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Rhythm Kalsil
School of Agriculture, Department of Food Technology and Nutrition, Lovely Professional University Phagwara, Jalandhar, Punjab, India

Corresponding Author:
Rhythm Kalsil
School of Agriculture, Department of Food Technology and Nutrition, Lovely Professional University Phagwara, Jalandhar, Punjab, India

Diversity in millets and their nutritional benefits: An overview

Rhythm Kalsil

Abstract
Millets are among the world's largest grain produce in African and Asian countries. Being the most primitive first cereal crop for domestication, it serves a major role in maintaining food security of millions of people throughout the world. Millets are gaining huge popularity as a major substitute to rice and wheat in many developing countries of the world due to their surprising health benefits in terms of nutritional (carbohydrates, proteins, fats, fibre) and phytochemical composition (phenols, flavonoids, tannins, saponins). This review focuses on major health prospects as well as quality characteristics of popular millet varieties namely; finger, foxtail, kodo, little, barnyard, proso, pearl and sorghum millets for effective utilization in human diets to overcome food security as well as deficiency disorders.

Keywords: Millets, nutritional, characteristics, food security, food utilization

1. Introduction
The nutritional value of food is one of the most important parameter for maintaining good human health (Sarita and Singh, 2016) [28]. Millets are minor, small seeded annual grass species belonging to family *Poaceae* (Gaikwad *et al*., 2021) [8] and genera viz., *Panicum*, *Setaria*, *Echinocloa*, *Pennisetum* and *Paspalum* in the tribe *Paniceae* and genus *Eleusine* with a short life span. Millets are the most primitive and first cereal crops used by the humans for domestic purposes (Karuppasamy, 2015) [17]. As believed, millets were originated in Africa (in India and Asian continents as well) near the Ethiopian region and thus regarded as the staple food in Africa (Ambati *et al*., 2019) [1]. They are considered as an important crop in Asia and Africa (especially India, Nigeria and Niger) where it's been cultivated in East Asia since 10,000 years. India is known as one of the world's largest producer of millet grains (Sarita and Singh, 2016) [28] with 10,910,000 tones of production reported in the year 2013. The period of sowing to harvesting of millets takes 65 days and millets have higher potential to sustain well under harsh environmental conditions like low water and moderate soil fertility (Bommy and Maheswari, 2016) [3]. They are highly resilient and adaptable crops that can grow in a variety of harsh environmental conditions, making them an important food source for many people around the world. In recent years, there has been a renewed interest in millets due to their high nutritional value and potential health benefits (Kumar *et al*., 2018) [20]. Millets are rich in fiber, vitamins, minerals and antioxidants, and have been linked to a range of health benefits, including improved digestion, lower risk of chronic diseases and better weight management (Gupta *et al*., 2017) [10]. Millets are gaining huge popularity as a substitute to rice and wheat in many countries of the world as they are rich in macro as well as micro nutrients and provide higher energy as compared to other cereals. Additionally, millets have many agricultural benefits for which they are preferred over rice and wheat. A number of health benefits are associated with different species of millet with significant common characteristic goal of growth and development such as treating calcium deficiency, hypoglycemia (low glucose level in blood), hypercholesterolemia, anti-ulcerative property, dyspepsia, poor digestion, improving bowel system, treating cardiovascular diseases, higher blood glucose and increased lipid levels. Millets have a potential to be utilized for the preparation of healthy foods for any age group people due to their numerous health benefits; these grain needs higher attention for maximum utilization. Therefore, the present review is an effort made to collect relevant literature on nutritional prospect of popular millets to explore and make valuable products out of it.

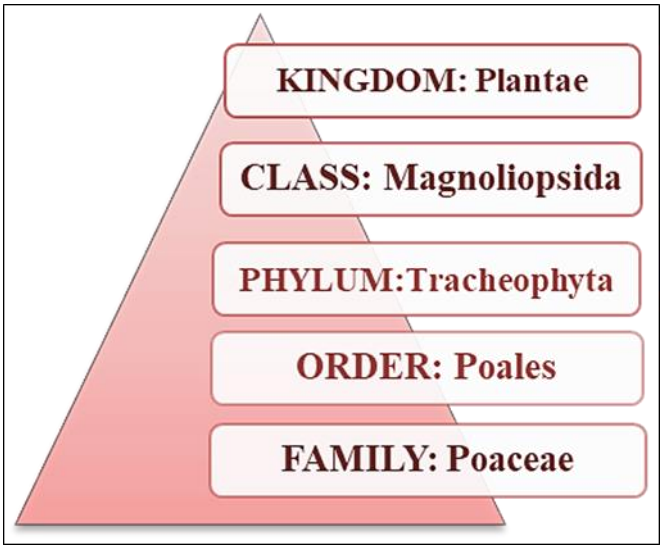

Fig 1: General taxonomical classification of millet

Table 1: Common names associated with popular millet varieties

Sr. No.	Millet	Common name	Scientific name	Sources
1.	Finger millet	Ragi	*Eleusine coracana*	Gaikwad *et al*., 2021 [8] Borkar *et al*., 2021 [4]
2.	Little millet	Moraiyo or Kutki or Shava	*Panicum sumatrense*	
3.	Sorghum millet	Jowar	*Sorghum bicolor*	
4.	Kodo millet	Kodon	*Paspalum scrobiculatum*	
5.	Foxtail millet	Kakum and kangni	*Setaria italica*	
6.	Pearl millet	Bajra	*Pennisetum glaucum*	
7.	Barnyard millet	Sanwa	*Echinochloa crusgalli*	
8.	Proso millet	Chena	*Panicum miliaceum*	

2. Major millet varieties in India

Millet differs from one another in terms of appearance, grain type, maturity time, morphological features, size and color of seed coat etc. (ICRISAT, 2007; Sarita and Singh, 2016) [16, 28]. This difference can be easily analyzed by the nutritional composition of the millet. Pearl millet and finger millet are the most consumed varieties of millets not in India but worldwide. Apart from this, foxtail, kodo, little, barnyard, proso and sorghum millets are also gaining much more importance in filling poor man's plate as well as maintaining food security.

2.1 Finger millet

Finger millet is scientifically known as *Eleusine coracana* (L.) which belongs to Family *Poaceae* and the genus *Eleusine*. It is annual herbaceous self-pollinated cereal crop as well as an allotetraploid (2n = 4X = 36, AABB) which people in Africa and Asia grow and consume as well. Finger millet has higher protein, dietary fiber, and iron, essential amino acids (isoleucine, leucine, methionine and phenylalanine) as well as mineral content on being compared to other cereal crops of same variety. It is well known for its calcium (Ca) content (Kumar *et al*., 2016) [19]. Most beneficiary advantage is its gluten free nature which suites best for gluten intolerant patients. It is a highly valuable crop in Africa's drought-prone regions (can grow in low water quantity as well). Finger millet has numerous health benefits, including treating calcium deficiency, hypoglycemia, hypercholesterolemia and an anti-ulcerative property which makes it potent for greater utilization in human as well as baby's diet (Gupta *et al*., 2017) [10].

2.2 Foxtail millet

Foxtail millet is scientifically known as *Setaria italica* (L.)., one of the most versatile cereal crops. The genus belongs to subfamily *Panicoideae* and tribe *Paniceae*. The genomes of *Setaria italica* are classified as AA genomes, with ploidy of (2n = 2x = 18). A single inflorescence produces hundreds of small convex seeds with a diameter of about 2 mm (Eduru *et al*., 2021) [7]. Foxtail millet is a very popular energy source for pregnant and lactating women, as well as sick people and children, especially those with diabetes. It has been reported to lower blood sugar levels in diabetic women. It's used to treat dyspepsia, poor digestion, and food stagnation in the intestines. As a result, foxtail millet is a highly adaptable crop as it can thrive well in unfavorable environmental conditions (Thathola *et al.* 2010) [32].

2.3 Kodo millet

Scientifically known as *Paspalum scrobiculatum* (L.) belongs to the family *Poaceae.* Kodo millet is also very popular by Araka or cow grass or ditch millet, typically grown in India (birthplace of kodo millet). Domestication and cultivation of kodo millet goes back to 3000 years ago. It is widely distributed in widely semi-arid regions of even poor soil of India and Africa. It's an annual grass which reaches a certain height of about 90 cm ranging from light red to dark grey color seeds. Kodo millet is well known for its higher drought resistance property and produces good yields in a shorter period of 80-135 days and can be stored for a longer duration of time (Saxena *et al.*, 2018) [29]. Higher percentage of carbohydrates, vitamins, minerals and sulfur-containing phytochemicals, non-essential amino acids such as lysine, threonine, valine, antioxidants and phenolics (phytates,

phenols and tannins), makes it a dense mineral nutrient for proper growth and development in children as well as adults.

2.4 Pearl millet

Pearl millet is scientifically known as *Pennisetum glaucum* (L.) which belongs to family *Poaceae*. Pearl millet is a staple food for the majority of the poor people and small landholders, as well as a good source of feed and fodder for livestock. It is a C4 plant with higher photosynthetic efficiency and greater dry matter production capacity which makes pearl millet outperforms all other cereals. It requires fewer resources and is used as nutritious food, feed and fodder (Nambiar and Patwardhan, 2014) [23]. Pearl millet is an excellent source of energy, carbohydrate, protein, fat, ash, dietary fibre and minerals such as iron and zinc therefore referred to as a "nutricereal". (Poonam *et al*., 2002) [26]. Pearl millets have recently gotten a lot of attention as a dietary option for diabetics too (Henry and Kaur 2014; Muthamilarasana *et al*., 2016) [14, 22].

2.5 Sorghum

Scientifically known as *Sorghum bicolor* (L.) belongs to family Poaceae. *Sorghum bicolor*is famous by great millet, Indian millet, milo, durra, or orshallu. This plant is thought to be originated in Africa, and serves as major staple food crop. Sorghum is locally known as jowar, cholam, or jonna in India, Guinea corn in West Africa, and kaoliang in China. Sorghum is most popular for its drought and heat resistance features in hot and arid climates (Mace *et al*., 2009) [21]. Due to less knowledge it is primarily grown only for forage and animal feed in many developed nations of the world (Hariprasanna and Patil, 2015; Venkateswaran *et al*., 2019) [13, 36]. Sorghum grain nutrient composition is highly variable with higher amount of B-complex vitamins. Certain level of antioxidants has shown to reduce the risk of cancer, atherosclerosis, arthritis, inflammatory bowel disease and cataracts by affecting the free radicals formation in the body (Harborne *et al*., 2000) [12].

2.6 Barnyard millet

Barnyard millet is scientifically known as *Echinochloa crusgalli* (L.) *P. Beauvois* or billion-dollar grass belongs to the family Poaceae. It is self-pollinated crop grown for food as well as fodder. It is the earliest known domesticated small millet. One such variety is *Echinochloa esculenta*, also known as Japanese Barnyard millet or Japanese millet, and another *Echinochloa frumentacea*, is also known as Indian Barnyard millet, are the two major species of Barnyard millet (Kumar *et al*., 2000) [18]. Being a good source of easily digested protein with high dietary fibre, barnyard millet is known miracle crop for sedentary workers. Barnyard millet is rich with linoleic acid followed by palmitic and oleic acids. Consumption of barnyard millets proves effective against cardiovascular diseases, higher blood glucose, and increased lipid levels. Well suited for people suffering from celiac diseases.

2.7 Little Millet

Little millet is scientifically known as (*Panicum sumatrense*) belongs to family *Poaceae*. Little millet seeds are smaller in size than common millet seeds as it is an annual herbaceous plant that grows up to a height of 30 cm to 1 m tall. Little millet seeds were discovered in Gujarati archaeological excavations back 2000 to 1500 BC (Venkatesh Bhat *et al*., 2018) [35]. It has excellent ability to withstand both drought and flooding. Due to its early maturity and immense resistance to adverse agro-climatic conditions, little millet is among the most reliable crop Little millet is rich in nutrients, has several health benefits which fits into a variety of cropping systems due to its short duration (Eduru *et al*., 2021) [7].

2.8 Proso millet

Proso millet is scientifically known as *Panicum miliaceum* L. is a summer annual grass which is most frequently grown as a late-seeded summer crop (Habiyaremye *et al*., 2017) [11]. It is also known as "broom corn" due to salient feature of drooping panicles like a broom (Changmei and Dorothy, 2014) [5]. It is a C4 plant with low transpiration rate and high drought tolerance. Its height ranges from 30 to 100 cm with an adventitious root system. The crop is highly sensitive to frost and temperature of 20 to 30 ˚C is highly recommended for germination. It is one of the richest source of lecithin supporting the neural system along with vitamin B complexes (Vitamin B3, B7) and several minerals (P, Zn, Fe) (Eduru *et al*., 2021) [7]. Studies have concluded that increased consumption of Proso millet or its byproducts results in reduced risk of chronic diseases like higher levels of serum cholesterol (Nishizawa *et al*., 1995; Himanshu *et al*., 2018) [24, 15].

3. Nutritional and phytochemical exploration of popular millets

Millets are gaining huge popularity as a major substitute to rice and wheat in many developing countries of the world due to their surprising health benefits. Millets majorly comprise of 60-70% carbohydrates, 7-11% proteins (sulphur containing amino acids; methionene and cysteine), 1.5-5% fat (linoleic, oleic and palmitic acids), 2-7% crude fibre, vitamins (Niacin, folacin, riboflavin, and thiamine) minerals (calcium, iron, potassium, magnesium and zinc), antioxidants and phytochemicals (phenols, tannins, alkaloids and saponins) on average (Sarita and Singh, 2016; Singh *et al*., 2012) [28, 31]. Below mentioned table 1 depicts the nutritional composition of 8 major millets. Duodu and Awika, 2019 [6] has concluded in their study of phytochemical analysis of ethanol extracts from different varieties of millets proves the presence of phenols, tannins, alkaloids and saponins, along with carbohydrates, proteins, glycosides, fibers and several flavonoids. Flavonoids are group of polyphenol compounds that causes the blue, red, and purple colors of foods. These are structurally characterized by the aromatic rings linked by heterocyclic compounds of tricarbon molecules. Different classes of anthocyanins, flavones, flavanols, flavonols and proanthocyanidins have been identified in several varieties of millet grains. Quantitative analysis of the extract showed the total phenolic content was higher in that kodo millet (11.35%) and the followed by barnyard millet (10.1%) whereas foxtail millet was reported to have lowest phenolic content (Sharma *et al*., 2021) [30]. Another study includes report where Xiang *et al*., 2019 [37] has concluded that the concentration in millets is directly linked with seed coat color of the grains. The study included four millet varieties with brown, white, reddish and red as the seed coat color with highest concentration was obtained in red (202.94 mg catechin eq/100 g) and lowest in white seed coat of Ragi (finger millet) as (90.24 mg catechineq/100 g). Similar study includes the report of

flavonoid content in barnyard millets as 101.3 mg catechin/ 100 g while 115.8 mg catechin/100 g in finger Italian millet (Ofosu *et al*., 2020) [25]. Another study was conducted by Vandana, L. (2018) where the quantitative analysis of extracts of millets for the determination of total Phenolics and Flavonoids content revealed that Kodo Millet (11.35%) stands highest for phenolic content followed by Little millet (10.3%) and Barnyard Millet (10.1%) whereas lowest phenolic content was observed in Foxtail Millet as 5.5%. Total flavonoids analysis showed, the Barnyard Millet (49.5±2.98) has maximum flavonoids content (49.5%) as compared to 6 other samples of millets. Despite their high nutritional value and potential health benefits, millets are often considered to be less popular than other grains such as rice and wheat. One of the main reasons for this is the cultural bias towards certain grains in different regions of the world. For example, rice is considered to be a staple food in many Asian countries, while wheat is commonly consumed in Europe and North America. In contrast, millets are often perceived as a poor man's food or a food of last resort, and are not widely accepted as a mainstream food crop.

Table 2: Nutritional composition of millets per 100g of the sample

Sr. No.	Millet	Protein (g)	Fat (g)	Carbohydrate (g)	Energy (Kcal)	Minerals (g)	Moisture (g)	Sources
1.	Finger millet	7.7	1.5	72.6	350	2.7	13.1	Gopalan *et al*., 2009 [9] Gaikwad *et al*., 2021 [8] Eduru *et al*., 2021 [7] USDA, 2019 [33]
2.	Little millet	9.7	5.2	60.9	341	1.5	11.5	
3.	Sorghum	10.6	3.1	70.7	329	1.67	12.4	
4.	Kodo millet	8.3	1.4	65.9	309	2.6	12.8	
5.	Foxtail millet	11.2	4.0	63.2	351	3.3	11.2	
6.	Pearl millet	11.8	4.8	67.0	363	2.3	12.4	
7.	Barnyard millet	6.2	2.2	65.5	307	4.4	11.9	
8.	Proso millet	12.5	1.1	70.4	341	1.9	11.9	

4. Conclusion and future prospect

The importance of review is to enlighten the nutrient composition and major health benefits of millets which may prove to be beneficial in near future. In still developing countries, primarily cereal based meals have lesser bioavailability of major minerals such as iron, calcium and zinc which provoke the crucial hassle for toddlers and younger children. Millets may prove to be as effective as other cereal crops for dealing with the severe malnutrition and global increasing population problems. It is thereby necessary to increase millet production and lower the processing cost by inventing some revolutionary improvements in production technologies. Overall, the low popularity of millets can be attributed to a combination of cultural, economic, and structural factors that have limited the promotion, consumption, and production of millets. Addressing these challenges will require a concerted effort from various stakeholders, including governments, researchers, farmers, and industry players, to increase awareness, investment, and innovation in millet-based food systems. Therefore, to enjoy the health benefits of millets, some food processing strategies must be implied to improve dietary quality which can further enhance the digestibility and bioavailability of nutrients.

5. References

1. Ambati Kimeera, Sucharitha KV. Millets-review on nutritional profiles and health benefits. International Journal of Recent Science Research. 2019;10(7):33943-33948.
2. Anitha S, Givens DI, Subramaniam K, Upadhyay S, Kane-Potaka J, Vogtschmidt YD, *et al.* Can Feeding a Millet-Based Diet Improve the Growth of Children?-A Systematic Review and Meta-Analysis. Nutrients. 2022;14:225. https://doi.org/10.3390/nu14010225
3. Bommy D, Maheswari SK. Promotion of millets cultivation through consumption. International Journal of Current Research Academic Review. 2016;3:74-80.
4. Borkar S, Dholariya PK, Borah A. Functional foods, their components and relevant health benefits: A review. Pharma Innovation. 2021;10(5):204-210. DOI: 10.22271/tpi.2021.v10.i5c.6206
5. Changmei S, Dorothy J. Millet-the frugal grain. International Journal Scientific Research and Reviews. 2014;3:75-90.
6. Duodu KG, Awika JM. Phytochemical-related health promoting attributes of sorghum and millets. In: Sorghum and Millets. Duxford, United Kingdom: Elsevier; c2019. p. 225-258.
7. Eduru A, Kamboj A, Manisha PR, Pal B, Vikas. Nutritional and health benefits of millets, present status and future prospects: A review. The Pharma Innovation Journal. 2021;10(5):859-868.
8. Gaikwad V, Rasane P, Singh J, Idate A, Kumthekar S. Millets: Nutritional potential and Utilization. Pharma Innovation. 2021;10(5):310-313. DOI: 10.22271/tpi.2021.v10.i5e.6225
9. Gopalan C, Rama Sastri BV, Balasubramanian SC. Nutritive value of Indian foods. Hyderabad, India: National Institute of Nutrition, Indian Council of Medical Research; c2009.
10. Gupta SM, Arora S, Mirza N, Pande A, Lata C, Puranik S, *et al*. Finger Millet: a “certain” crop for an “uncertain” future and a solution to food insecurity and hidden hunger under stressful environments. Frontier Plant Science. 2017;8:643. Doi: 10.3389/fpls.2017.00643.
11. Habiyaremye C, Matanguihan JB, D’Alpoim Guedes J, Ganjyal GM, Whiteman MR, Kidwell KK, *et al*. Proso Millet (*Panicum miliaceum* L.) and Its Potential for Cultivation in the Pacific Northwest, U.S.: A Review. Frontiers in Plant Science; c2017. p. 7. Doi: 10.3389/fpls.2016.01961
12. Harborne JB, Williams CA. Advances in flavonoid research since 1992. Phytochemistry. 2000;55(6):481-504.
13. Hariprasanna K, Patil JV. Sorghum: Origin, classification, biology and improvement, in Sorghum molecular breeding. Eds. Madhusudhana R, Rajendrakumar P and Patil JV (New Delhi, India: Springer); c2015. p. 3-20. doi: 10.1007/978-81-322-2422-8_1.

14. Henry CJ, Kaur B. Diet-based management and treatment of diabetes. World Clinical Diabetology. 2014;1:1-19.
15. Himanshu K, Chauhan M, Sonawane SK, Arya SS. Nutritional and Nutraceutical Properties of Millets: A Review. Clin J Nutr. Diet. 2018;1(1):10.
16. ICRISAT. International Crops Research Institute for the Semi-Arid Tropics, Annual report; c2007. http://test1.icrisat.org/Publications/EBooksOnlinePublications/Annul-report2007.pdf
17. Karuppasamy P. Overview on Millets. Trends in Biosciences. 2015;8(13):3269-3273.
18. Kumar P, Jyothi Lakshmi N, Dube SD, Mani VP. Genotypic difference in photosynthesis and its associated parameters in relation to yield among Barnyard Millet (*Echinochloa frumentacea*) genotypes under condition in hills. Indian Journal of Agricultural Science. 2000;70(6):374-377.
19. Kumar A, Metwal M, Kaur S, Gupta AK, Puranik S, Singh S, *et al.* Nutraceutical value of finger millet [*Eleusine coracana* (L.) Gaertn. and their improvement using omics approaches. Frontier Plant Science. 2016;7:934. Doi: 10.3389/fpls.2016.00934.
20. Kumar A, Tomer V, Kaur A, Kumar V, Gupta K. Millets: a solution to agrarian and nutritional challenges. In Agriculture; Food Security. Springer Science and Business Media LLC, 2018, 7(1). https://doi.org/10.1186/s40066-018-0183-3
21. Mace ES, Rami JF, Bouchet S, Klein PE, Klein RR, Kilian A, *et al.* A consensus genetic map of sorghum that integrates multiple component maps and high-throughput Diversity Array Technology (DArT) markers. (Research article) (Report). BMC Plant Biol. 2009;9:13. Doi: 10.1186/1471-2229-9-13.
22. Muthamilarasana M, Dhakaa A, Yadav R, Prasad M. Exploration of millet models for developing nutrient rich graminaceous crops. Plant Science. 2016;242:89-97. Doi: 10.1016/j.plantsci.2015.08.023.
23. Nambiar VS, Patwardhan T. Millets in diabetes-emic views. International Journal of Pure Applied Biosciences. 2014;2:89-97.
24. Nishizawa N, Fudamo Y. The elevation of plasma concentration of high-density lipoprotein chloesterol in mice fed with protein from proso millet (*Panicum miliaceum*). Bio Sci Biotech Biochem. 1995;59:333-5.
25. Ofosu FK, Elahi F, Daliri EBM, *et al.* Phenolic profile, antioxidant and antidiabetic potential exerted by millet grain varieties. Antioxidants. 2020;9:254.
26. Poonam. Effect of acid and heat treatment on nutrient composition and shelf life of pearl millet (*Pennisetum glaucum*) flour. MSc thesis, CCS Haryana Agricultural University, Hisar, Haryana, India; c2002. p. 106.
27. Puranik S, Kam J, Sahu PP, Yadav R, Srivastava RK, Ojulong H, *et al.* Harnessing finger millet to combat calcium deficiency in humans: challenges and prospects. Frontier Plant Science. 2017;8:13-11. Doi: 10.3389/fpls.2017.01311.
28. Sarita, Singh E. Potential of Millets: Nutrients Composition and Health Benefits. Journal of Scientific and Innovative Research. 2016;5(2):46-50.
29. Saxena R, Vanga SK, Wang J, Orsat V, Raghavan V. Millets for Food Security in the Context of Climate Change: A Review. Sustainability. 2018;10:1-31.
30. Sharma R, Sharma S, Dar BN, Singh B. Millets as potential nutri-cereals: A review of nutrient composition, phytochemical profile and techno-functionality. International Journal of Food Science & Technology. 2021;56(8):3703-3718. Doi: 10.1111/ijfs.15044
31. Singh KP, Mishra A, Mishra HN. Fuzzy Analysis of Sensory Attributes of Bread Prepared from Millet-Based Composite Flours. LWT-Food Science and Technology. 2012;48:276-82.
32. Thathola A, Srivastava S, Singh G. Effect of foxtail millet (*Setaria italica*) supplementation on serum glucose, serum lipids and glycosylated hemoglobin in type 2 diabetics. Diabetologia Croat. 2010;40:23-28.
33. USDA. National nutrient database for standard reference legacy release: Full report (all nutrients) 20067, Sorghum Grain; c2019. Retrieved from https://ndb.nal.usda.gov/ndb/foods/show/20067?n1=%7BQv%3D1%7D&fgcd=&man=&lfacet=&count=&max=25&sort=default&qlookup=sorghum&offset=&format=Full&new=&measureby=&Qv=1&ds=&qt=&qp=&qa=&qn=&q=&ing=
34. Vandana L. in vitro Study for Evaluation of Proximate Composition, Phytochemical & Neutraceutical Properties of Different Millet Samples; c2018.
35. Venkatesh Bhat B, Dayakar Rao B, Tonapi VA. The Story of millets (Ed). Karnataka State Department of Agriculture, Bengaluru and ICAR-Indian Institute of Millets Research, Hyderabad, India; c2018. p. 110.
36. Venkateswaran K, Elangovan M, Sivaraj N. Origin, Domestication and Diffusion of *Sorghum bicolor*, in Breeding Sorghum for Diverse End Uses. Eds. Aruna C, Visarada KBRS, Bhat BV, Tonapi VA. (Cambridge, United Kingdom: Woodhead Publishing); c2019. p. 15-31.
37. Xiang J, Apea-Bah FB, Ndolo VU, Katundu MC, Beta T. Profile of phenolic compounds and antioxidant activity of finger millet varieties. Food Chemistry. 2019;275:361-368.