Scientific Research Publishing

Food and Nutrition Sciences, 2024, 15, 1317-1333
https://www.scirp.org/journal/fns
ISSN Online: 2157-9458
ISSN Print: 2157-944X

Comparative Study on Nutrition Properties of Different Types of Millet Powder

Kalaiarasi Gnanaprakasam[1], Jayabalan Kaliyamoorthy[1*], Muthu Kumara Pandiyan Asokan[2]

[1]Food Processing Laboratory, Department of Chemical Engineering, Faculty of Engineering and Technology, Annamalai University, Chidambaram, India
[2]Vivekanandha College of Engineering for Women, Namakkal, India
Email: *kalaiprakasam257@gmail.com

How to cite this paper: Gnanaprakasam, K., Kaliyamoorthy, J. and Asokan, M.K.P. (2024) Comparative Study on Nutrition Properties of Different Types of Millet Powder. *Food and Nutrition Sciences*, **15**, 1317-1333.
https://doi.org/10.4236/fns.2024.1512083

Received: November 15, 2024
Accepted: December 21, 2024
Published: December 24, 2024

Abstract

The study determined the nutritional properties of different species of millets namely, millet (Bajra, red sorghum, Ragi, little millet, Kodo millet, Foxtail millet and Barnyard millet). The properties included protein, fat, carbohydrates, fiber, minerals (iron, cobalt, copper, aluminum, calcium) and B group vitamins. (Give a highlight of your methodology and discussion before conclusion) The study concluded that millets are good sources of nutrients and in this different type of millet powder, the highest amount of nutrients is achieved by Bajra—Kambu is (fat 5.21 ± 0.3 g, fiber 11.50 ± 0.5 g, Cobalt 0.035 ± 0.012, Iron 7.52 ± 0.94, Vitamin B2 0.18 ± 0.02 and Vitamin B6 0.35 ± 0.03), Sorghum—Solam is (Protein 11.21 ± 0.3 g, Vitamin B9 38.63 ± 2.50), Ragi—Kezhvaragu is (Aluminium 3.65 ± 0.72, Calcium 383 ± 24), Little millet—Saamai (Vitamin B7 6.52 ± 0.65), Foxtail millet—Thinai is (Vitamin B1 0.45 ± 0.05, Vitamin B5 0.75 ± 0.03), Barnyard millet—Kuthiravali is Vitamin B3 0.15 ± 0.04.

Keywords

Millet Powder, Nutrients, Vitamins, Minerals

1. Introduction

Small-seeded millets are commonly cultivated in developing nations, accounting for 97% of total production. Millets are called “future crops” because they can survive most pests and diseases and flourish in the harsh circumstances of dry and semi-arid parts of Asia and Africa [1]. Regretfully, despite being the world leader in the production of nutrient-dense rice, lentils, and millet, India ranks second in the world for the prevalence of child malnutrition. India is home to more than one-third of the world’s hungry children [2]-[4]. Millets are a crop that is high in

vitamins and minerals and particularly nutrient-dense. Because millet is a rich source of energy and dietary fiber, slowly digesting starch and resistant starch, it provides a continuous release of glucose and, hence, satiety.

Owing to the easy access to nutrients and energy found in millets, researchers, the agricultural sector, and food security programs are focusing more on millet processing and production in order to better utilize it and reduce the amount of hidden hunger that exists in the globe [5]-[7]. A range of benefits, such as enhanced digestive system health, decreased cholesterol, heart disease prevention, diabetes prevention, cancer risk reduction, increased energy levels, and improved muscle function [8] [9].

The macronutrients are dietary fiber, lipids, protein, and carbohydrates. Since they make up almost half of our daily caloric intake, carbohydrates are a necessary component of our diet. The ratio of carbon, hydrogen, and oxygen in carbohydrates is 1:2:1. Based on the degree of polymerisation, carbohydrates are categorized as monosaccharaides, disaccharides, oligosaccharides, and polysaccharides [10] [11]. The carbohydrate content in millets ranges from 55.0 gm/100 gm (barnyard millet) to 72.6 gm/100 gm (Sorghum). The most important component of both human and animal tissue is protein [12]-[14]. Only when the food protein is hydrolyzed by peptides and proteases to amino acids 1 and dipeptides can it be beneficial. Therefore, the ratios of amino acids determine the nutritional value of dietary protein [15]-[17]. Millets are preferable because they include necessary amino acids like phenylalanine, valine, leucine, and isoleucine. Additionally, fiber is necessary for the maintenance of bodily weight, blood sugar, cholesterol, triglycerides, and digestion. Fiber is made of complex carbohydrates called polysaccharides. Dietary fiber comes from millet seed coatings. With a crude fiber level of 9.8 g/100 g, barnyard millet has the greatest content compared to rice and wheat. Millets are preferable because they include necessary amino acids like phenylalanine, valine, leucine, and isoleucine. Additionally, fiber is necessary for the maintenance of bodily weight, blood sugar, cholesterol, triglycerides, and digestion. Fiber is made of complex carbohydrates called polysaccharides. Dietary fiber comes from millet seed coatings [18]. With a crude fiber level of 9.8 g/100 g, barnyard millet has the greatest content compared to rice and wheat [12] [19].

Epidemiological studies have shown that consumption of millet reduces the risk of heart disease, protects from diabetes, improves the digestive system, lowers the risk of cancer, detoxifies the body, increases immunity in respiratory health, increases energy levels and improves muscular and neural systems and are protective against several degenerative diseases such as metabolic syndrome and Parkinson's disease [20]-[23]. This present was to present the comparative study of nutritional properties of various types of millets namely bajra, sorghum, ragi, little millet, kodo millet, foxtail millet and barnyard millet.

2. Materials and Methods

2.1. Raw Materials

Millet species namely bajra, sorghum, ragi, little millet, kodo millet, foxtail millet,

barnyard millet was purchased from the local market of Chidhambaram, Cuddalore district. The millet samples are sorted based on the literature review [24].

2.2. Preparation of Millet Powder

Measured millets were sorted to remove the dust, sticks, wood, etc., and it was rinsed with water. Then it was dried and grinded using mortar and pestle (traditional method). Then the powder is sieved to discard the coarse mixture. The same procedure is used for all types of millets. The powdered form of millet is shown in (**Figures 1-7**) [25].

2.3. Determination of Nutritional Properties

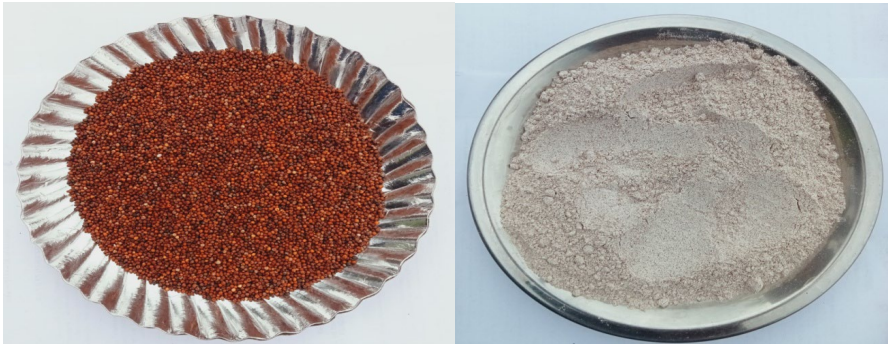
Analysis was carried out according to the procedure of Association of Official Analytical Chemist (A.O.A.C., 2005 for moisture, ash, fibre and protein content. The carbohydrate was calculated by a different method (A.O.A.C., 2005) by subtracting the sum (g/100 g dry matter) of crude protein, crude fat, ash and fibre from 100 g. The energy was calculated by factorial method. Mineral Analysis of metal using FAAS Elemental analysis was carried out by Flame Atomic Absorption Spectrometry (FAAS). Calcium, iron and zinc were measured using a flame photometer [26]. The standard solutions of vitamins were analyzed under chromatographic condition.

(a) (b)

Figure 1. (a) bajra millet (Kambu), (b) bajra millet powder (Kambu).

(a) (b)

Figure 2. (a) red sorghum (Solam), (b) red sorghum powder (Solam).



(a) (b)

Figure 3. (a) ragi (Kezhvaragu), (b) ragi powder (Kezhvaragu).

(a) (b)

Figure 4. (a) little millet (Saamai), (b) little millet powder (Saamai).

(a) (b)

Figure 5. (a) kodo millet (Varaguarisi), (b) kodo millet powder (Varaguarisi).

(a) (b)

Figure 6. (a) foxtail millet (Thinai), (b) foxtail millet powder (Thinai).

(a) (b)

Figure 7. (a) barnyard millet (Kuthiravali), (b) barnyard mil-let powder (Kuthiravali).

3. Result and Discussion

3.1. Study of energy in various types of Millet powder

In Table 1 and Figure 8. It shows the comparative study of energy in various millet powders. Among these varieties Bajra (Kambu) had the highest amount of energy 1450 ± 10 and the lowest amount of energy 310 ± 10 in Barnyard millet (Kuthiravali).

Table 1. Study of energy in various types of millet powder.

Millet	Energy (KJ)
Bajra (Kambu)	1450 ± 10
Sorghum (Solam)	1400 ± 12
Ragi (Kezhvaragu)	1345 ± 10
Little millet (Saamai)	1440 ± 15
Kodo millet (Varagu)	1380 ± 10
Foxtail millet (thinai)	330 ± 5
Barnyard millet (Kuthiravali)	310 ± 10

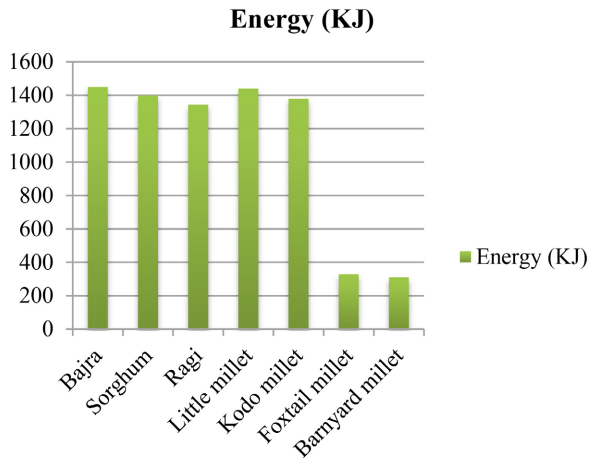


Figure 8. Study of energy in various types of millet powder.

3.2. Study of Carbohydrate in Various Types of Millet Powder

In Table 2 and Figure 9. It shows the comparative study of carbohydrate in

various millet powders. Among these varieties Sorghum (Solam) had the highest amount of carbohydrate 68.5 ± 0.81 and the lowest amount of carbohydrate 58.3 ± 0.5 in Foxtail millet (Thinai).

Table 2. Study of carbohydrate in various types of millet powder.

Millet	Carbohydrate (g)
Bajra (Kambu)	60.70 ± 0.5
Sorghum (Solam)	70 ± 0.72
Ragi (Kezhvaragu)	68.5 ± 0.81
Little millet (Saamai)	65.5 ± 1.5
Kodo millet (Varagu)	65.8 ± 1.19
Foxtail millet (thinai)	58.3 ± 0.5
Barnyard millet (Kuthiravali)	60.07 ± 1.5

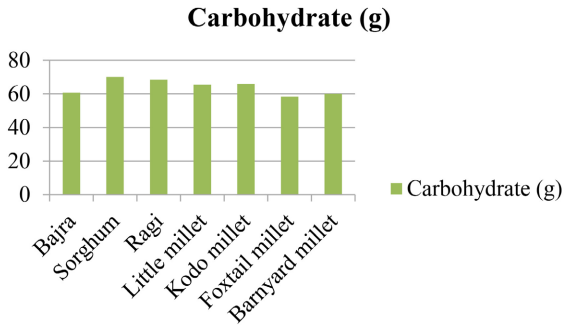


Figure 9. Study of carbohydrate in various types of millet powder.

3.3. Study of Protein in Various Types of Millet Powder

In **Table 3** and **Figure 10**. It shows the comparative study of protein in various millet powders. Among these varieties Foxtail millet (Thinai) had the highest amount of protein 12.0 ± 0.31 and the lowest amount of protein 5.2 ± 0.12 in Barnyard millet (Kuthiravali).

Table 3. Study of protein in various types of millet powder.

Millet	Protein (g)
Bajra (Kambu)	10.85 ± 0.26
Sorghum (Solam)	11.21 ± 0.3
Ragi (Kezhvaragu)	8.5 ± 0.53
Little millet (Saamai)	9.2 ± 1.2
Kodo millet (Varagu)	8.92 ± 1.0
Foxtail millet (thinai)	12.0 ± 0.3
Barnyard millet (Kuthiravali)	5.2 ± 0.12

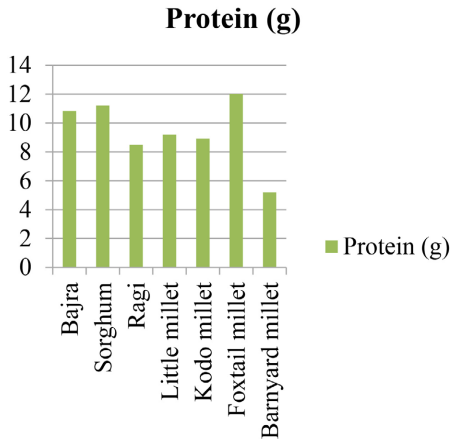


Figure 10. Study of protein in various types of millet powder.

3.4. Study of Fat in Various Types of Millet Powder

In Table 4 and Figure 11. It shows the comparative study of fat in various millet powders. Among these varieties Bajra (Kambu) had the highest amount of fat 5.21 ± 0.3 and the lowest amount of fat 1.72 ± 0.2 in Sorghum (Solam).

Table 4. Study of fat in various types of millet powder.

Millet	Fat (g)
Bajra (Kambu)	5.21 ± 0.3
Sorghum (Solam)	1.72 ± 0.2
Ragi (Kezhvaragu)	1.90 ± 0.2
Little millet (Saamai)	2.50 ± 0.2
Kodo millet (Varagu)	2.50 ± 0.3
Foxtail millet (Thinai)	4.28 ± 0.4
Barnyard millet (Kuthiravali)	2.18 ± 0.12

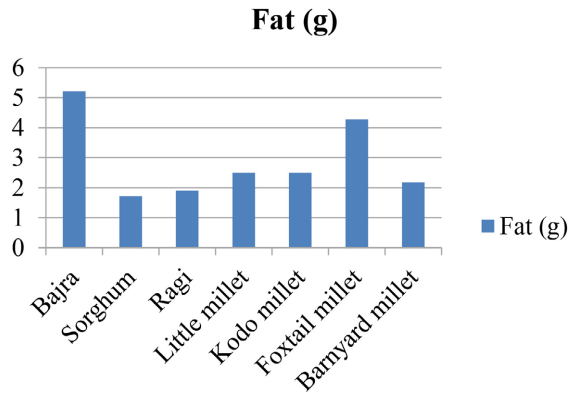


Figure 11. Study of fat in various types of millet powder.

3.5. Study of Fibre in Various Types of Millet Powder

In Table 5 and Figure 12. It shows the comparative study of fibre in various millet

powders. Among these varieties Bajra (Kambu) had the highest amount of fibre 11.50 ± 0.5 and the lowest amount of fibre 6.25 ± 0.45 in Kodo millet (Varagu).

Table 5. Study of fibre in various types of millet powder.

Millet	Fibre (g)
Bajra (Kambu)	11.50 ± 0.5
Sorghum (Solam)	10.21 ± 0.4
Ragi (Kezhvaragu)	11.20 ± 0.5
Little millet (Saamai)	6.39 ± 0.5
Kodo millet (Varagu)	6.25 ± 0.45
Foxtail millet (Thinai)	-
Barnyard millet (Kuthiravali)	-

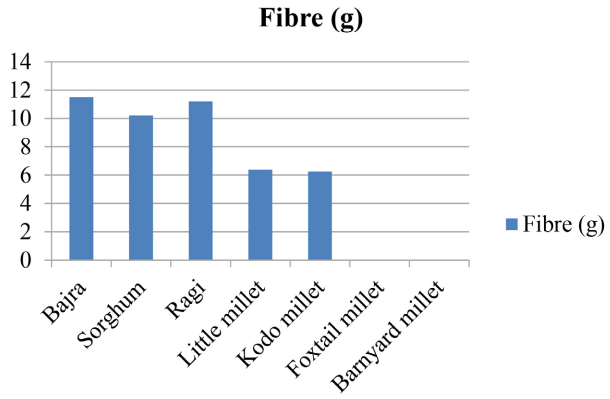


Figure 12. Study of fibre in various types of millet powder.

3.6. Study of Moisture in Various Types of Millet Powder

In Table 6 and Figure 13. It shows the comparative study of moisture in various millet powders. Among these varieties Kodo millet (Varagu) had the highest amount of moisture 14.2 ± 0.52 and the lowest amount of moisture 8.94 ± 0.2 in Bajra (Kambu).

Table 6. Study of moisture in various types of millet powder.

Millet	Moisture (g)
Bajra (Kambu)	8.94 ± 0.2
Sorghum (Solam)	9.00 ± 0.2
Ragi (Kezhvaragu)	10.85 ± 0.5
Little millet (Saamai)	13.25 ± 0.4
Kodo millet (Varagu)	14.2 ± 0.52
Foxtail millet (Thinai)	-
Barnyard millet (Kuthiravali)	-

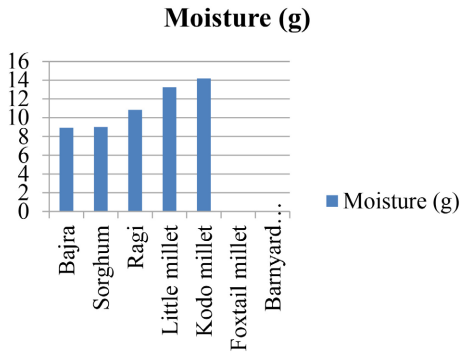


Figure 13. Study of moisture in various types of millet powder.

3.7. Study of Ash in Various Types of Millet Powder

In Table 7 and Figure 14. It shows the comparative study of ash in various millet powders. Among these varieties Ragi (Kezhvaragu) had the highest amount of ash 1.95 ± 0.3 and the lowest amount of moisture 1.35 ± 0.2 in Sorghum (Solam).

Table 7. Study of ash in various types of millet powder.

Millet	Ash (g)
Bajra (Kambu)	1.37 ± 0.3
Sorghum (Solam)	1.35 ± 0.2
Ragi (Kezhvaragu)	1.95 ± 0.3
Little millet (Saamai)	1.65 ± 0.2
Kodo millet (Varagu)	1.62 ± 0.2
Foxtail millet (Thinai)	-
Barnyard millet (Kuthiravali)	-

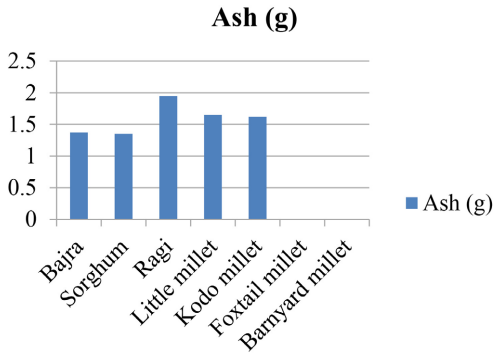


Figure 14. Study of ash in various types of millet powder.

3.8. Study of Minerals in Various Types of Millet Powder

In Tables 8-9 and Figures 15-20. It shows the comparative study of minerals (Cobalt, Copper, Iron Aluminium, Calcium, Chromium) in various millet powders. Among these varieties Bajra (Kambu) had the highest amount of Cobalt 0.035 ± 0.012, Iron 7.52 ± 0.94, Foxtail millet (Thinai) had the highest amount of copper 1.63 ± 0.02, Ragi (Kezhvaragu) had the highest amount of Aluminium 3.65 ± 0.72,

Calcium 383 ± 24, Barnyard millet (Kuthiravali) had highest amount of Chromium 0.092 ± 0.021 and lowest amount of Cobalt 0.002 ± is Little millet (Saamai), Copper 0.36 ± 0.01, Iron 3.52 ± 0.32, Aluminium 1.85 ± 0.49, Calcium 17.23 ± 1.32 is Kodo millet (Varagu) and chromium 0.015 ± 0.005 is Sorghum (Solam).

Table 8. Study of cobalt, copper and iron in various types of millet powder.

Millet	Cobalt (mg)	Copper (mg)	Iron (mg)
Bajra (Kambu)	0.035 ± 0.012	0.63 ± 0.026	7.52 ± 0.94
Sorghum (Solam)	0.016 ± 0.002	0.56 ± 0.02	4.62 ± 0.46
Ragi (Kezhvaragu)	0.026 ± 0.007	0.75 ± 0.05	5.21 ± 0.31
Little millet (Saamai)	0.002 ± 0.00	0.42 ± 0.02	2.31 ± 0.51
Kodo millet (Varagu)	0.005 ± 0.001	0.36 ± 0.01	3.52 ± 0.32
Foxtail millet (Thinai)	0	1.63 ± 0.02	0
Barnyard millet (Kuthiravali)	0	0.82 ± 0.03	0

Table 9. Study of aluminium, calcium and chromium in various types of millet powder.

Millet	Aluminium (mg)	Calcium (mg)	Chromium (mg)
Bajra (Kambu)	2.45 ± 0.53	30.23 ± 2.46	0.026 ± 0.003
Sorghum (Solam)	2.89 ± 0.62	32.92 ± 2.56	0.015 ± 0.005
Ragi (Kezhvaragu)	3.65 ± 0.72	383 ± 24	0.032 ± 0.001
Little millet (Saamai)	0	19.8 ± 1.52	0.02 ± 0.002
Kodo millet (Varagu)	1.85 ± 0.49	17.23 ± 1.32	0.026 ± 0.015
Foxtail millet (Thinai)	0	0	0.03 ± 0.002
Barnyard millet (Kuthiravali)	0	0	0.092 ± 0.021

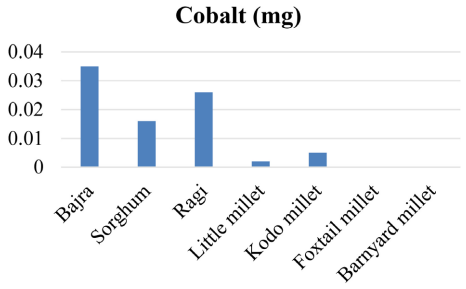


Figure 15. Study of cobalt in various types of Millet powder.

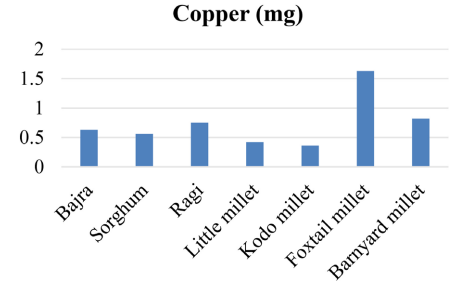


Figure 16. Study of copper in various types of millet powder.

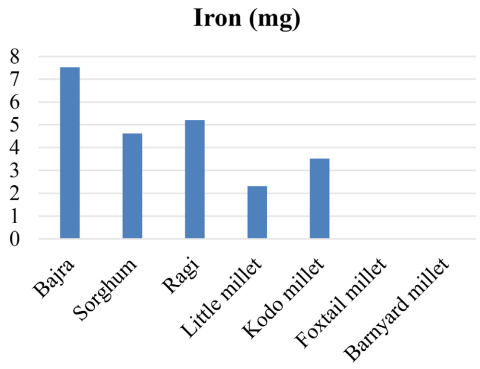


Figure 17. Study of iron in various types of millet powder.

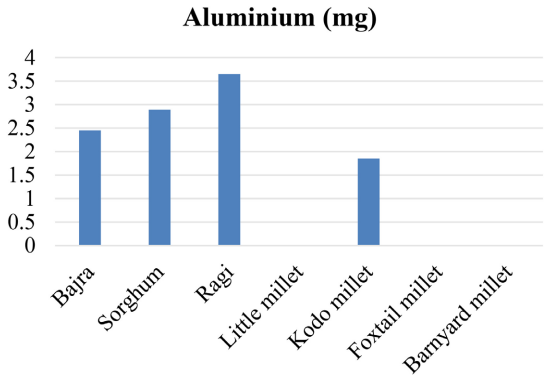


Figure 18. Study of aluminium in various types of millet powder.

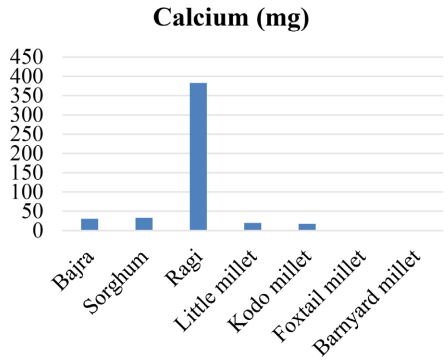


Figure 19. Study of calcium in various types of millet powder.

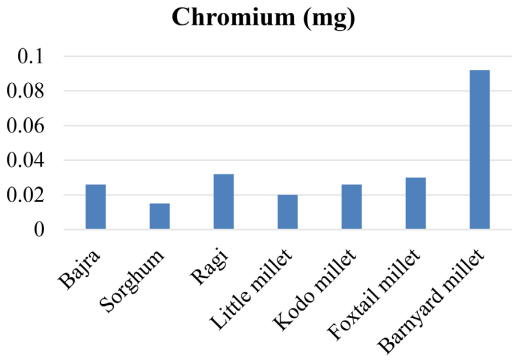


Figure 20. Study of chromium in various types of millet powder.

3.9. Study of Vitamins in Various Types of Millet Powder

In Tables 10-11 and Figures 21-27. It shows the comparative study of vitamins (B1, B2, B3, B5, B6, B7 and B9). Among these varieties Foxtail millet had highest amount of Vitamin B1 0.45 ± 0.05, Vitamin B5 0.75 ± 0.03, Barnyard millet (Kuthiravali) had highest amount of Vitamin B3 0.15 ± 0.04, Bajra (Kambu) had highest amount of Vitamin B2 0.18 ± 0.02 and Vitamin B6 0.35 ± 0.03, Little millet (Saamai) had highest amount of Vitamin B7 6.52 ± 0.65, Soghum (Solam) had highest amount of Vitamin B9 38.63 ± 2.50 and lowest amount of Vitamin B1 0.24 ± 0.04, Vitamin B2 0.04 ± 0.02, Vitamin B6 0.05 ± 0.005 is Little millet (Saamai), Vitamin B3 0.90 ± 0.11 is Bajra (Kambu), Vitamin B5 0.34 ± 0.03, Vitamin B9 34.25 ± 0.43 is Ragi (Kezhvaragu) and Vitamin B7 0.74 ± 0.03 is Sorghum (Solam).

Table 10. Study of Vitamin B1, B2, B3 and B5 in various types of millet powder.

Millet	B1 (mg)	B2 (mg)	B3 (mg)	B5 (mg)
Bajra (Kambu)	0.24 ± 0.02	0.18 ± 0.02	0.9 ± 0.11	0.62 ± 0.023
Sorghum (Solam)	0.38 ± 0.01	0.15 ± 0.01	2.15 ± 0.34	0.35 ± 0.02
Ragi (Kezhvaragu)	0.37 ± 0.02	0.19 ± 0.02	2.12 ± 0.24	0.34 ± 0.03
Little millet (Saamai)	0.24 ± 0.04	0.04 ± 0.002	1.56 ± 0.41	0.63 ± 0.07
Kodo millet (Varagu)	0.26 ± 0.04	0.18 ± 0.02	1.52 ± 0.31	0.53 ± 0.06
Foxtail millet (Thinai)	0.45 ± 0.05	0.13 ± 0.03	3.45 ± 0.26	0.75 ± 0.03
Barnyard millet (Kuthiravali)	0.3 ± 0.01	0.15 ± 0.04	4.86 ± 0.43	0

Table 11. Study of Vitamin B6, B7 and B9 in various types of millet powder.

Millet	B6 (mg)	B7 (mg)	B9 (mg)
Bajra	0.35 ± 0.03	0.75 ± 0.024	35.1 ± 0.52
Sorghum	0.32 ± 0.023	0.74 ± 0.03	38.63 ± 2.50
Ragi	0.06 ± 0.002	0.89 ± 0.04	34.25 ± 0.43
Little millet	0.05 ± 0.005	6.52 ± 0.65	35.5 ± 0.35
Kodo millet	0.09 ± 0.012	1.93 ± 0.26	38.25 ± 0.45
Foxtail millet	0	0	0
Barnyard millet	0	0	0

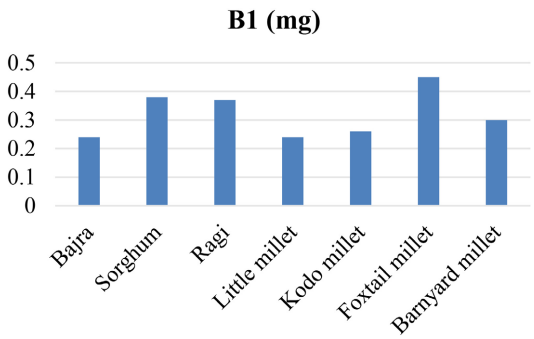


Figure 21. Study of vitamin B1 in various types of millet powder.

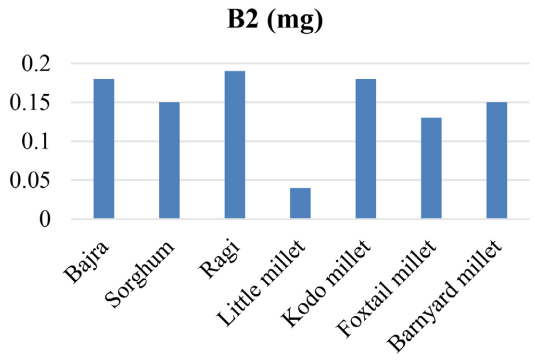


Figure 22. Study of vitamin B2 in various types of millet powder.

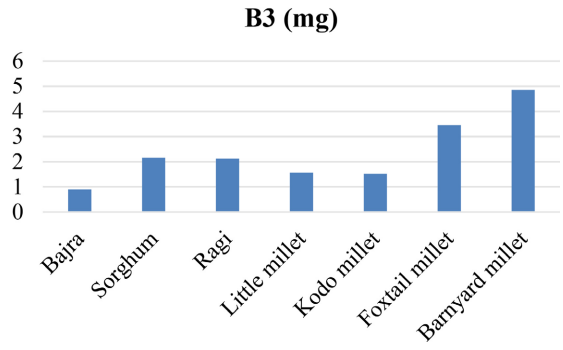


Figure 23. Study of vitamin B3 in various types of millet powder.

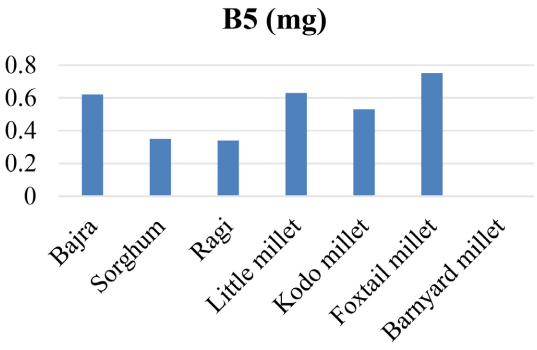


Figure 24. Study of vitamin B5 in various types of millet powder.

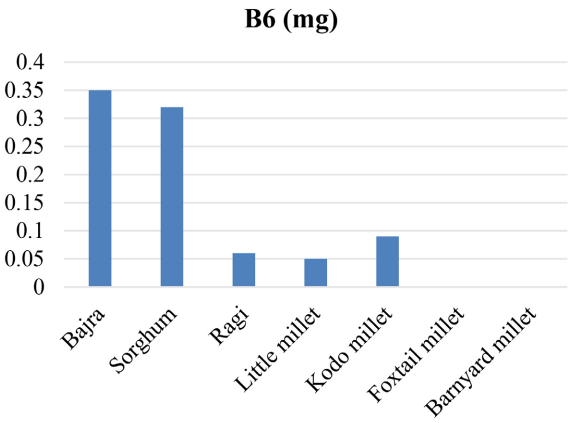


Figure 25. Study of vitamin B6 in various types of millet powder.

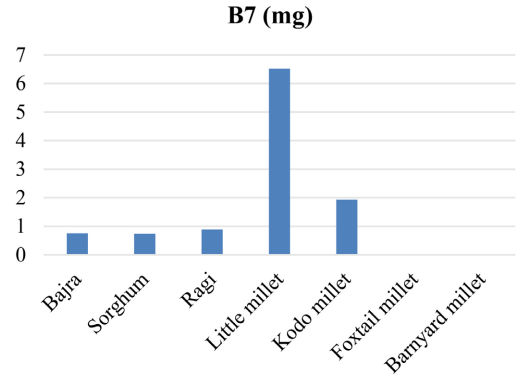


Figure 26. Study of vitamin B7 in various types of millet powder.

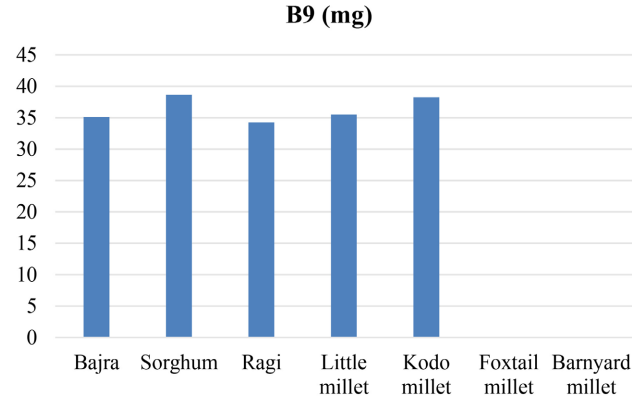


Figure 27. Study of vitamin B9 in various types of millet powder.

The maximum amount of energy gained from millet is 1450 ± 10 (Bajra-Kambu), an average amount of carbohydrate present in various millet powders is 65 g, Sorghum (Solam) is rich source of Protein 11.21 ± 0.3 g, Bajra (Kambu) is rich source of fat (5.21 ± 0.3 g) and fibre (11.50 ±0.5 g). In minerals, among these varieties Bajra (Kambu) had highest amount of Cobalt 0.035 ± 0.012, Iron 7.52 ± 0.94, Foxtail millet (Thinai) had highest amount of copper 1.63 ± 0.02, Ragi (Kezhvaragu) had highest amount of Aluminium 3.65 ± 0.72, Calcium 383 ± 24, Barnyard millet (Kuthiravali) had highest amount of Chromium 0.092 ± 0.021 and lowest amount of Cobalt 0.002 ± is Little millet (Saamai), Copper 0.36 ± 0.01, Iron 3.52 ± 0.32, Aluminium 1.85 ± 0.49, Calcium 17.23 ± 1.32 is Kodo millet (Varagu) and chromium 0.015 ± 0.005 is Sorghum (Solam). In vitamins, Foxtail millet had highest amount of Vitamin B1 0.45 ± 0.05, Vitamin B5 0.75 ± 0.03, Barnyard millet (Kuthiravali) had highest amount of Vitamin B3 0.15 ± 0.04, Bajra (Kambu) had highest amount of Vitamin B2 0.18 ± 0.02 and Vitamin B6 0.35 ± 0.03, Little millet (Saamai) had highest amount of Vitamin B7 6.52 ± 0.65, Soghum (Solam) had highest amount of Vitamin B9 38.63 ± 2.50 and lowest amount of Vitamin B1 0.24 ± 0.04, Vitamin B2 0.04 ± 0.02, Vitamin B6 0.05 ± 0.005 is Little millet (Saamai), Vitamin B3 0.90 ± 0.11 is Bajra (Kambu), Vitamin B5 0.34 ± 0.03, Vitamin B9 34.25 ± 0.43 is Ragi (Kezhvaragu) and Vitamin B7 0.74 ± 0.03 is Sorghum (Solam).

4. Conclusion

This study concluded that millets are good sources of nutrients and in these different types of millet powder the highest amount of nutrients is achieved by Bajra, Sorghum, Ragi, and Little millet. According to the comparative statement, all millet sources are good sources of carbohydrates. Solam (Protein 11.21 g, Chromium 0.015 mg, Vitamin B9 34.25 mg, Vitamin B7 0.74 mg) and Bajra (Fat 5.21 g, Fibre 11.50 g, Vitamin B2 0.18 mg, Vitamin B3 0.90 mg) had the highest source of nutrients by comparing with other minerals.

Acknowledgements

This study was supported by the Department of Chemical Engineering, FEAT Campus, Annamalai University, Annamalai Nagar, Chidambaram.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Rao, D.B., Malleshi, N.G., Annor, G.A. and Patil, J.V. (2017) Millets Value Chain for Nutritional Security: A Replicable Success Model from India. Indian Institute of Millets Research (IIMR), Nutritional and Health Benefits of Millets, 112.

[2] Nainwal, K. (2018) Conservation of Minor Millets for Sustaining Agricultural Biodiversity and Nutritional Security. *Journal of Pharmacognosy and Phytochemistry*, **SP1**, 1576-1580.

[3] Chethan, S., Dharmesh, S.M. and Malleshi, N.G. (2008) Inhibition of Aldose Reductase from Cataracted Eye Lenses by Finger Millet (*Eleusine coracana*) Polyphenols. *Bioorganic & Medicinal Chemistry*, **16**, 10085-10090. https://doi.org/10.1016/j.bmc.2008.10.003

[4] Antony, U., Sripriya, G. and Chandra, T.S. (1996) Effect of Fermentation on the Primary Nutrients in Finger Millet (*Eleusine coracana*). *Journal of Agricultural and Food Chemistry*, **44**, 2616-2618. https://doi.org/10.1021/jf950787q

[5] Yousaf, L., Hou, D., Liaqat, H. and Shen, Q. (2021) Millet: A Review of Its Nutritional and Functional Changes during Processing. *Food Research International*, **142**, Article ID: 110197. https://doi.org/10.1016/j.foodres.2021.110197

[6] Shobana, S., Sreerama, Y.N. and Malleshi, N.G. (2009) Composition and Enzyme Inhibitory Properties of Finger Millet (*Eleusine coracana* L.) Seed Coat Phenolics: Mode of Inhibition of A-Glucosidase and Pancreatic Amylase. *Food Chemistry*, **115**, 1268-1273. https://doi.org/10.1016/j.foodchem.2009.01.042

[7] Amadoubr, I. and Le, M. (2013) Millets: Nutritional Composition, Some Health Benefits and Processing—A Review. *Emirates Journal of Food and Agriculture*, **25**, 501-508. https://doi.org/10.9755/ejfa.v25i7.12045

[8] Lestienne, I., Buisson, M., Lullien-Pellerin, V., Picq, C. and Trèche, S. (2007) Losses of Nutrients and Anti-Nutritional Factors during Abrasive Decortication of Two Pearl Millet Cultivars (*Pennisetum glaucum*). *Food Chemistry*, **100**, 1316-1323. https://doi.org/10.1016/j.foodchem.2005.11.027

[9] Amadou, I., Le, G., Shi, Y., Gbadamosi, O.S., Kamara, M.T. and Jin, S. (2011) Optimized Lactobacillus Plantarum LP6 Solid-State Fermentation and Proteolytic Hydrolysis

Improve Some Nutritional Attributes of Soybean Protein Meal. *Journal of Food Biochemistry*, **35**, 1686-1694. https://doi.org/10.1111/j.1745-4514.2010.00493.x

[10] Amadou, I. (2011) Millet-Based Traditional Processed Foods and Beverages—A Review. *Cereal Foods World*, **56**, 115-121. https://doi.org/10.1094/cfw-56-3-0115

[11] Izadi, Z., Nasirpour, A., Izadi, M. and Izadi, T. (2012) Reducing Blood Cholesterol by a Healthy Diet. *International Food Research Journal*, **19**, 29-37.

[12] Bravo, L. (2009) Polyphenols: Chemistry, Dietary Sources, Metabolism, and Nutritional Significance. *Nutrition Reviews*, **56**, 317-333. https://doi.org/10.1111/j.1753-4887.1998.tb01670.x

[13] Ramachandra, G., Virupaksha, T.K. and Shadaksharaswamy, M. (1977) Relation between Tannin Levels and *in Vitro* Protein Digestibility in Finger Millet (*Eleusine coracana* Gaertn.). *Journal of Agricultural and Food Chemistry*, **25**, 1101-1104. https://doi.org/10.1021/jf60213a046

[14] Thompson, L.U. (1993) Potential Health Benefits and Problems Associated with Antinutrients in Foods. *Food Research International*, **26**, 131-149. https://doi.org/10.1016/0963-9969(93)90069-u

[15] Shafaeizadeh, S., Muhardi, L., Henry, C., Van de Heijning, B. and Van der Beek, E. (2018) Macronutrient Composition and Food Form Affect Glucose and Insulin Responses in Humans. *Nutrients*, **10**, Article 188. https://doi.org/10.3390/nu10020188

[16] Ludwig, D.S., Hu, F.B., Tappy, L. and Brand-Miller, J. (2018) Dietary Carbohydrates: Role of Quality and Quantity in Chronic Disease. *BMJ*, **361**, k2340. https://doi.org/10.1136/bmj.k2340

[17] Wu, G. (2016) Dietary Protein Intake and Human Health. *Food & Function*, **7**, 1251-1265. https://doi.org/10.1039/c5fo01530h

[18] Icmr, I.F.M. (2010) Nutrient Requirements and Rcommended Dietary Allowances for Indians. A Report of the Expert group of the Indian Council of Medical Research.

[19] Chethan, S. and Malleshi, N. (2007) Finger Millet Polyphenols: Optimization of Extraction and the Effect of Ph on Their Stability. *Food Chemistry*, **105**, 862-870. https://doi.org/10.1016/j.foodchem.2007.02.012

[20] Carr, T.P., Weller, C.L., Schlegel, V.L., Cuppett, S.L., Guderian, D.M. and Johnson, K.R. (2005) Grain Sorghum Lipid Extract Reduces Cholesterol Absorption and Plasma Non-Hdl Cholesterol Concentration in Hamsters. *The Journal of Nutrition*, **135**, 2236-2240. https://doi.org/10.1093/jn/135.9.2236

[21] Manach, C., Mazur, A. and Scalbert, A. (2005) Polyphenols and Prevention of Cardiovascular Diseases. *Current Opinion in Lipidology*, **16**, 77-84. https://doi.org/10.1097/00041433-200502000-00013

[22] Scalbert, A., Manach, C., Morand, C., Rémésy, C. and Jiménez, L. (2005) Dietary Polyphenols and the Prevention of Diseases. *Critical Reviews in Food Science and Nutrition*, **45**, 287-306. https://doi.org/10.1080/1040869059096

[23] Chandrasekara, A. and Shahidi, F. (2010) Content of Insoluble Bound Phenolics in Millets and Their Contribution to Antioxidant Capacity. *Journal of Agricultural and Food Chemistry*, **58**, 6706-6714. https://doi.org/10.1021/jf100868b

[24] Mishra, A., Pattnaik, B., Dutta, T. and Baitharu, I. (2022) Nutritional Values and Potential Health Benefits of Millets—A Review. *Journal of Nutrients*, **8**, 9-26. https://doi.org/10.18488/87.v8i1.3176

[25] Vijayakumar T, P. and Beryl Mohankumar, J. (2009) Formulation and Characterization of Millet Flour Blend Incorporated Composite Flour. *International Journal of*

Agriculture Sciences, **1**, 46-54. https://doi.org/10.9735/0975-3710.1.2.46-54

[26] AOAC (2005) Association of Official Analytical Chemist. Official Methods of Analysis. 18th Edition, AOAC International.