Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2022; 11(3): 177-185
Received: 07-03-2022
Accepted: 13-04-2022

Ahire Nikita Sanjay
Department of Pharmaceutics, SNJB'S Shriman Sureshdada Jain College of Pharmacy, Chandwad, Nashik, Maharashtra, India

Ganesh Basarkar
Department of Pharmaceutics, SNJB'S Shriman Sureshdada Jain College of Pharmacy, Jain Gurukul, Neminagar Chandwad, Nashik, Maharashtra, India

Vaibhav Buchake
Department of Pharmaceutics, SNJB'S Shriman Sureshdada Jain College of Pharmacy, Jain Gurukul, Neminagar Chandwad, Nashik, Maharashtra, India

Corresponding Author:
Ahire Nikita Sanjay
Department of Pharmaceutics, SNJB'S Shriman Sureshdada Jain College of Pharmacy, Jain Gurukul, Neminagar Chandwad, Nashik, Maharashtra, India

Millets: An overview- A treatise on healthy option in daily diet

Ahire Nikita Sanjay, Ganesh Basarkar and Vaibhav Buchake

Abstract
Millets are nutri-cereals have excellent nutrient content contains proteins, vitamins, essential fatty acids, dietary fibres, minerals such as zinc, iron, potassium, calcium, magnesium. They help in consign health benefits like blood pressure management, regulation of blood sugar level, thyroid, cardiovascular and celiac disease. This review aims to collect information available in the existing literature, both online and offline, on the detailed information about millets, including their pharmaceutical applications as a novel excipients in formulation development, health, recent millets production status in India and market availability. Health benefits aim their nutritional value and attempts to present the collected data in an easily documented model with the given nutritional benefits of millets. Their nutritional value must make an effort to encourage peoples to add millets in their diet and pharmaceutical applications of millets as novel pharmaceutical excipients as a part of formulation to replace synthetic excipients with natural one leads to reduce cost of formulation.

Keywords: Millets, millets availability in market, health benefits of millets

Introduction
Millets are the cereals of grass family Poaceae, They are small seeded grasses, many from them adapted to tropical and in arid climates, and they are characterized according to their ability to thrive in less fertile soil [1]. Millets are classified into three types on the basis of their grain size. Major millets i.e. Sorghum (Jowar), Pearl (Bajra), Finger (Ragi/Mandua) millet, Minor millets i.e.Foxtail (Kangi/Kakum), Kodo (Kodon), Barnyard (Sanwa), little (Kutki) and Proso (Cheena) millet. Pseudo millets i.e. Amaranth (Ramdana), Buckwheat (kuttu) millet [2]. Pseudo millets are not part of Poaceae botanical family but they are nutritionally similar to other type of millets. Millets were declared nutri-cereals by Indian government in April 2018. Mr.VilasTonapi director, Indian Institute of Millets Research (IIMR). He stated that the year 2023 has been designated as International year of millets and every effort willl be made to expand countries millet cultivation and consumption. It has been cultivated for thousands of years and used all over the world. Most of the world's commercial millet is produced in India, China, Greece, Africa and Egypt. However, even in rural areas part of millet are used as food, such as finger millet, pearl millet, sorghum etc.
and the remaining part is used as livestock feed. Dr.Khadar Vali is a nutritionist, he is also known as "Millets man of India" suggests millet containing diet. He has been promoting the use of 'Siridhanya' or positive grains or rich grains to achieve good health (Barnyard Millet, Kodo Millet, Little Millet, Foxtail Millet and Browntop Millet). Millets are non-glutinous and they having many
nutraceutical and health promoting benefits due to high fibre content act as probiotics. Lower cholesterol due to the presence of niacin content. Millets consumption triglycerides and C-reactive proteins, however preventing cardiovascular diseases. Fibres also increase transit time of food in gut, which helps in reducing the risk inflammatory bowel disease and act as detoxifying agent in the body. A calories restricted diet, moderately lower in carbohydrates, helpful in lowering insulin resistance and other metabolic abnormalities in overweight individual [3-8].

Fig 1: Different type of millets

3. Classification of millets

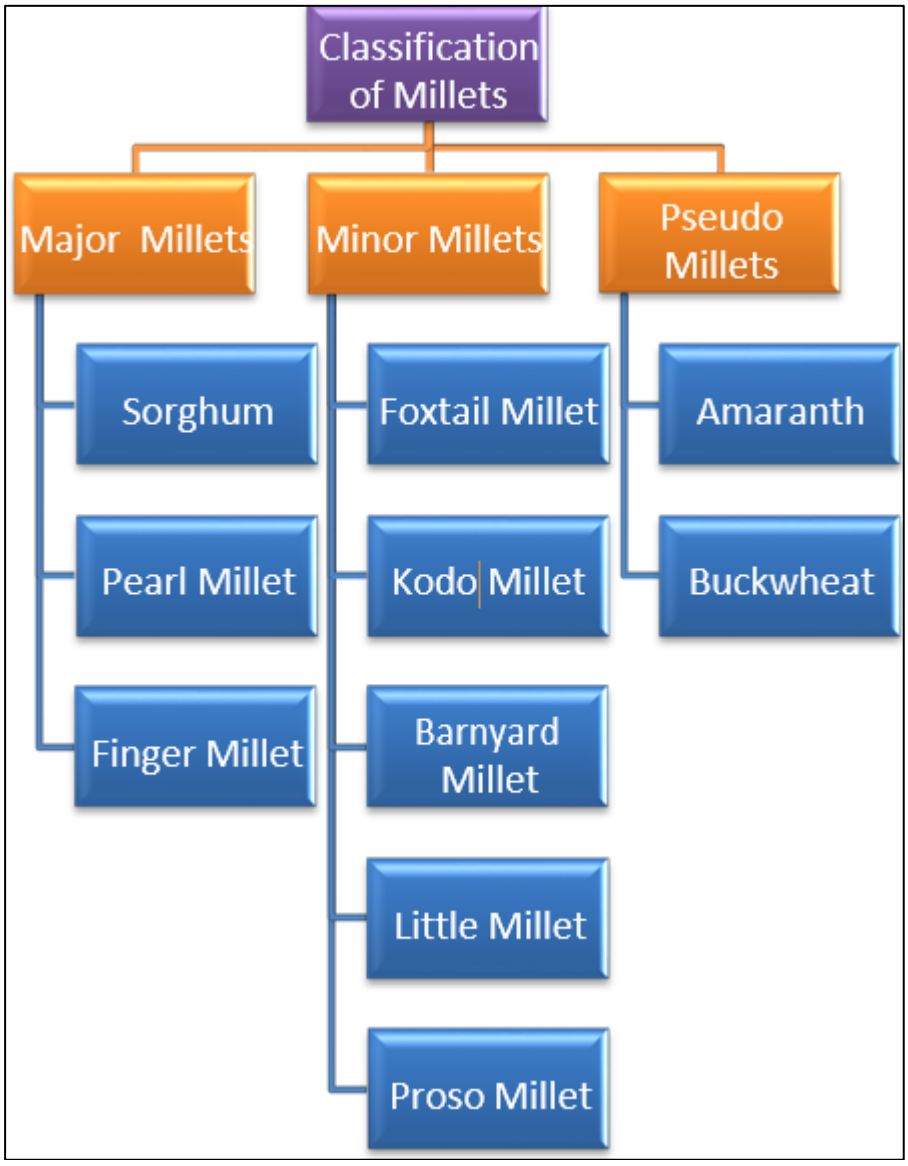

Fig 2: Classification of millets

Major millets

***Sorghum bicolor* (Sorghum)**

Sorghum bicolor, also known as great millet, belonging to the family Poaceae, originated in Africa. Sorghum is major cerel in the semi-arid region of the world. It is an important food and feed crop [9]. The USA is major producer of sorghum, but the grains is consumed as human food in very less extent, while in the semi-arid tropics of Africa and India the grain forms the staple diet for large populations. There are total 30 species of sorghum. *S. bicolor* is cultivated for grain and forage. Sorghum is gluten-free cereal, nowadays play significant role for individuals having celiac disease and gluten intolerance. Sorghum grains play vital role in tumour development inhibition due to the presence of phenolic

compounds like flavonoids [10]. The starches and sugars present in sorghum released in slow rate assign comparison with another cereal [11] and hence it could be beneficial for patients suffering from diabetes [12].

***Pennisetum glaucum* (Pearl millet)**

Pennisetum glaucum, also known as Bajra, originated in tropical western Africa. It is placed closed to the genus *cenchrus* on the basis of spikelet's that are arranged groups surrounded by involucre [13, 14]. It is member of family Poaceae. Pearl millet is the most popular millet, contributing for 95% of total production [72, 73]. Pearl millet crop mostly cultivated in Gujarat, Haryana, Maharashtra, Rajasthan and Uttar Pradesh states in India. It is an important coarse grain cereal and forage crop of arid and semi-arid tropics of the Indian subcontinent and many several Africa regions [15]. It consists of more than 8000 species belonging to about 60 genera, genus *Pennisetum* includes approximately 140 species that are distributed in tropics and subtropics [16]. Recently pearl millet introduced as a grain crop in south-eastern coastal plain of the United States, where it has been used as summer forage.

***Eleusine coracana* (Finger millet)**

Eleusine coracana, also known as ragi, member of family Poaceae. Originated in highlands of Eastern Africa. Finger millet is the sixth most widely grown crop in the world, serve as primary food for rural communities [75]. It is widely cultivated in Africa and India. There are total 10 species of *Eleusine coracana* under the genus *Eleusine Gaertn.*, different studies confirmed that the *Eleusine coracana* was originated from *E. Indica* and *E. Floccifolia* genomes and selected for cultivation from wild type of *E. Africana* [17, 18]. Research suggest that whole grains and cereal fibre consumption are inversely associated with BMI, total cholesterol, waist circumstances, metabolic syndrome, mortality from cardiovascular disease, insulin resistance and in case of type2 diabetes [4-6].

Minor millets

***Panicum italicum L* (Foxtail millet)**

Panicum italicum L., is originated in china, at present foxtail millet is cultivated in 26 countries and rank second in world production of millet. In terms of it's yielding ability, Foxtail millet ranks 4th among all millets [19]. It is world's second-largest millet crop used for food cultivated in India, China, Africa, USA, Russia and some parts of Europe [74]. Foxtail millet contains inclusive health benefiting components such starch, dietary fibres, proteins, fat, minerals and vitamins [20].

***Paspalum scrobiculatum* (Kodo millet)**

Paspalum scrobiculatum, commonly known as kodo or koda millet. It belongs to the family gramineae, originated from Africa. Kodo millet crop mainly grown in the Deccan region and evaluation extends to the foothills of Himalayas. It is domesticated in India 3000 years ago [78]. Millet having rich dietary fibre and minerals like antioxidants, iron [21].

***Echinochloa esculenta* (Barnyard millet)**

Echinochloa esculenta is a species of grass in the family Poaceae and subfamily Panicoideae [22]. Barnyard millet is one of the oldest domesticated millet in the semi-arid tropics of Asia and Africa, there are around 35 species in those two main species *E. utilis. Esculenta* (Japanese barnyard millet and *E. Frumentacea* (Indian Barnyard Millet) are cultivated in Asia particularly in north-eastern parts of India, China, Nepal, Japan, Korea, and Pakistan [23]. It is fastest growing crop having 6weeks harvesting period [77]. Barnyard millet crop has wide adaptability and occupies a special place in marginal rainfed areas because of its short life cycle.

***Panicum sumatrense* (Little millet)**

Panicum sumatrense is a grass species of millet belonging to family Poaceae. Little millet was domesticated in India's Eastern Ghats, where it became a prominent part of the tribal diet and it moved to Sri Lanka, Nepal and Myanmar [79]. cultivation of millets mainly observed in the states of Karnataka, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Odisha, Gujrat, Maharashtra, and Chhattisgarh. Little millet is also one of the rich source of nutrients.

***Panicum* miliaceum (Proso millet)**

Panicum miliaceum is a grain crop with genus *Panicum*, popularly known as broomcorn millet, member of family Poaceae. It is short-season crop grow in drier regions of Africa, Australia, Asia, Europe and North America [76]. It is largely cultivated in China, India, Nepal, Russia, Ukraine, Belarus, the Middle East, Turkey, Romania and United States. It was introduced in North America in 1878 by the German – Russian immigrants [24, 25]. Proso millet is rich in all nutrients contains high lecithin, which supports the neural health system. It is also the excellent source of vitamin (Vitamin-B complex, niacin, folic acid), essential amino acids (methionine, cysteine) and minerals like (P, Ca, Zn, Fe). Proso millet possess low glycemic index hence, beneficial for patients suffering from type-2 diabetes.

Pseudo millets

***Amaranthus caudatus* (Amaranth)**

Amaranthus caudatus, member of family Amaranthaceae. It is also gluten-free pseudo cereal, mainly cultivated in South America and Mexico also in all temperate-tropical areas in the world. Amaranth grain cover the high nutritive value, has higher proteins and lysine content [26]. Amaranth millet exhibits antitumor, hypercholesterolemia and anti-oxidant activity [27-29].

***Fagopyrum esculentum* (Buckwheat)**

Fagopyrum esculentum, belonging to family Polygonaceae. Worldwide there are total 18 species of genus Fagopyrum from those two species are mostly cultivated *F. esculentum* and *F. tataricum* [30]. Buckwheat is mostly cultivated in areas of Europe, East Asia and the Himalayan region. Japan is largest importer of buckwheat and China is biggest producer and exporter [31]. Buckwheat is biggest source of nutrients, exhibit various health benefits such as reducing blood pressure, boost heart health, aid in weight loss, management of diabetes, prevention of certain cancers, act as immunity booster, improve digestion [32].

Pharmaceutical Applications of millets

- Starch obtained from *Pennisetum americamum (*pearl millet) serve as novel tablet excipient due to its disintegrant property [33]. Acid modification and pre-gelatinization enhance the water retention capacity and swelling of starches results improve disintegration property of starches so, pearl millet starch in tablet formulation can be used as disintegrant for commercial purpose [34].

- Pearl millet starch can be used as an alternative in comparison with physicochemical properties of maize and potato starch [35, 36].
- Pearl millet starch is serve as binder as well as disintegrant in formulation of tablet alone and in combination with maize starch [37].
- Pearl millet grains serve as a prominent source of starch in comparison with other cereals it is also the cheaper, containing up to 70%of starch content in its grain [38].
- Pre-gelatinized Freeze Dried Millet Starch (PFDMS) and Pre-gelatinized Over Dried Millet Starch (PODMS) in directly compressed tablet formulation in comparison with native starch shows satisfactory mechanical and disintegration properties so it conclude that *Pennisetum glaucum* (Pearl millet) starch is the excellent source of direct compression excipient for tablet formulation [39].
- Starch extracted from botanical source such as *Pennisetum glaucum* L (pearl millet),
- *Sorghum bicolor L* (sorghum) millet and *colocasia esculanta L* grains starch co-processed with montmorillonite clay (MMT), the obtained starch clay composites shows better mechanical and controlled release delivery of drug exhibits good results than formulation containing a prostile starches that could be excellent novel directly compressible excipient in tablet formulation [40].
- Amylase extracted from *Pennisetum glaucum* (pearl millet) used to prepare enzyme loaded nanoparticles shows novel approach for use of millets in pharmaceutical formulations [41].
- Acetylated (AcFM) and oxidised (OxFM) *Eleusine coracana* (Finger millet) starch shows higher bulk density and tapped density leads to enhanced die filling during tableting. Also due to high bulk and tap densities of oxidised Finger millet (OxFM) starch shows high flow ability and solubility may display practical application as fillers in formulation of capsule, find broad implementation as a pharmaceutical excipient [42].
- Freeze-dried Pre-gelatinized starches of *pennisetum glaucum L* (pearl millet) and *sorghum bicolor L* (sorghum) are the suitable directly compressible excipient for controlled drug delivery system plays vital role in formulation where slower release of drug is desired [43].
- Starch from *Eleusine* (Finger millet) in tablet formulation serve as a disintegrant, fulfils the requirements for dissolution and disintegration time [44].
- Proteins derived from the Proso millet extracted by the wet milling process or by using 60
- % (v/v) aq. Ethanol used in encapsulation of lipophilic bioactive compounds for preparation of nanoparticles. It conclude that Proso millet proteins become a novel encapsulant for the lipophilic compounds delivery [45].
- Miliacin oil obtained from waste product of *Panicum miliaceum* (Proso millet) shows Antiinflammatory action on local application, helps in rapid cleansing of wounds, useful for purulent wounds treatment [46], also effective for healing of trophic ulcer had marked Antiinflammatory effect [47].
- *Panicum italicum* (Foxtail millet) prolamine serve as effective and novel encapsulant for
- the delivery of curcumin in form of nanoparticles for targeted delivery of hydrophobic substances [48].
- Sorghum starch exhibits excellent binding and disintegrant properties at different concentrations in tablet formulation in comparison with maize starch moreover sorghum starch shows better bonding property than acacia [49, 50].
- Pre-gelatinized *Sorghum bicolour* (Sorghum) starch improves the mechanical properties of
- tablet produces low bond and brittleness in comparison with corn starch also overcome tablet defects such as lamination, capping [51, 52].

Health Benefits of Millets

Cardiovascular disease

Proso millet and sorghum improve the high density lipoproteins and adiponectin level in plasma [53]. Millets are rich source of magnesium, plays the important role in managing blood pressure and also reduce the risk of heart stroke s especially in case of atherosclerosis. Finger millets and Proso millets significantly reduce the risk of cardiovascular disease by reducing the level of plasma triglycerides [54]. Millets are excellent source of potassium shows vasodilation by keeping low blood pressure, managing of blood pressure level is the best way to keep you away from cardiovascular diseases.

Diabetes mellitus

Millets reduces the alpha-glucosidase and pancreatic amylase, ultimately postprandial hyperglycaemia reduces, hence consumption of millets reduces blood sugar level [55]. National Institute of Nutrition (ICMR) in 2010 assessed Glycemic Index (GI) of sorghum based food in collaboration with the Indian Institute of Millets research, Hyderabad under National Agricultural Innovation project (NAIP). The results indicate that sorghum containing food having low glycemic index and also low level of postprandial blood glucose. Finger millet based diet good for patients having type 2 diabetes mellitus. Due to the presence of high fibre content shows low glycemic index [56]. Millets contains good magnesium content, which helps in improving insulin efficiency plays vital role in managing type 2 diabetes [57].

Cancer

Millets are rich source of phenolic acids, phytates and tannins, these nutrients lower the risk colon and breast cancer [58]. Millets have linoleic acid, which shows anti-tumour activity [59]. Sorghum also contains polyphenols and tannins having anti-mutagenic and anti-carcinogenic properties [60]. Also act against human melanoma cells shows positive melanogenic activity [61].

Antioxidant effect

Millets are rich source of antioxidants exhibit neutralisation of free radicals, it reduces the risk of cancer and also clean up other toxins from the body, such as those present in kidney and liver [62, 63]. Defatted foxtail millet proteins hydrolysates exhibits antioxidant potency [64], thus millets may serve as source of natural antioxidants can be used as functional food ingredients in disease risk reduction)

Gastrointestinal disorders

Due to high fibre content millets helps in reducing the disorders like constipation, bloating, cramping, excess gas, they also help in lowering the celiac disease, which is usually triggered due to ingestion of gluten [65] as the millet are gluten free is the suitable option for individuals suffering from celiac disease [66, 67].

Miscellaneous benefits

Pearl millet is good for lactating mothers for increasing milk production [68]. Finger millet is rich source of magnesium (137 milligrams approx.) can combat the anaemia condition [69]. also due to presence of high level of tryptophan Improves brain health [70]. Barnyard millet is rich source of niacin, vitamin B3, iron and zinc thus it may act as immunity booster [71].

Millets production status in India (As per Department of Agriculture, Cooperation and Farmers Welfare)

As seen in figure 1, It should be noted that, there was increase trend of millets production i.e. from 2013-14 to 2021-22 collected data shows positive growth and figure 4 shows that in India Rajasthan state is the biggest producer of millets in year 2021. Table 1 and 2 indicates increasing millets production ratio in India.

Status of millets production ratio in India (In million Tonnes)

Table 1: Millets production status (In million Tonnes)

Years	Production (In Million Tonnes)
2013-14	43.3
2014-15	42.86
2015-16	38.52
2016-17	33.77
2017-18	46.97
2018-19	42.95
2019-20	49.66
2020-21	49.7
2021-22	49.86

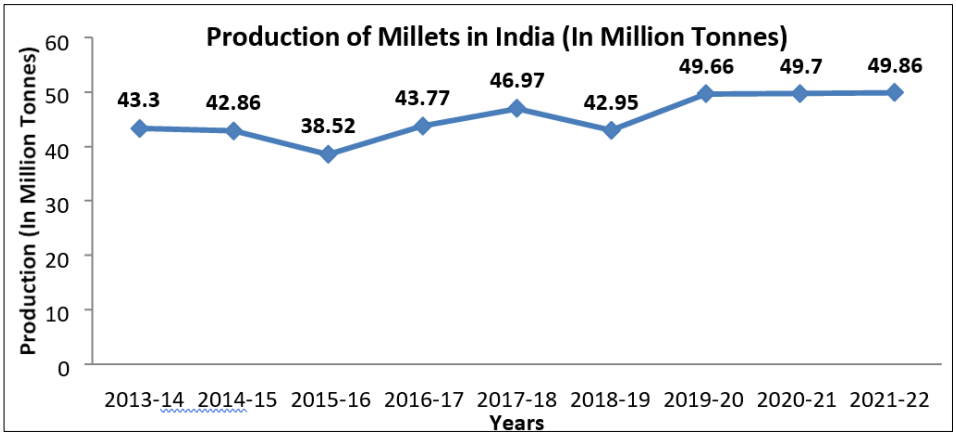

Fig 3: Graphical representation of millets production (In Million Tonnes)

States with maximum millets production in India (2021)

Table 2: Millets production ratio in different states of India (2021)

Sr. No.	State	Production (Tonnes)
1)	Rajasthan	3750.00
2)	Uttar Pradesh	1800.00
3)	Gujarat	920.00
4)	Madhya Pradesh	760.00
5)	Haryana	750.00
6)	Maharashtra	610.00
7)	Karnataka	290.00

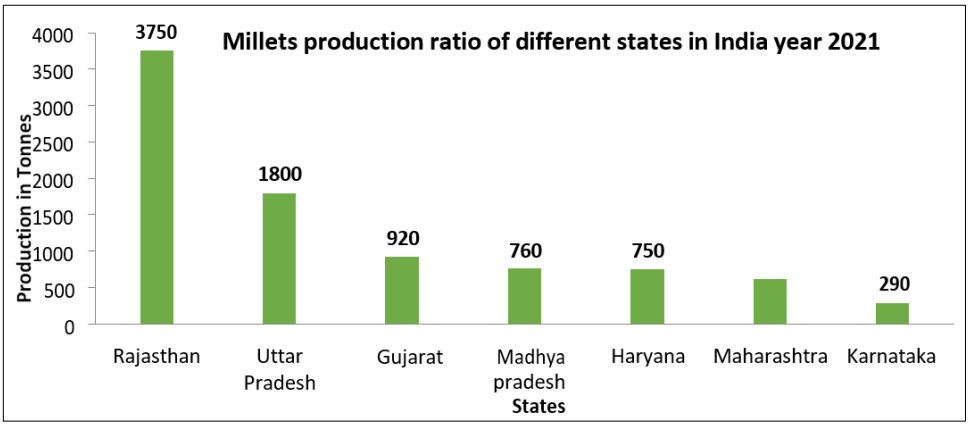

Fig 4: Graphical representation of millets production ratio in different states of India (2021)

Millets availability in market

Table 3: Millets availability in market

Scientific Name	Botanical Name	Brand Name	Manufactured by		
1) Broom Corn (Jawar)	*Sorghum bicolor*	**Rukmini**	**Rukmini Energy Kolkata.**	**Pvt**	**Ltd.**
		S Siddhagiri's Satvyk The Health re Store	S Siddhagiri's Satvyk The Health re Store, Sant Nagar, Lahegaon, Pune.		
		Another brands in Also market like B&B, Producer, Nature Food, Annaprash, Geeta Nature Pure, Pristine, Organic Nature.			
2) Pear millet (Bajra)	*Pennisetum glaucum*	Ancient Wisdom	Prithvi Market Makers Mulund (West), Mumbai.		
		The Millet company	The Millet Company, Kothrud, pune.		
		Another brands in market like Swasth, Good Food			
3) Finger Millet (Ragi / Nagli)	*Eleusine coracana*	Black Soil	Soil Agri Pvt. Ltd. Tirupur.		
		Geeta Nature Pure	Geeta Nature Pure, Mansarovar, Jaipur.		
		Another brands in market like S Siddhagiri's Satvyk The Health re Store, Alswamitra, Arya Farm.			
4) Foxtail Millet (Kangni/kakum)	*Setaria italica*	Value Life	Value Life Essentials, Rajeev Nagar, Hyderabad		
		Superlet Championing Millet	Taproot Farms, Hyderabad.		
		Another brands in market like Mann, Organic Sphere, Sirimart, Alswamitra.			
5) Kodo Millet (Cow Grass/Ditch Millet)	*Paspalum scrobiculatum*	Concious Food	Concious Food Pvt Ltd. Mumbai, Maharashtra.		
		Shridhanya Millets	Alankar Foods, Mumbai, Maharashtra.		
		Another brands in market like Sirimart, Forgotten Foods, B&B, Swasth, Superlet Championing Millet, Mann, Good Food, Organic Sphere.			
6) Barnyard Millet (Sawan)	*Echinochloa* Esculenta	Superlet Championing Millets	Taproot Farms, Hyderabad, Telangana.		
		Shri Hari	Shri Hari Industries, Bikaner, Rajasthan.		
		Another brands in market like Superlet Championing Millet, B&B, Mann, Supple Food, Thanjal Natural, Forgotten Foods, Organic Sphere, Siridhanya, value Life.			
7) Little Millet (Kutki/Shavan)	*Panicum sumatrense*	Sirimart	AJ Enterprises, Shimoga, Karnataka.		
		B&B	B&B Organics, Menaga Nagar, Tamil Nadu.		
		Another brands in market like Superlet Championing Millet, Alswamitra, Mann, Value Life.			
8) Proso Millet	*Panicum miliaceum*	Swasth	Swasth Food Products, Panchaxari Nagar, Karnataka.		
		Black Soil	Black Soil Agri Pvt. Ltd. Tirupur.		
		Another brands in market like Mann, Sureva Healthy Foods, S. Siddhagiri's Satvyk The Health re store.			
9) Amaranth (Ramadan/Ranger)	*Amaranthus caudatus L.*	Arrowhead Mills	Hain Celestial		
		Pristine	Pristine Organics put Ltd.		
10) Buckwheat	*Fagopyrum esculentum*	Nutribuck	Nutri Buck, Raigarh.		
		Nature Vit.	Nature Vit, Jodhpur, Rajasthan.		
		Another brands in market like Value Life, Swabhiman 33, Shri Hari, Sundar Laxmi, Easybee, True Element.			

Conclusion

This review aims to provide detailed information related to millets and explore to create awareness about the usefulness of millets in our regular diet as well as in Pharmaceutical development including their market availability by adding market search. Nowadays millets can be used in pharmaceutical formulation development as binder, disintegrant etc. due to their properties. So, by using these natural excipients we can easily replace costly synthetic excipients with natural one and can also reduce the cost of formulation and they are significantly safe. As per Dr. Khader Valli, they are wonder millets for women health. Along with fibers, they have a variety of therapeutic qualities. His tireless efforts in increasing awareness about the relevance of Siridhanya and its beneficial properties are very commendable. Millets are not only nutritious but also aid nutraceuticals value. They can grow in dry land and need only 200cm of rainfall and only 200 litres of water is required to grow 1 kg of millet in comparison to almost 9,000 litres of water for growing 1 kg of rice and wheat. Millets is prominent crop for dry land. It has number of health benefits, therefore including them in our normal diet is a good approach. The goal of this review is to assist people understand the value of food and to introduce millets as a healthy food wherein that can meet the nutritional needs. This is an attempt to develop ways to eat millets in a nutritious and efficient manner and help alleviate malnutrition and other health issue such as obesity, diabetes and cardiovascular disease. In addition to this millets are antioxidant in nature which may protect body cells from free radical damage.

References

1. Holes JH, Laing EM, Pearson OE. Sorghum and the millets: Their composition and nutritive value. London: Academic Press, 1980, 877-965.
2. Bandyopadhyay T, Muthamilarasan M. Millets for next generation climate-smart agriculture. Frontiers in plant science. 2017;8:1266.
3. de Munter, JSL, Hu FB, Spiegelman D, Franz M, Dam VRM. Whole grain, bran, and germ intake and risk of type 2 diabetes: A prospective Cohort study and systematic review. PLoS Medicine. 2007;4(8):13851395.
4. Newby PK, Maras J, Bakun P, Muller D, Ferrucci L, Tucker KL. Intake of whole grains, refined grains and cereal fiber measured with 7-d diet recordsand associations with risk of chronic disease. Am J ClinNutr. 2007;86(6):1745-1753.
5. Pereira MA, Jacobs DR, Pins JJ, Raatz SK, Gross MD, Slavin JL. Effect of whole grains on insulin sensitivity in overweight hyperinsulinemic adults. Am J ClinNutr. 2002;75(5):848-855.
6. Sahyoun NR, Jacques PF, Zhang XL, Juan W, McKeown NM. Whole-grain intake is inversely associated with the metabolic syndrome and mortality in older adults. Am J ClinNutr. 2006;83(1):124-131.

7. Backes AC, Abbasi F, Lamendolan C, McLaughlin TL, Reaven G, Palaniappan LP. Clinical experience with a relatively low carbohydrate, calorie-restricted diet improves insulin sensitivity and associated metabolic abnormalities in overweight, insulin resistant South Asian Indian women. Asia Pacific Journal of Clinical Nutrition. 2008;7(4):669–671.
8. Dixit AA, Azar KMJ, Gardner CD, Palaniappan LP. Incorporation of whole, ancient grains into a modern Asian Indian diet to reduce the burden of chronic disease. Nutrition Reviews. 2011;69(8):479-488.
9. Bugusu BA, Campanella O, Hamaker BR. Improvement of sorghum-wheat composite dough rheological properties and breadmaking quality through zein addition. Cereal Chemistry. 2001;78(1):31-35.
10. Shahidi F, Naczk M. Phenolics in cereals and legumes. In Food Phenolics. Sources, effects, applications. Technomic Publishing Co, 1995, 9-52.
11. Huang MT, Ferraro T, Ho CT, Lee CY. Phenolics compounds in food and cancer prevention. In Phenolic Compounds in Food and Their Effects on Health, II. American Chemical Society, Washington D.C. 1992, 1-2(507).
12. Klopfenstein CF, Hoseney RC. "Nutritional Properties of Sorghum and the Millets", in Dendy DAV (Ed.), Sorghum and Millets: Chemistry and Technology, American Association of Cereal Chemists, St Paul, MN, 1995, 125-168.
13. Stapf O, Hubbard CE. *Pennisetum*. The Flora of Tropical Africa. (D. Prain, ed.) Landon: Crown Agents. 1934;9:954-1070.
14. Bor NL. The Grasses of Burma, Ceylon, India and Pakistan. International Monograph on Pure and Applied Biology. Pergamon Press. 1960;547;576-583.
15. Begg JE. The growth and development of a crop of bulrush millet (*Pennisetum typohoides* S. & H.). Indian Journal of Agricultural Sciences. 1965;65(3):341-349.
16. Clayton WD. Gramineae. In: Flora of West Tropical Africa. (F.N. Hepper, ed.). Crown Agents. 1972;1:170-465.
17. Hilu KW, Johnson JL. "Systematics of *Eleusine Gaertn.* (Poaceae: Chloridoideae): Chloroplast DNA and Total Evidence". Annals of the Missouri Botanical Garden. 1997;84(4):841-847.
18. Bisht MS, Mukai Y. "Genome organization and polyploidy evaluation in the genus *Eleusine* (Poaceae)". Plant Systematics and Evaluation. 2002;233(3):243-258.
19. Bala-Ravi S. Neglected millets that save the poor from starvation. LEISA India. 2004;6(1):1-8.
20. Yang XS, Wang LL, Zhou XR, Shuang SM, Zhu ZH, Li N, *et al*. Determination of protein, fat, starch, and amino acids in foxtail millet [*Setaria italica (L.) Beauv.*] by Fourier transform near-infrared reflectance spectroscopy. Food Sci. Biotechnol. 2013;22(6):1495-1500.
21. Chandrasekara A, Naczk M, Shahidi F. Effect of processing on the antioxidant activity of millet grains. Food Chemistry. 2012;133(1):1-9.
22. Clayton WD, Renvoize SA. Genera Graminum: Grasses of the world. Kew Bulletin Additional Series. 1986;13:389.
23. Yabuno T. Japanese barnyard millet (*Echinochloa utilis*, Poaceae) in Japan. Econ. Bot. 1987;41(4):484-493.
24. Dwivedi S, Upadhyaya H, Senthilvel S, Hash C, Fukunaga K, Diao X. Millets: Genetic and Genomic Resources. 2011;35(5):247-375.
25. Santra DK. Proso millet varieties for western Nebraska western Nebraska. University of Nebraska-Lincoln Neb Guide. G2219. 2013. Available online: http://www.ianrpubs.unl.edu/epublic/live/g2219/build/g2219. pdf.
26. Correa AD, Jokl L, Carlsson R. Amino acid composition of some *Amaranthus sp.* grain proteins and of its fractions. Arch Latinoam Nutr. 1986;36(3):466-476.
27. Qureshi AA, Lehmann JL, Peterson DM. Amaranth and its oil inhibit cholesterol biosynthesis in 6-week-old female chickens. J Nutr. 1996;126(8):1972-1978.
28. Bennink MR, Om AS. Inhibition of colon cancer (CC) by soy phytochemicals but not by soy protein. FASEB J. 1998;12(5):3806.
29. Klimczak I, Malecka M, Pacholek B. Antioxidant activity of ethanolic extracts of amaranth seeds. Nahrung. 2002;46(3):184186.
30. Ohsaki T, Fukuoka S, Bimb HP, Baniya BK, Yasui Y, Ohnishi O. "Phylogenetic analysis of the genus *Fagopyrum* (Polygonaceae), including the Nepali species *F. megacarpum*, based on nucleotide sequence of the rbcL-accD region in chloroplast DNA." Fagopyrum. 2001;18:9-14.
31. Joshi BK. Buckwheat Genetic Resources: Status ans Prospects in Nepal. Agriculture Development Journal. 2008;5:13-30.
32. Nepali B, Bhandari D, Jiban S. Mineral Nutrient Content of Buckwheat (*Fagopyrum esculentum Moench*) for Nutritional Security In Nepal. Malaysian Journal of Sustainable Agriculture. 2019;3(1):01-04.
33. Mhana BY, Mezogi JS, El-Magi MA, Abushoffa AM. Evaluation of pearl millet starch as tablet disintegrant. Libyan Int. Med. Uni. J. 2017;2(2):152-163.
34. Odeku OA, Alabic CO. Evaluation of native and modified forms of *pennisetum glaucum* (millet) starch as disintegrant in chloroquine tablet formulation. J Drug Del. Sci. Technol. 2007;17(2):115-157.
35. Gideon OO, Amodu Y, Hassan M, Ademola RO. Evaluation of millet (*Pennisetum glaucum* and *Pennisetum americamum*) starches as tablet disintegrants. Journal of Science and Practice of Pharmacy. 2018;5(2):231-239.
36. Osman Z, Farah Y, Hassan M, Elsayel S. Comparative Physicochemical l Evaluation of starch Extracted from pearl millet seeds grown in Sudan as a pharmaceutical excipient against Maize and Potato starch using Paracetamol as a model drug. Ann Pharm Fr. 2021;79(1):28-35.
37. Akande OF, Deshpande AV, Bangudu AB. An evaluation of Starch obtained from Pearl millet-Pennisetum typhoides. As binder and disintigrant for compressed tablets. Drug development and Industrial Pharmacy. 1991;17(3):451-455.
38. Punia S, Kumar M, Siroha AK, Kennedy JF, Dull SB, Whiteside WS. Pearl millet grain as an emerging source of starch :A review on its structure, physicochemical properties, functionalization and industrial applications. Carbohydr Polym. 2021;260:01448617.117776.
39. Femi-oyewo MN, Ajala TO, Babs-Awolowo D. The compaction mechanical and disintigration properties of modified *Pennisetum glaucum*, (Poaceae) starch in directly compressed chloroquine tablet formulations. Journal of Applied Pharmaceutical science. 2015;5(2):43-50.

40. Alabi CO, Singh I, Odeku OA. Evaluation of starch clay composites as a pharmaceutical excipient in tramadol tablet formulations. Polymery w Medycynie. 2020;50(1):33-40.
41. Rani K, Gupta C, Chauhan C. Biodegradation of Almond oil Driven Bovin Serum albumin Nanoparticles for Controlled Release of Encapsulated Pearl millet Amylase. American J Phytomedicine Clin Therapeutics. 2015;3(3):222-230.
42. Afolabi TA, Olu-Owolabi BI, Adebowale KO, Lawal OS, Akintayo CO. Investigation of functional and tableting properties of acetylated and oxidized finger millet (*Eleusine corocana*) starch. Starch/starke. 2012;64(4):326-337.
43. Alabi CO, Singh I, odeku OA. Evaluation of natural and Pregelatinized forms of three tropical starches as excipients in tramadol tablet formulation., Journal of Pharmaceutical investigation. 2018;48(3):333-340.
44. Shihii SO, Musa H. Bhatia PG, Allagh TS. Disintigrant effect of finger millet (*Eleusine coracana*) Starch on dissolution profile and disintigration time in high dose tablets. 2012;3(2):532-535.
45. Wang L, Gulati P, Santra D, Rose D, Zhang Y. Nanoparticles prepared by proso millet protein as novel curcumin delivery system. food chemistry. 2018;240:1039-1046.
46. Nuzor BG. Effect of miliacin oil on the healing of purulent wounds. 1990;(6):51-53. Available online : https://europepmc.org/article/med/2082266
47. Nuzor BG. Effect of miliacin oil in the treatment of trophic ulcers. 1991;(1):34-35,2057230.
48. Chen X, Zhang TY, Wu YC, Gong PX, Li XJ. Foxtail millet prolamine as an effective encapsulant deliver curcumin by fabricating caseinate stabilized composite nanoparticles. Food Chemistry. 2022;367:0308-8146.130764.
49. https://doi.org/10.1016/j.foodchem.2021.130764.
50. Deshpande AV, Panya LB, Evaluation of sorghum starch as a tablet disintegrant and binder. J Pharm Pharmacol. 1987;39(6):495-496.
51. Garr JSM, Bangudu AB. Evaluation of sorghum starch as a tablet excipient. Drug Dev. Ind. Pharm. 1991;17(1):1-6.
52. Alebiowu G, Itiola OA. Compressional characteristics of native and pregelatinized sorghum, plantain and corn starches and the Mechanical properties of their tablets. Drug Dev. Ind. Pharm. 2002;28(6):663-672.
53. Alebiowu G, Itiola OA. The effects of starches on mechanical properties of paracetamol tablet formulations. Sorghum and plantain starches a disintegrantActu. Pharm. 2003;53(3):231-237.
54. Choi YY, OsadaK, ItoY, Nagasawa T, Choi MR, Nhshizawa N. Effects of dietary protein of Korean foxtail millet on plasma adiponectin ,HDL-cholesterol ,and insulin levels in genetically Type 2 diabetic mice.Biosci. Biotechnol. Biochem. 2005;69(1):3137.
55. Lee SH, Chung IM, Cha YS, Parka Y. Millet consumption decreased serum concentration of triglyceride and C-reactive protein but not oxidative status in hyperlipidemic rats. Nutrition Research 2010;30(4):290-296.
56. Rajasekaran NS, Nithya M, Rose C, Chandra TS. The Effect of Finger millet feeding on the early responses during the process of wound healing in Diabetic rats. Biochimica et Biophysica. Acta. 2004;1689(3):190-201.
57. Kumari PL, Sumathi S. Effect of consumption of finger millet on hyperglycemia in noninsulin dependent diabetes mellitus (NIDDM) subjects. Plant Foods for Human Nutrition. 2002;57(3):205-213.
58. Hegde PS, Rajasekaran NS, Chandra TS. Effects of the antioxidant properties of millet species on oxidative stress and glycemic status in alloxan-induced rats. Nutrition Research. 2005;25(12):1109-1120.
59. Graf E, Eaton JW. Antioxidant functions of phytic acid. Free Radical Biology and Medicine. 1990;8(1):61-79.
60. Aburai N, Esumi Y, Koshino H, Nishizawa N, Kimura K. Inhibitory activity of linoleic acid isolated from Proso and Japanese millet toward histone deacetylase. Bioscience, Biotechnology and Biochemistry. 2007;71(8):2061-2064.
61. Mathanghi SK. Nutraceutical properties of great millet-Sorghum vulgare. IntJ Food Agric Veter Sci. 2012;2(2):40-45.
62. Gomez-Cordoves C, Bartolome B, Vieira W, Virador VM. Effects of wine phenolics and sorghum tannins on tyrosinase activity and growth of melanoma cells. Journal of Agricultural and Food Chemistry. 2001;49(3):1620-1624.
63. Dayakar RB, Bhaskarachary K, Arlene Christina GD, Sudha Devi G, Tonapi A. Nutritional and Health benefits of millets. ICAR. Indian Institute of Millets Research (IIMR)Rajendranagar, Hyderabad, 2017, 112.
64. Tsao R. Chemistry and biochemistry of dietary polyphenols. Nutrients. 2010;2(12):12311246.
65. Issoufou A, Tidjani A, Yong-Hui S, Guo-Wei Le. Chemical analysis and antioxidant properties of foxtail millet bran extracts. Songklanakagin J. Sci. Technol. 2011;33(5):509515.
66. Catassi C, Fasano A. Celiac disease. In: Gallagher E, editor. Gluten-free cereal products and beverages. Burlington, MA: Elsevier. 2008, 1-27.
67. Rai S, Kaur A, Chopra CS. Gluten-free products for celiac susceptible people. Frontiers in nutrition. 2018;5:116.
68. Hosseini SM, Soltanizadeh N, Mirmoghtadaee P, Banavand P, Mirmoghtadaie L, Shojaee-Aliabadi S. Gluten-free products in celiac disease: Nutritional and technological challenges and solutions. J Res Med Sci. 2018;23:109.
69. Miaki T, Tanaka S, Kawamura O, Adania K, Ohashi T, Yamauchi K *et al*. A comparison of the feeding value of sorghum, pearl millet and maize silages on the basis of milk production. Bulletin of the Faculty of Agriculture, Miyazaki University. 1990;36(2):361366.
70. Singh P, Srivastava S. Nutritional composition of sixteen new varieties of finger millet. J. Community Mobilization Sustainable Dev. 2006;1(2):81-84.
71. Nakarani UM, Singh D, Suthar KP, Karmakar N, Faldu P, Patil HE. Nutritional and phytochemical profiling of nutracereal finger millet (*Eleusine coracana L.*) genotypes. Food Chemistry. 2021;341(2):128271.
72. Sood S, Khulbe RK, Gupta AK, Agrawal PK, Upadhyaya HD, Bhatt JC. Barnyard millet– A potential food and feed crop of future. Plant Breeding, 2015;134(2):135-147.
73. Yadav OP, Rai KN, Bidinger FR, Gupta SK, Rajpurohit BS, Bhatnagar SK. Pearl millet (*Pennisetum* glaucum) restorer lines for breeding dual-purpose hybrids adapted to arid environments. Ind. J Agric. Sci. 2012;82:922-927.
74. Agricultural Statistics, Government of India. "Pearl Millet," in Agricultural Statistics at a Glance-2014,

Government of India (New Delhi: Oxford University Press), 2014, 85-86.
75. Austin D. Fox-tail millets (Setaria: Poaceae): Abandoned food in two hemispheres. Econ. Bot. 2006;60:143-158.
76. Vijayakumari J, Mushtari Begum J, Begum S, Gokavi S. Sensory attributes of ethinic foods from finger millet (*Eleusine coracana*). Recent Trends in Millet processing and utilisation. In proceeding of national seminar on processing and utilization of millet for nutrition security held on, 2003 Oct, 7-12.
77. Balten Sperger DD. Progress with proso, pearl and other millets. In trends in new crops and new uses. Proceedings of the Fifth National Symposium, Atlanta, Georgia, USA, ASHS Press 10-13 November, 2001-2002, 100-103.
78. Sood S, Khulbe RK, Gupta AK, Agrawal PK, Upadhyaya HD, Bhatt JC. Barnyard millet- a potential food and feed crop of future. Plant Breed. 2015;134(2):135-147. doi: 10.1111/pbr.12243
79. De Wet JM, Brink DE, Rao KE, Mengesha MH. Diversity in kodo millet, Paspalum scrobiculatum. Econ. Bot. 1983 Apr;37(2):159-63. doi: 10.1007/BF02858779
80. De Wet JM, Prasada Rao KE, Brink DE. Systematics and domestication of Panicum sumatrense (Graminae). J. Agric. Trad. Bot. Appl. 1983;30(2):159-68. doi:10.3406/jatba.1983.3898
81. https://m.indiamart.com/impcat/organic-millet.html
82. Mensah EE, Asamoah YD, Yunus S, Issah N, Kofi E. A comparative study of the effect of microwave and conventional heating methods on proximate composition of spiced millet porridge. International Journal of Food Science and Nutrition. 2022;7:56-61.