (per 100 g) showed a content of 8.804%, higher than the fiber content of unprocessed jackfruit seeds (2.14%). This occurs because the fiber in jackfruit seeds is insoluble in water and therefore remains carried in the jackfruit seed juice. Thus, jackfruit seed milk is a plant-based milk that is rich in fiber compared to other plant-based milks, including soy milk, and has a competitive nutritional profile (Sulastri et al., 2018). The main nutritional content of jackfruit seeds based on proximate analysis can be seen in Table 1.

Table 1. Nutritional content of jackfruit seeds (per 100 g)

Nutritional components	Amount	Unit
Energy	165	kcal
Protein	12.19	g
Calcium	39.24	mg
Phosphorus	38.98	mg
Vitamin C	13.82	mg
Fiber (dairy products)	8,804	g

Notes. Data sources: energy (Arpit & John, 2015); protein (Diningrum & Antika, 2024); calcium, phosphorus, and vitamin C (Meiranny et al., 2024); fiber in dairy products (Sulastri et al., 2018).

DISCUSSION

This discussion outlines the health benefits of jackfruit seed milk based on the reviewed literature, namely on reproductive health and prevention of anemia, as well as prevention of metabolic diseases and digestive disorders.

Benefits of jackfruit seed milk for reproductive health and preventing anemia

Jackfruit seed milk is beneficial in increasing hemoglobin (Hb) levels in pregnant women in the third trimester (Meiranny et al., 2024). Hemoglobin functions to transport oxygen and distribute nutrients throughout the body's tissues. This increase in Hb levels is thought to be related to the iron (Fe) content in jackfruit seed milk; iron plays a role in helping red blood cell

formation and hemoglobin synthesis (Indraswari et al., 2020). Furthermore, vitamin C, at 13.8274 mg/100 g, helps maximize iron absorption (Krisnanda, 2020; Meiranny et al., 2024).

Iron and vitamin C play a crucial role in preventing anemia, including in adolescent girls (Indraswari et al., 2020; Krisnanda, 2020). Furthermore, the calcium and phosphorus contained in jackfruit seed milk are beneficial for supporting bone health (Meiranny et al., 2024). However, the iron content of jackfruit seed milk has not been reported quantitatively in the reviewed literature (Table 1), so further research is needed to strengthen the evidence for this benefit.

The role of jackfruit seed milk in preventing metabolic and digestive diseases

In vivo studies have shown jackfruit seed powder to be effective in preventing metabolic diseases caused by a high-sugar diet (HSD) (Alam et al., 2025). Jackfruit seeds can lower the glycemic index, maintain stable blood sugar levels after meals, and lower cholesterol. This is beneficial for preventing various chronic diseases such as diabetes, obesity, heart disease, and the risk of gallstones. It also helps the body absorb minerals because jackfruit seeds contain resistant starch (RS). RS is a type of dietary fiber that is currently attracting attention in health research, and studies in rice have shown that RS formation is influenced by a combination of the natural structure of starch (such as the amylose-amylopectin ratio) and the presence of other substances such as protein or fat (Shen et al., 2022).

Jackfruit seeds also contain phytonutrients and bioactive compounds, including lectins such as artocarpin (Kushwaha et al., 2020), which have been linked to anti-aging, antihypertensive, antiulcer, and even anticancer activities (Fabil et al., 2024). However, this evidence generally comes from studies on jackfruit seeds or their extracts, so their effects on dairy products require further investigation.

For digestive health, jackfruit seed milk has the potential to be a source of prebiotics. Prebiotics are substances that cannot be digested in the digestive tract but serve as a food source for good bacteria in the intestines (Ignatova et al., 2025; Nirmalasari et al., 2023). Furthermore, jackfruit seeds can help prevent constipation due to their relatively high fiber content (Waghmare et al., 2019). This is relevant because the 2023 Indonesian Health Survey (SKI) reported that approximately 96.7% of the population aged ≥ 5 years did not consume enough vegetables and fruit (Ministry of Health of the Republic of Indonesia, 2024), indicating that daily fiber intake is inadequate compared to the requirement of 20–37 g/day for age groups (Ministry of Health

of the Republic of Indonesia, 2019). With a crude fiber content of 8.804%, jackfruit seed milk has the potential to help meet daily fiber needs (Sulastrı et al., 2018).

Overall, the reviewed literature demonstrates the potential of jackfruit seed milk as a functional food based on local ingredients. However, most of the evidence comes from studies on jackfruit seeds, flour, or extracts, while direct evidence of the benefits of jackfruit seed milk in this literature is limited to one study in pregnant women in their third trimester (Meiranny et al., 2024). Further research, particularly clinical trials with larger sample sizes and analysis of iron and other micronutrient levels in jackfruit seed milk, is needed to strengthen this evidence.

CONCLUSION

Based on a literature review, it can be concluded that jackfruit seeds (*Artocarpus heterophyllus*) have great potential to be processed into highly nutritious and economical plant-based milk. Jackfruit seed milk has a competitive nutritional profile, particularly protein content reaching 12.19 g/100 g, high crude fiber (8.804%), and important micronutrients such as calcium, phosphorus, and vitamin C. The health benefits of consuming jackfruit seed milk include its ability to increase hemoglobin levels in pregnant women in the third trimester, maintain digestive health through prebiotic properties, and prevent degenerative diseases such as diabetes and hypercholesterolemia thanks to its resistant starch and antioxidant content. Utilization of jackfruit seed waste not only supports the diversification of functional foods but also contributes to the reduction of food waste in line with the sustainable development goals (SDGs). It is recommended that wider socialization regarding appropriate processing techniques and the development of flavor variations be carried out to increase public acceptance.

LIMITATION

This literature review has several limitations. First, the search was conducted in only three databases (Google Scholar, PubMed, and Garuda) covering publications from 2015–2025 and only full-text articles, so some relevant research may have been missed.

Second, the analysis was qualitative descriptive without study quality assessment or statistical synthesis, so the strength of evidence between studies could not be formally compared. Third, most of the studies reviewed examined jackfruit seeds, flour, or extracts, not jackfruit seed milk; human evidence is limited to one study in pregnant women in the third trimester, and iron

levels in jackfruit seed milk have not been reported quantitatively. Therefore, the described health benefits should be interpreted with caution and cannot be generalized.

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REFERENCES

- Alam, O., Kazal, M.K.H., Moon, R.J., Goswami, C., & Chacrabati, R. (2025). Jackfruit (*Artocarpus heterophyllus*) seed powder supplementation helps to maintain metabolic homeostasis in both normal and high-sugar diet-fed mice. *Journal of Advanced Veterinary and Animal Research*, 12(2), 374–384. <https://doi.org/10.5455/javar.2025.1905>
- Arpit, S., & John, D. (2015). Effects of different levels of jackfruit seed flour on the quality characteristics of chocolate cake. *Research Journal of Agriculture and Forestry Sciences*, 3(11), 6–9.
- Celestial, MKJ, Sagum, R.S., & Trinidad, T.P. (2023). Nutritional and physicochemical properties and safe consumption of jackfruit seeds (*Artocarpus heterophyllus* Lam.). *International Journal on Food, Agriculture and Natural Resources*, 4(4), 1–12.
- Daniela, C., Sihombing, DR, & Siregar, EA (2025). Innovation of jackfruit seed milk with moringa leaf extract as a functional drink for health. *Journal of Food Technology and Agricultural Products Research (RETIPA)*, 5(2), 139–149. <https://ejournal.ust.ac.id/index.php/retipa/article/view/5331>
- Diningrum, RL, & Antika, RB (2024). Analysis of protein content and organoleptic test of milk pie substituted with jackfruit seed flour. *SAGO Journal of Nutrition and Health*, 5(3A), 594. <https://doi.org/10.30867/gikes.v5i3a.1438>
- Fabil, M., Dubey, P. K., Roy, S., & Sharma, M. (2024). Jackfruit seed valorization: A comprehensive review of nutritional potential, value addition, and industrial applications. *Food and Humanity*, 3, Article 100406. <https://doi.org/10.1016/j.foohum.2024.100406>
- Hajj, VF, Lopes, AP, Visentainer, JV, Petenuci, ME, & Fonseca, GG (2022). Physicochemical properties, mineral and fatty acids composition of jackfruit seeds flour of two varieties from Brazilian Midwest. *Acta Scientiarum. Technology*, 44, 1–9. <https://doi.org/10.4025/actascitechnol.v44i1.60187>
- Ignatova, I., Arsov, A., Petrova, P., & Petrov, K. (2025). Prebiotic effects of α - and β -galactooligosaccharides: The structure-function relationship. *Molecules*, 30(4), Article 803. <https://doi.org/10.3390/molecules30040803>
- Indraswari, DAR, Padmiari, IAE, & Suarjana, IM (2020). Zinc (Zn) and iron (Fe) consumption and hemoglobin levels in female students of SMA Negeri 1 Gianyar. *Journal of Nutrition Science*, 13(2), 86–93.
- Ministry of Health of the Republic of Indonesia. (2019). Regulation of the Minister of Health of the Republic of Indonesia Number 28 of 2019 concerning the recommended nutritional adequacy figures for the Indonesian people. Ministry of Health of the Republic of Indonesia.
- Ministry of Health of the Republic of Indonesia. (2024). Thematic report of the 2023 Indonesian Health Survey. Ministry of Health of the Republic of Indonesia.

- Ministry of National Development Planning/National Development Planning Agency. (2021). Indonesia's Sustainable Development Goals (SDGs) roadmap towards 2030. Ministry of National Development Planning/Bappenas. https://sdgs.bappenas.go.id/website/wp-content/uploads/2021/02/Roadmap_Bahasa-Indonesia_File-Upload.pdf
- Krisnanda, R. (2020). Vitamin C helps in iron absorption in iron deficiency anemia. *Journal of Professional Nursing Research*, 2(3), 279–286.
- Kushwaha, R., Fatima, N.T., Singh, M., Singh, V., Kaur, S., Puranik, V., Kumar, R., & Kaur, D. (2020). Effect of cultivar and maturity on functional properties, low molecular weight carbohydrate, and antioxidant activity of jackfruit seed flour. *Journal of Food Processing and Preservation*. <https://doi.org/10.1111/jfpp.15146>
- Levit, R., Savoy de Giori, G., de Moreno de LeBlanc, A., & LeBlanc, J. G. (2021). Recent update on lactic acid bacteria producing riboflavin and folates: Application for food fortification and treatment of intestinal inflammation. *Journal of Applied Microbiology*, 130(5), 1412–1424. <https://doi.org/10.1111/jam.14854>
- Mustaghfiroh, L., & Asiyah, N. (2019). The Impact of Anemia Towards Students' Academic Achievement. 5(2), 28–36.
- Meiranny, A., Yumna, JD, & Jannah, M. (2024). Jackfruit seeds milk administration increased hemoglobin levels in third-trimester pregnant women at Bangetayu Health Center, Semarang, Indonesia. *Jurnal Obstetri & Gynecologi*, 32(1), 1–7. <https://doi.org/10.20473/mog.v32i12024.1-7>
- Nirmalasari, R., Norrahmah, M., & Septina, N. (2023). The effect of storage temperature on the organoleptic quality of jackfruit seed milk (*Artocarpus heterophyllus*) probiotic beverage. *Jurnal Ilmiah Biosaintropis (Bioscience-Tropic)*, 9(1), 70–80. <https://doi.org/10.33474/e-jbst.v9i1.539>
- Nisrina, SP, & Gusnadi, D. (2023). Utilization of jackfruit sap in panna cotta products as a substitute for gelatin. *Journal of Food Processing*, 8(2), 107–112. <https://doi.org/10.31970/pangan.v8i2.120>
- Polii, R., Engka, JNA, & Sapulete, IM (2016). The relationship between sodium levels and blood pressure in adolescents in West Bolangitang District, North Bolaang Mongondow Regency. *Jurnal e-Biomedik*, 4(2), 37–45. <https://doi.org/10.35790/ebm.4.2.2016.14862>
- Rakhmawati, EA, & Musdholifah, S. (2019). Quality testing of jackfruit seed flour (*Artocarpus heterophyllus* Lamk) using dry and wet method manufacturing techniques. *MEDFARM: Journal of Pharmacy and Health*, 1(2), 55–60.
- Requirements of vitamin A, thiamine, riboflavine and niacin. (1967). *Annals of Internal Medicine*, 67(6), 1361. https://doi.org/10.7326/0003-4819-67-6-1361_1
- Septiarin, M., Mika, F., & Nurmaini, P. (2025). Utilization of jackfruit seeds as an alternative raw material in making environmentally friendly tempeh. *Journal of Education and Learning (JPP)*, 7, 182–188.
- Shah, N.S., & Ershler, W.B. (2007). Immune system. In JE Birren (Ed.), *Encyclopedia of gerontology* (2nd ed., Vol. 1, pp. 742–749). Elsevier. <https://doi.org/10.1016/B0-12-370870-2/00097-4>
- Shen, L., Li, J., & Li, Y. (2022). Resistant starch formation in rice: Genetic regulation and beyond. *Plant Communications*, 3(3), Article 100329. <https://doi.org/10.1016/j.xplc.2022.100329>
- Sulastrri, Laenggeng, AH, & Masrianih. (2018). Crude fiber content in jackfruit seed milk products (*Artocarpus heterophyllus*) and its use as a learning medium. *Journal of Biology Science and Education*, 6(1), 316–320.

- Swami, SB, & Kalse, SB (2019). Jackfruit (*Artocarpus heterophyllus*): Biodiversity, nutritional contents, and health. In J.-M. Mérillon & KG Ramawat (Eds.), *Bioactive molecules in food* (pp. 2237–2259). Springer. https://doi.org/10.1007/978-3-319-78030-6_87
- Thirunavukarasu, A. J., Ross, A. C., & Gilbert, R. M. (2022). Vitamin A, systemic T-cells, and the eye: Focus on degenerative retinal disease. *Frontiers in Nutrition*, 9, Article 914457. <https://doi.org/10.3389/fnut.2022.914457>
- Waghmare, R., Memon, N., Gat, Y., Gandhi, S., Kumar, V., & Panghal, A. (2019). Jackfruit seed: An accompaniment to functional foods. *Brazilian Journal of Food Technology*, 22, 1–9. <https://doi.org/10.1590/1981-6723.20718>