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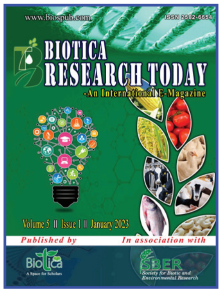

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Impact of Processing Techniques on Nutritional Attribution of Indian Millets

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Abstract

Cereal grains are the most important source of the world's food and have a significant role in the human diet throughout the world. As one of the most important drought-resistant crops, millet is widely grown in the semiarid tropics of Africa and Asia and constitutes a major source of carbohydrates and proteins for people living in these areas. In addition, because of their important contribution to national food security and potential health benefits, millet grain is now receiving increasing interest from food scientists, technologists, and nutritionists. It also envisages the effect of processing techniques on millet's nutritional properties. Understanding the changes happening in the nutrient value of millets due to processing can help the food industry, researchers, and consumers select a suitable processing technique to optimize the nutrient value, increase the bioavailability of nutrients, and help combat food and nutrition security.

Introduction

Millets are termed as "yesterday's coarse grains and today's nutricereals." Millets are considered to be "future crops" as they are resistant to most of the pests and diseases and adapt well to the harsh environment of the arid and semi-arid regions of Asia and Africa. Millet is one of the most important drought-resistant crops and the 6th cereal crop in terms of world agriculture production. Therefore, millet grains are now receiving specific attention from these developing countries in terms of utilization as food as well as from some developed countries in terms of its good potential in the manufacturing of bioethanol and biofilm. The majority of millets are three to five times more nutritious than most cereals (rice, *Oryza sativa*; wheat, *Triticum aestivum*; maize, *Zea mays*) in terms of vitamins, fiber, proteins, and minerals (calcium and iron) and are gluten-free; hence, they are known as "superfoods". However, the nutrients, bioactive compounds, and functions of cereal grains can be influenced by the food preparation techniques. Millets are usually processed before consumption to remove the inedible portions, extend the shelf life, and improve nutritional and sensory properties. Primary processing techniques such as dehulling, soaking, germination, roasting, drying, polishing and milling (size reduction) are followed to make millets fit for consumption. At the same time, modern or secondary processing methods such as fermenting, parboiling, cooking, puffing, popping, malting, baking, flaking, extrusion, *etc*., are used to develop millet-based value-added processed food. Thus, understanding the influence of processing on nutritional properties is extremely important for effective utilization of millets. It also assists in choosing an appropriate processing technique for millets to maximize nutrient availability, improve palatability, and increase shelf life (Gowda *et al*., 2022; Yousaf *et al*., 2021).

Nutritional Profile of Millets

Nutritional quality of food is a key element in maintaining human overall physical well-being because nutritional well-being is a sustainable force for health and development and maximization of human genetic potential. Therefore, for solving the problem of deep-rooted food insecurity and malnutrition, dietary quality should be taken into consideration (Nithiyanantham *et al.,* 2019; Gowda *et al*., 2022). A detailed summary of the nutritional profile of selected Indian millets is discussed below.

Proso Millet

Proso millet has a higher nutritional value when compared with staple cereals as it contains a higher concentration of minerals and dietary fiber. It is a rich source of vitamins and minerals such as iron (Fe), calcium (Ca), potassium (K), phosphorus (P), zinc (Zn), magnesium (Mg), vitamin B-complex, niacin, and folic acid. It contains essential amino acids in significantly higher quantities, except for lysine, the limiting amino acid. However, proso millet has an almost 51% higher essential amino acid index than wheat.

Pearl Millet

Pearl millet shows an energy value comparable to the staple cereals. Pearl millet contains a lesser amount of carbohydrates than the staple cereals, and it mainly contains high amylose starch (20-22%), and the insoluble dietary fiber fraction helps in exhibiting a lower glycemic response. Pearl millet is high in omega-3 fatty acids and also important nutritional fatty acids such as alphalinolenic acid, eicosapentaenoic acid, and docosahexaenoic acid. It also contains other micronutrients such as Fe, Zn, copper (Cu), K, Mg, P, manganese (Mn), and B-vitamins.

Kodo Millet

Kodo millets contains high amounts of vitamins and minerals, especially B-complex vitamins, B6, niacin and folic acid, Fe, Ca, Mg, K, and Zn. Kodo millet is very easy to digest and thus can be beneficial for infant and geriatric product formulation.

Foxtail Millet

Foxtail millet has a greater nutritional value compared to major cereals such as wheat and rice due to its copious dietary fiber content, resistant starch, vitamins, minerals, and essential amino acids, except for lysine and methionine, but it is richer than most cereals. Among the selected millets, foxtail millet contains the highest protein.

Finger Millet

Finger millet contains around 7% protein, which is less than that of other millets, but it has a good amino acid score and contains more threonine, lysine, and valine than other millets. Subsequently, micronutrients such as Ca, Fe, Mg, K, and Zn, as well as B-vitamins, especially niacin, B6, and folic acid, are abundantly available.

Little Millet

The nutritional value of little millet is comparable to other cereal and millet crops. It contains around 8.7% protein and balanced amino acids, and it is a rich source of sulphur-containing amino acids (cysteine and methionine) and lysine, which is lacking in most cereals. It is also a good source of micronutrients such as Fe, P, and niacin. Recently, many value-added products have been prepared using little millet to capitalize on the health benefits of little millet (Saleh *et al.,* 2013; Gowda *et al*., 2022).

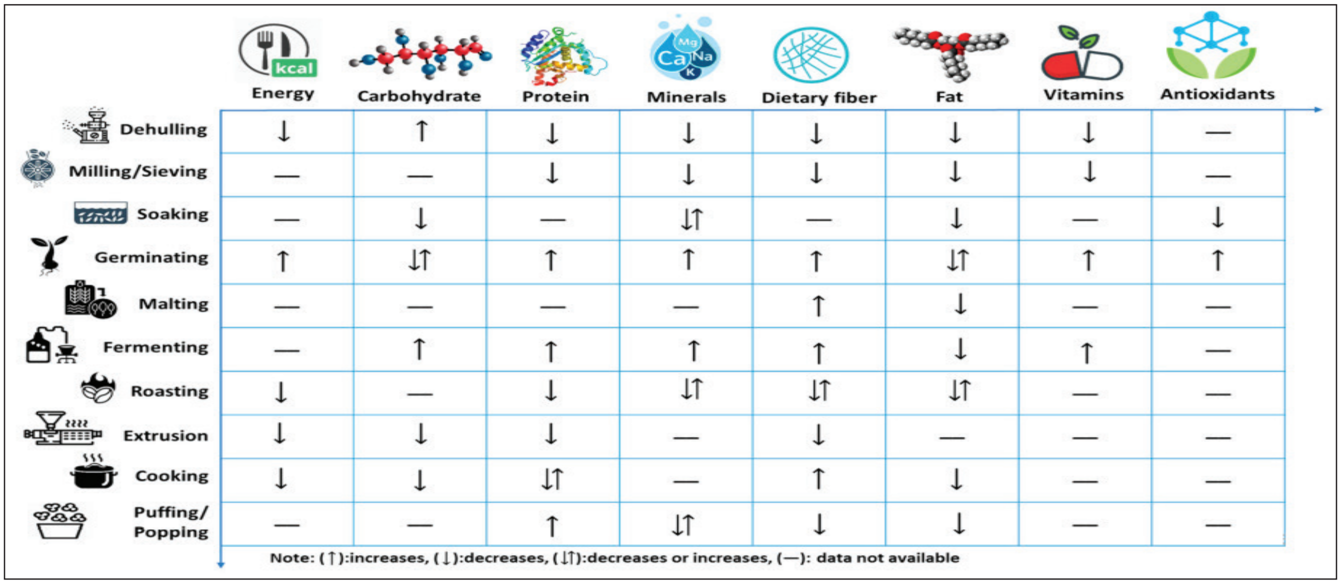
Primary and Secondary Processing of Millets

Processing may be of two types, namely, primary and secondary processing. Processes such as cleaning, washing (soaking/ germination), dehulling, milling (into flour and semolina), and refining to remove the undesired seed coat and anti-nutritional factors are termed as primary processing, while secondary processing involves converting primary processed raw materials into “ready-to-cook” (RTC) or “ready-to-eat” (RTE) products by flaking, popping, extrusion, and baking. The traditional processing technologies include debranning, milling, roasting, soaking, steaming germination, popping, flaking, ready-to-eat salted grains, and fermented products. These processing techniques aim to convert grains into edible forms, with an extended shelf life, improved texture, specific flavor, taste, as well as improved nutritional quality and digestibility (Rathore *et al.,* 2019). The processing methods may have positive as well as negative impacts on the nutrient and anti-nutrient profile. Various research studies on millet processing have shown positive results on the effective usage of millets in a variety of traditional and convenience health foods. Significant levels of phytates, tannins, phenols, and trypsin inhibitors decrease nutrient bioavailability and quality, limiting maximum utilization of nutritional potential in millets (Yousaf *et al*., 2021). The changes in nutritional composition and digestibility with respect to different mechanical processing methods are below summarized (Figure 1).

Effect of Processing on Nutritional Properties of Indian Millets

Proteins

Millets are a rich source of proteins and are widely consumed by vegans. They are regarded as an excellent plant protein with negligible amounts of saturated fats compared to animal proteins. The presence of antinutrients inhibits protein digestibility; hence, reducing the antinutrients level is important. Simple techniques such as dehulling, milling, soaking, and heating decrease the



	Energy	Carbohydrate	Protein	Minerals	Dietary fiber	Fat	Vitamins	Antioxidants
Dehulling	↓	↑	↓	↓	↓	↓	↓	—
Milling/Sieving	—	—	↓	↓	↓	↓	↓	—
Soaking	—	↓	—	↓↑	—	↓	—	↓
Germinating	↑	↓↑	↑	↑	↑	↓↑	↑	↑
Malting	—	—	—	—	↑	↓	—	—
Fermenting	—	↑	↑	↑	↑	↓	↑	—
Roasting	↓	—	↓	↓↑	↓↑	↓↑	—	—
Extrusion	↓	↓	↓	—	↓	—	—	—
Cooking	↓	↓	↓↑	—	↑	↓	—	—
Puffing/ Popping	—	—	↑	↓↑	↓	↓	—	—

Note: (↑):increases, (↓):decreases, (↓↑):decreases or increases, (—): data not available

Figure 1: Inference on nutritional properties changes during different processing methods (Gowda *et al*., 2022)

antinutrient levels and increase the in vitro protein digestibility. Protein digestibility in cereals, millets, and legumes has been shown to improve throughout the germination and fermentation processes. Similarly the malting of pearl millet (24 h soaking, followed by 18 h germination) significantly enhanced the protein. Soaking, malting germination, and fermentation processes lead to an increment in the total protein and improved protein digestibility, and thus can be used as an effective processing treatment in the development of protein-rich foods. Decortication removes about 12-30% of the outer husk, bran, and germ portion of grains, limiting the significant loss of proteins and amino acids such as histidine, lysine, and arginine (Gowda *et al*., 2022).

Carbohydrates

Starch is the principal carbohydrate of the millets like other cereals. The amount of available carbohydrates in food grains is affected by various domestic processing and cooking methods such as soaking, sprouting, pressure cooking, autoclaving, and so on. The increase in carbohydrates during the germination of foxtail millet is associated with the decrease in moisture, ash, crude protein, and fat, because the carbohydrate levels depend on these attributes of the grains. The effect of fermentation and germination on the carbohydrates of pearl millet revealed that germination greatly increases the total soluble sugar concentration, as well as the reducing and non-reducing sugar concentration. These results indicate that the germination and fermentation processes improve the carbohydrate digestibility by breaking down the complex starch into simple soluble sugars. This shows the importance of germination and fermentation in the development of energy-dense, easily digestible food products such as infant formula (Yousaf *et al*., 2021).

Dietary Fiber

The millet bran fraction is a major and abundant source of dietary fiber, which is characterized as complex polysaccharides that are not readily available. Therefore, removal of the bran fraction during decortication/ dehulling results in substantial reduction in fiber component. Since most of the millets are consumed in their decorticated form, it is very important to control the extent of dehulling so as to maximize the fiber content. Dehulling and milling (debranning) operations reduce dietary fiber, while high temperature extrusion processes lead to thermal degradation of dietary fiber. Dietary fiber, particularly which accumulated in the outer bran layer, plays a vital role in reducing type 2 diabetes and constipation. For a healthy millet diet, it is important to discourage millers from polishing millets and to advise consumers to prefer whole millets (unpolished) and their by-products (Yousaf *et al*., 2021).

Minerals

Millets are rich source of minerals such as potassium, magnesium, iron, calcium, and zinc. Soaking millet grains prior to cooking helps to reduce anti-nutrients while also improving mineral bioavailability. Millet grains soaked in water were shown to have reduced Zn and Fe content, which might be attributed to minerals leaching into the soaking water. The mineral content in pearl millet flour was affected by germination and fermentation. Germination of foxtail millet improved and modified the nutrient profile by increasing the mineral compounds availability. Germination increased the availability of minerals by the catabolism process of anti-nutrients such as saponins and polyphenols, which inhibit the mineral bioavailability. The decortication process reduces the anti-nutrients, which inhibit mineral bioavailability by creating complexes. The anti-nutrient level reduction leads to an improvement in the bioavailability of minerals. The report suggests that the majority of minerals are accumulated in the germ and bran layer which will be lost during dehulling and sieving operations. However, the process of germination and fermentation was found to increase the mineral content to some extent which could be exploited to develop value-added products (Nithiyanantham *et al.,* 2019).

Vitamins

Millets when polished/ debranned contain a lower nutritional value since the bran and germ components of refined millet flour are eliminated, resulting in a loss of vitamins. Millets are considered superior to wheat, sorghum, and maize in terms of vitamin content and other nutrients that include fats, proteins, and minerals. Millet grains are high in vitamins such as riboflavin, thiamine, niacin, and folic acid. It has been noted that the germination and fermentation processes in pearl millet affect the vitamin content of the grains. Improved vitamin levels (thiamin) after the fermentation process were reported. The milling affects the bran portion of the millet grains, which reduces vitamins that are mainly accumulated in the outer bran layer of grains. Similarly, increased levels of vitamins (thiamine, niacin) after germination and probiotic fermentation were reported. The studies on milling or dehulling suggest that the vitamins are lost during these processing operations as the majority of vitamins are accumulated in the outer layer of millets. The availability of important vitamins can be improved by germinating the millets and developing by-products from germinated millets (Yousaf *et al*., 2021).

Fats

Fats are necessary for calorie supply, brain development, and the absorption and transport of vitamins A, D, E, and K in the body. The germination time has an impact on fat content. A study to investigate the effect of high-pressure soaking on the nutritional characteristics of foxtail millet revealed that the fat content is reduced by 27.98%. The simple processing techniques such as soaking, germination and malting could be the ideal option for manufacturers to develop low-fat food products from millets. The high temperature processing would damage the fat quality and might reduce the taste and flavor of the processed foods (Nithiyanantham *et al.,* 2019; Gowda *et al*., 2022).

Conclusion

Based on various studies, we can observe that millet grains contain many health-promoting components such as dietary fiber, minerals, vitamins, and phytochemicals that include phenolic compounds, and they are comparable to those of major grains and they also have several potential health benefits. However, novel processing and preparation methods are needed to enhance the bioavailability of the micronutrients and to improve the quality of millet diets. Looking into the variability of the impact of processing on the nutritional characteristics of millets, there is still a need to focus on optimizing the processing techniques for minor millets to make them more acceptable without compromising the health benefits. Moreover, to combat food insecurity and malnutrition, awareness needs to be created at both commercial and household levels regarding the impact of processing methods on the nutritional properties of millets and the health benefits of millets.

References

Gowda, N.N., Siliveru, K., Prasad, P.V., Bhatt, Y., Netravati, B.P., Gurikar, C., 2022. Modern processing of Indian millets: a perspective on changes in nutritional properties. *Foods* 11, 499. DOI: https://doi.org/10.3390/foods11040499.

Nithiyanantham, S., Kalaiselvi, P., Mahomoodally, M.F., Zengin, G., Abirami, A., Srinivasan, G., 2019. Nutritional and functional roles of millets - A review. *Journal of food Biochemistry* 43, 12859. DOI: 10.1111/jfbc.12859.

Rathore, T., Singh, R., Kamble, D.B., Upadhyay, A., Thangalakshmi, S., 2019. Review on finger millet: Processing and value addition. *Pharma Innov. J.* 8, 283-291.

Saleh, A.S., Zhang, Q., Chen, J., Shen, Q., 2013. Millet grains: nutritional quality, processing, and potential health benefits. *Comprehensive Reviews in Food Science and Food Safety* 12, 281-295. DOI: 10.1111/1541-4337.12012.

Yousaf, L., Hou, D., Liaqat, H., Shen, Q., 2021. Millet: A review of its nutritional and functional changes during processing. *Food Research International* 142, 110-197.