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Critical appraisal of Millets - A Conceptual Study

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ABSTRACT

Recently the millets have been recognised with their enormous potential and they are renovate as Nutri-cereals (*shree anna*). Millets are good source of protein, vitamins, and minerals like phosphorus, calcium, magnesium, iron etc. As millets are loaded with phytochemicals, they help in management of various life style disorders like cardiovascular disease, obesity, diabetes mellitus, cancer. Millets are one of the oldest staples for various civilisation across the continents. In Ayurveda literature they are explained under the *Dhanya Varga* as *Trindhanya, Kudhanya* and *Kshudradhanya.* General properties of millets are *Ushna Veerya, Kashaya* and *Madhura Rasa, Katu Vipaka, Laghu* and *Ruksha Guna*. But beyond these, some specific properties have also been mentioned in detail in Ayurveda Classics. In Ayurveda literature millets have been described as *Pathya-Apathya* in various diseases. Present paper encompasses various aspect of Millets described in Ayurveda and contemporary science so that the importance of millets is known to each and every person.

Key words: *Millets, Trindhanya, Kudhanya, Kshuhdradhanya, Lifestyle disorders.*

INTRODUCTION

Millets are one of the oldest staples far various civilisation across Asia and Africa. They have been used as a food in India since 2500 BC. Millets contains many vitamins and minerals while being low in fat and high in fibres. In *Ayurveda* literature millets are explained under the heading of *Dhanya Varga* and described their therapeutic values in detail. In recent time lifestyle disorder like Diabetes mellitus, Cardiovascular disease, Obesity etc. have become prevalent due change in our lifestyle particularly in our 'diet'. Several researches have proved that millets have immense potential in treating lifestyle disorder as they are loaded with abundant vitamins, minerals, fibres, and varieties of polyphenols. So, if we want to get rid of lifestyle disorder, we have to introduce it in our diet which has been our traditional food. Somehow during the course of modernisation the production and consumption of millets has declined significantly. So, there is a great need to revive the awareness about the nutritive and therapeutic value of millets.

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REVIEW ON MILLETS

Recently the millets have been recognised with their enormous potential and they are renovating as Nutri-cereals (*Shree Anna*). Millets are abundant in nutrition, the presence of phytochemicals in millets have beneficial effect on human health.

In *Ayurveda* literature detailed explanation of millets are available under *Dhanya Varga* (group of grains) as *Kudhanya/Truna Dhanya/Kshudradhanya*. Millets have been used as food as well as a therapeutic diet.

Various references of millets in Ayurveda

- Millets have been described by *Acharya Charaka* under *Sukadhanya Varga* (ch.sutra 27)[1]

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- *Acharya Shusruta* has described millets under *Kudhanya Varga/ Kshudradhanya* as they grow stray and wild (sus sutra 46)[2]
- *Acharya Bhavprakash* has mentioned them in *Trindhanya Vargas* (grows like grass)[3]
- In *Nighantu Aadarsha* it has been termed as *Munidhanya* because *Rishimunis* used to consume them due to its rich nutritional food value and easy digestibility.[4]

Table 1: Different millets mentioned in *Ayurveda*.

Types of Millets	*Charaka*	*Sushruta*	*Vagbhata*	*Bhavprakash*
Jowar	✓	✓		✓
Bajra		✓		
Ragi	✓			
Sanwa	✓	✓	✓	✓
Kodo	✓	✓	✓	✓
Vanshyava		✓		✓
Kusumbh				✓
Sharbeeja				✓
Kanguni/Prashatika	✓		✓	✓
Cheena				✓
Neewara	✓	✓	✓	✓
Gavedhuka	✓	✓	✓	✓
Lohitaanu	✓			
Priyangu	✓	✓		✓
Mukunda	✓	✓	✓	
Jhinti	✓			
Varak	✓	✓	✓	
Utkata	✓		✓	
Garmuti	✓		✓	
Toyaparni		✓		
Uddalak		✓		
Madhulika		✓	✓	
Nandimukhi		✓		
Shantanu		✓		
Karuvinda		✓		
Hastishyamaka	✓		✓	
Varuk	✓		✓	
Jalsanwa	✓			
Varunpadika			✓	
Toyshaymaka				
Shisiruddalaka			✓	
Shilbika/Shimbir			✓	
Venuparni			✓	
Antanirgandi/ Shantanusandi			✓	
Andalohitya				

Types of Millets

Table 2: Classification of millets on the basis of grain size

Major Millets	Sorghum, Pearl millet, Finger millet
Minor Millets	Foxtail, Kodo, Barnyard, Little, Porso
Pseudo Millets	Amaratha, Buckwheat

Properties of millets:

Along with the general properties of the millets, specific properties have also been mentioned. These properties when taken in account will be beneficial in the use of millets from person to person for prevention of diseases accordingly.

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1. *Jowar* (Sorghum)

Botanical Name: *Sorghum Vulgare*

Family: Poaceae

Classical Name: *Yavanala*

Regional Name: *Joyaar, Jwaari, Juaar*

Description: *Sorghum* is an annual herb with erect stem. It grows to a height of 10-15 feet.

Distribution: In India it is grown majorly in the states of Maharashtra, Rajasthan, Gujarat.

Fig. 1: *Jowar* (Sorghum)

Pharmacodynamics[5]

Rasa: *Kashaya, Madhura*

Guna: *Laghu, Ruksha*

Veerya: *Sheeta*

Vipaka: *Katu*

Dosha Karma: *Pittakaphashamak, Vatavardhaka*

***Karma* and *Roghagnata*:** *Sukranasana, Kledahara, Sthaulya*

2. *Bajara* (Pearl Millet)

Botanical Name: *Pennisetum Glaucum*

Family: Poaceae

Classical Name: *Vajraanna*

Regional Name: *Bajari, Sajje*

Description: The pearl millet plant is a tall, erect annual grass that ranges from 10 feet in height.

Distribution: In India it is grown majorly in the states of Rajasthan, Maharashtra, Haryana.

Fig. 2: *Bajara* (pearl millet)

Pharmacodynamics[6]:

Rasa: *Madhura*

Guna: *Ruksha*

Veerya: *Ushna*

Vipaka: *Madhura*

Dosha Karma: *Kaphavatahara*

Karma* and *Roghagnata: *Balya, Punsatvahara, Durjara*

3. *Ragi* (Finger Millet)

Botanical Name: Eleusine Coracana

Family: Poaceae

Regional Name: *Madua*

Classical Name: *Madhulika*

Description: They are robust, tufted, tillering annual grass, grows up to 2-4 feet high.

Distribution: In India it is grown majorly in the states Tamil Nadu, Gujarat.

Fig. 3: *Ragi* (Finger millet)

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Pharmacodynamics[7]

Rasa: *Kashaya, Madhura*

Guna: *Laghu*

Veerya: *Sheeta*

Vipaka: *Katu*

Dosha Karma: *Tridoshahara, Pittahara*

Karma* and *Roghagnata: *Mutra- Alpakara, Jalodara, Pandu*

4. *Sanwa* (Barnyard Millet)

Botanical Name: Echinochloa frumentacae

Family: Poaceae

Regional Name: *Oodalu, Bhagara*

Classical Name: *Shayamaka*

Description: It is a multipurpose crop which is cultivated for food and fodder which grows up to the height of 2-4 feet.

Distribution: Mostly found in Southern and central states.

Fig. 4: Sanwa (Barnyard millet)

Pharmacodynamics[8]

Rasa: *Madhura, Kashaya*

Guna: *Laghu, Ruksha*

Veerya: *Sheeta*

Vipaka: *Katu*

Dosha Karma: *Pittakaphashamaka, Vatavardhaka*

Karma* and *Roghagnata: *Soshaka, Urustambha, Jalodara, Snehavyapada, Medoroga*

5. *Kodo* (Kodo Millet)

Botanical Name: Paspalum Scrobiculatum

Family: Poaceae

Regional Name: *Kodra, Kodava*

Classical Name: *Kodrava, Kordusha*

Description: It is and an annual grass that grows to height of approximately 3 feet.

Distribution: Mostly found in Southern states (Kerela) and in north Uttar Pradesh.

Fig 5: *Kodo* (Kodo millet)

Pharmacodynamics[9]

Rasa: *Kashaya, Madhura*

Guna: *Laghu, Ruksha*

Veerya: *Sheeta*

Vipaka: *Katu*

Dosha Karma: *Vatakaraka*

Karma* and *Roghagnata: *Grahi, Sosana, Prameha, Medoraga, Urustambha, Raktapitta.*

6. *Kanguni* (Foxtail Millet)

Botanical Name: *Setaria Itali*

Family: Poaceae

Regional Name: *Kangni, Kakum*

Classical Name: *Priyangu*

Description: It is fairly tolerant of drought. It grows up to the height of 1-1.5 meters.

Distribution: Mostly found in Southern and central states.

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Fig. 6: *Kanguni* (Foxtail millet)

Pharmacodynamics[10]

Rasa: *Kashaya, Madhura*

Guna: *Guru, Ruksha*

Veerya: *Ushna*

Vipaka: *Katu*

Dosha Karma: *Kaphanashka, Vatakaraka*

Karma **and** ***Roghagnata:*** *Bhagnasandhankruta, Bruhanan*

7. *Cheena* (Proso millet)

Botanical Name: Panicum Miliaceum

Family: Poaceae

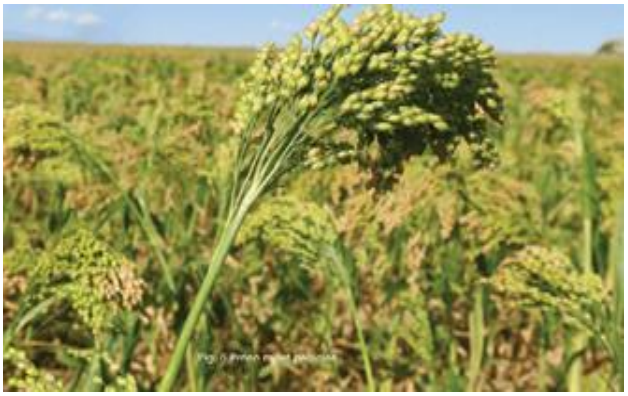
Regional Name: Barre, Cheno

Classical Name: *Cheenaka*

Description: It is an annual grass. It grows up to the height of 6-12 feet.

Distribution: Central India and Gujarat

Fig. 7: *Cheena* (Porso millet)



Pharmacodynamics[11]

Rasa: *Kashaya, Madhura*

Guna: *Guru, Rukhsha*

Veerya: *Sheeta*

Veepaka: *Katu*

Dosha Karma: *Kaphanashka,*

Karma **and** ***Roghagnata*****:** *Bhagnasandhankruta, Bruhanana*

Table 3: Nutritional values of different millets (per 100g)

Millet	Protein	Carbohydrate	Fat	Glycaemic index	Calorific value	Ca(mg)	Fe(mg)	P(mg)	Mg(mg)	Zn(mg)
Jowar	10.4	72.6	1.9	61.2	349	25	4.1	222	133	1.9
Bajara	11.6	67.5	5	56.6	361	42	8	296	124	2.7
Ragi	7.3	72	1.3	61.1	328	344	3.9	283	210	2.5
Sanwa	6.2	65.5	2.2	42.3	307	20	5	280	82	3
Kodo	8.3	65.5	1.4	65.4	309	27	0.5	188	122	1.6
Kanguni	12.3	60.9	4.3	54.5	-	31	2.8	290	81	2.4
Cheena	7.7	67	4.7	-	341	17	9.3	220	153	1.4

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Source: Nutritive value of Indian foods by C. Gopalan, B.V. Sastri, S.C Bala Subramanian, revised and updated by B.S Narasinga Rao, Y.G. Deosthale and K.C. Pant, NIN 1989.

Table 4: Millets as a *Pathya-Apathya* described in different Ayurveda classics[12,13]

SN	Millet	*Pathya* for disease	*Apathya* for disease
1.	*Kodo*	*Urustambha, Medoroga, Trushna, Prameha, Raktapitta, Kasa, Aamvata, Atishtula*	*Kushtha*
2.	*Kanguni*	*Raktapitta, Prameha, Atistula*	*Vatavyadhi*
3.	*Jowar*	*Atistula*	-
4.	*Teenee*	*Raktapitta*	-
5.	*Neevara*	*Raktapitta, Prameha, Vatarakta, Atistula*	*Vatavyadhi*
6.	*Sanwa*	*Kasa, Amavata, Prameha, Vidradhi, Urustambha, Atistula*	-
7.	*Vanshayava*	*Prameha*	-
8.	*Cheena*	-	*Kushtha*
9.	*Gavedhuka*	*Atishula, Chardi, Trushna*	-

Health Benefits of Millets

Cardiovascular Disease[14]

Being rich sources of magnesium, millets help in reducing blood pressure. Also, the potassium present in millets helps in keeping blood pressure low by acting as a vasodilator and help to reduce cardiovascular risk. Proteins and phenolic extracts of some millets display control over renin-angiotensin system by reducing the level of angiotensin-converting enzyme thus helping in the management of hypertension.

Obesity [15]

Studies showed that consuming high fibre food helps in improving the bowel function and improving the digestion and absorption in the body. Millets helps in satiating hunger satisfaction and helps in management of obesity. With high fibre content, millets help to reduce problems like constipation, flatulence, bloating and stomach cramping.

Diabettes Mellitus[16]

Millets help in prevention of Diabetes Mellitus due to their significant levels of magnesium. Magnesium is an important mineral which helps in increasing the efficiency of insulin and glucose receptors by producing many carbohydrate digesting enzymes, which manages insulin action.

Celiac Disease[17]

Celiac disease is a problem triggered by the consumption of gluten. As the millets are gluten free, they help in reducing the celiac disease by reducing the irritation caused by the common cereal grains like wheat and rice which contain gluten.

Antioxidant Property[18]

Millets, are good source of phytochemicals. Phytochemicals like phenolics, sterols, lignans, inulin, resistant starch. Many of the antioxidants found in millet have beneficial impact on neutralizing the free radicals and helps in cleaning up other toxins from body.

Cancer[19]

Millets are rich phenolic acids, phytates and tannins which are the antinutrients which help in reducing the risk for colon and breast cancer. Recent research has revealed that eating more than 30 gm of fibres can reduce their chances of breast cancer by more than 50%. The free radical scavenging activity of phytochemicals help in managing oxidative stress and its associated metabolic disorders.

Some Researches on Millets:

SN	Author and Title	Result
1.	T Anju Jr *et al.* in the year 2010. Suitability of foxtail millet (*Setaria italica*) and barnyard millet	The result shows that biscuit from foxtail millet flour had the lowest GI of 50.8 compared to 68 for

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	(*Echinochloa frumentacea*) for development of low glycaemic index biscuits	biscuits from barnyard millet flour and refined wheat flour.[20]
2.	Sakshi Sharma *et al.* in the year 2017 Evaluation of health potential of nutritionally enriched *Kodo* millet (*Paspalum Scrobiculatum*) grown in Himachal Pradesh, India,	Kodo millet shows antimicrobial action against Staphylococcus aureus, Leuconostoc mesenteries, Bacillus cereus Because kodo contains polyphenols ferulic acid and cinnamic acid which were analysed by using HPLC.[21]
3.	Golda Sahaya Rani *et al.* in the year 2021 Effectiveness of physical activity and finger millet-based food supplement on biochemical parameters and bone mineral density among premenopausal women	In this study the ragi laddu supplement was given to the experimental group, three days per week for 3 months. This study shows physical activity and finger millet supplement improved the calcium level and BMD.[22]
4.	Xin r. *et al.* In the year 2018. The glucose-lowering effect of foxtail millet in subjects with impaired glucose tolerance: A self-controlled clinical trial	The result of this study shows that intervention of 12 weeks, intake of 50 gm foxtail millet per day significantly improved glycaemic control especially the postprandial glucose.[23]
5.	Saurabh Mehta *et al.* in the year 2022 A randomized trial of iron-zinc-biofortified pearl millet-based complementary feeding in children aged 12-18 months living in urban slums.	In this study the fe-Zn-Pm-based complementary foods did not significantly impact iron and zinc status or growth in children living in Mumbai's urban slum. However, there is significantly improved in haemoglobin concentrations among male children.[24]
6.	Abubakar A *et al.* in the year 2015. Characterization and the Anti-nutritional Composition of Unprocessed Finger Millet (Eleusine coracana)	The result obtained in the study showed high percentage of nutrients which are needed for the normal functioning of the body.[25]
7.	Seetha Anitha *et al.* in the year 2021 A systemic review and Meta- analysis of potential of millet for managing and reducing the risk of developing diabetes mellitus.	This study shows that it is evident that mean GI of millet is 52.7±10.3, which is about 36% lower than in typical staples of milled rice.[26]
8.	Janani Narayanan *et al.* in the year 2016 Postprandial glycaemic response of foxtail millet dosa in comparison to a rice dosa in patient with type-2 diabetes	The result of this study shows that participants who consumed a millet based dosa showed a significant reduction in their postprandial glucose level of those who consumed to the rice based dosa.[27]
9.	Varsha Vishwanath *et al.* in the year 2009 Evaluation of antioxidant and antimicrobial property of finger millet polyphenol (Eleusine Coracana).	Finger millet seed coat could be used as a source of natural antioxidant as it is a good source of polyphenols which significantly higher in antioxidant activity compared to whole wheat.[28]
10.	Mueni H *et al.* in the year 2014. Comparative study on the antibacterial and chemical constituent of *Pennisetum glaucum* (pearl millet)and Zea mays (maize).	The result shows that from the phytochemical analysis the pearl millet grains were found to contain tannins, flavonoids, terpenoids glycoside, phenols, and steroids while saponins and alkaloids were found to be absent.[29]
11.	Theodoro VMJ *et al.* in the year 2022. Germinated millet (*Pennisetum glaucum* (L.) R. Br.) flour improved the gut function and its microbiota composition in rats fed with high-fat high-fructose diet.	The result demonstrates that germinated millet flour to improve the intestinal dysbiosis caused by HFHF diet consumption since it is rich in dietary fibre, resistant starch, and proteins. It also improves gastrointestinal tract.[30]
12.	P Lakshmi Kumari *et al.* in the year 2002. Effect of consumption of finger millet on hypergycemia in non- insulin dependent diabetes millets (NIDDM) subjects.	The result shows that there is significantly decrease in plasma glucose levels which was studied in 6 non-insulin dependent diabetes mellitus subjects.[31]

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Some major initiatives taken by Ministry of AYUSH to popularize the adoption of Shree-Anna or millets[32]

1. Millet canteen (*Pathya-Ahara* unit): Start on 2nd Jan 2023 in All India Institute of Ayurveda, New Delhi.
2. Health and millet expo 2023: organised in ITRA Jamnagar from 18-21 march 2023 for spreading awareness to the common public on the usage of millet-based foods.
3. Partner in *Poshan Abhiyana*: Ministry of Ayush has been the knowledge partner and actively participates in various activities for promotion of millet under *Poshan Abhiyana.*
4. Ayush startup for millets: A startup named *Agastya* foods from Institute and Research in Ayurveda Jamnagar has worked on millets along with the theme of "*Ayurved Se Poshan*"
5. Cookies made with ragi was developed in the pharmacy of the National institute of Ayurveda, Jaipur.
6. All India Institute of Ayurveda, New Delhi organised a workshop named millet-based food products development workshop in collaboration with NIFTM, Sonipat.
7. Food festival was organised by the Government Yoga and Naturopathy medical college and hospital Chennai called Millet and Natural food festival.
8. Some other initiatives are conducting various activities like exhibition of millet-based recipes, circulating millet calendars, awareness lectures and various quizzes.

DISCUSSION

General properties of millets as mentioned in Ayurveda classics are *Ushna Veerya, Kashay* and *Madhura Rasa*, *Katu Vipaki, Laghu* (light), *Ruksha* (dry*), Kledashoshak* (absorbs moistness), *Lekhaniya* (scrapping*), Vatakarak* (increases *Vata*), *Baddha Vitak* (binds stools), *Pitta-Rakta* and *Kapha Shamak* (balances *Pitta-Rakta* and *Kapha*) [33]

Ayurveda literature reflects that, apart from the dietary components, millets have been used as therapeutic agent as well. They have *Lekhana* (Scraping) and *Kledashoshana* (dries up excessive moisture) action thus useful in treating *Santapanajanya Vyadhi* (diseases due to over nourishment of single or multiple tissues).

Millets have immense potential in treating lifestyle disorders as they are loaded with good amount of proteins, carbohydrate, fibres, vitamins and minerals which indicates towards the wholesome diet (*Pathya Ahara*). Research showed that millets contain varieties of polyphenols (phenolic acids and flavonoids) because of these properties they exhibit antioxidant, hypolipidemic, hypoglycaemic and antimicrobial activity and thus, are useful in control and prevention of lifestyle disorders.

Millets are highly nutritious grain that provides a good balance of carbohydrates, protein, fibres, vitamins and minerals. Their nutritional composition makes them a valuable addition to a healthy and well-balanced diet, additionally; it is gluten free in nature. So, wheat can be replaced with gluten free grains such as sorghum, barnyard etc.

Millets are not only highly nutritious but also offer environmental benefits as they are drought-resistant, require less water, and exhibit resistance to pests and diseases.

In *Ayurveda* it has been mentioned that everyone should consume food in contrast with their *Prakriti*. If *Vata Prakriti* individuals regularly use millets then because of their pharmacodynamics they definitely induce *Rukshata* in body and disturbs the physiological functions of the body. Similarly, due to their *Lekhan* property *Atikrusha* individuals should be discourage from consuming millets on a regular basis. Likewise, in diabetes mellitus, those with low glycaemic index can be used to substitute the staple food.

As discussed earlier millets are very much useful in lifestyle disorders, Santarpanjanya vyadhis. After analysing the pharmacodynamics, nutritional values and various researches they may be specifically indicated as follows-

1. Finger millet is loaded with minerals like calcium, phosphorus, iron so we can advise them in disease

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related with bone mineral density (BMD) and iron deficiency. Along with this it has good amount of magnesium (mg^{+2}) so helps in supporting muscles and nerve functioning.

2. *Kodo* and *Sanwa* due to their *Grahi* (absorbs excessive fluids) property can be advisable in *Atisara* (diarrhoea).
3. *Bajara* due to their *Balya Karma* (helps to improve energy and strength) can be advisable in *Durbala Purusha*.
4. Analysing the general properties of millets, it is obvious that millets are best advised in *Kaphaja Roga, Pittaja Roga* and necessary to abstain them from *Vataja Roga*. But *Vata Dosha* of millets can be pacify through *Samskara* (processing) such as by adding ghee, *Vata Shamaka Prakshepaks, Deepan-Pachana* (helps in digestion) *Dravyas* in the recopies made with millets.

Conclusion

Ayurveda, acknowledges millets as an essential part of a wholesome diet and considers them beneficial for health. Millets can be included in a daily diet by creating a variety of healthy as well as delicious meals for example *Ragi Ladoo*, *Sorghum* cookies, *Sattu, Chilla, Khichdi, Khakara, Barfi* etc. Eventually millets are considered as best food but one should consume it by analysing the *Prakriti, Awastha* (disease condition), *Agni* of individual. And finally, the marketing of these products should be done so that the importance of millets is known to each and every person.

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