

## Review



### Ayurvedic Insight into *Kshudra Dhanya*: A Review on the Nutritional and Health Benefits of Millets

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#### ABSTRACT:

**Background:** Ayurveda, the science of life, grossly classified into 8 limbs known as *Ashtaangas*. There are other branches like the culinary science that remains less explored, which highlights the different branches of food edibles, food processing, dietary rules etc. The different branches of edibles are explained in different texts of Ayurveda. One such branch is the *Kshudra Dhanya* or the millets. Enriched with nutrients, they serve as the most preferred meal in today's era of lifestyle disorders. Although millet is in trend again due to awareness campaigns but very few is explored and written about Ayurvedic view on millets. **Objective:** This article aims to highlight the varieties of *Kshudra Dhanya* (Millet) which marks up to 13 varieties; and nutritional analysis the different *Kshudra Dhanya*, and exploring their health benefits. **Materials and Methods:** A comprehensive review of Ayurveda classic, modern literatures and published scholarly article were done. This data has been analyzed, and reported in summarized view to explore the role of millets in prevention and treatment of Non-Communicable Diseases. **Result:** Millets contain high amount of dietary fiber, protein, vitamin and minerals. According Ayurveda millets mainly pacifies *Pitta & Kapha Dosha* along with maintaining homeostasis with *Rakta Dhatu*. It aggravates *Vata Dosha* when consumed for a prolonged period. Millets are good for the individuals with gluten intolerance or celiac disease. **Conclusion:** In today's fast paced world, millets come as a boon to the society. Millets benefits in diseases like Obesity, Diabetes, CVD, Hyperlipidemia etc. attracts the people's attention towards this poor man's crop.

**KEYWORDS:** Millets, *Kshudra Dhanya*, Ayurveda, Lifestyle diseases, Phytochemicals.

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## 1. INTRODUCTION

Ayurveda, a holistic science of health, preaches about the way of living. The different branches of Ayurveda are still being explored. One of the less explored branches is the culinary science in Ayurveda. The different properties and therapeutic benefits of each food article according to the respective *Vargas* (classes/sects) have been mentioned. One such category is that of Millets which is termed as *Kudhanya*. According to Ayurveda, the *Dhanya Varga* (class of cereals & pulses) are classified under five main categories [1]. The fifth category is the *Kudhanya* (Millets). It is also called as *Trunadhanya*, as it predominantly belongs to the Grass family (Poaceae); and is called *Kshudra Dhanya*, as it was previously a part of the poor man's meal, hence it would be considered the lowest rated cereal. But in today's era it has become the most researched cereal for its multiple benefits.

More than 1/3rd of the world's population consumes millets & it is the 6th most grown cereal in terms of its agricultural production. It is drought resistant hence they provide a good yield in areas where the water facility is limited. They can easily grow in low rainfall areas (200-500 mm) and even in

non-irrigated areas. Some of these millets like *Kangu* (Foxtail millet), remain pest free which makes them anti-pest agents to store pulses like green gram. These millets also do not require any fumigants. [2] In the present era, with majority of the population choosing a sedentary lifestyle, it becomes important to introduce food articles like millets in our diet. These millets are not only fulfilling, but also prevent many non-communicable diseases.

## 2. METHODOLOGY

The data for the review has been gathered from the classical Ayurveda texts of *Charaka Samhita*, *Sushruta Samhita*, *Ashtanga Hridayam* and *Nigantus* (lexicons). Indexed articles from reliable database like PubMed, Scopus, Web of Science, Google Scholar etc. are utilized for the contemporary review. Various keyword like *Ayurveda* AND millet, millet AND nutrition, millets AND health etc. are used to search relevant articles. Further each millet mentioned in *Ayurveda* classics were analyzed for their nutritional content and health benefits.

## 3. RESULTS & OBSERVATIONS

**Table 1: A comprehensive list of all *Ayurveda* classics and their chapter explaining *Kshudra Dhanya***

Sr. No	Classical texts/ Nighantu's	Chapter No./ Varga	Nomenclature
1.	<i>Charaka samhita- Sutrasthana</i>	27- <i>Annapana Vidhi Adhyaya</i>	<i>Shukadhanya varga</i>
2.	<i>Sushruta samhita- Sutrasthana</i>	46- <i>Annapana Vidhi Adhyaya</i>	<i>Kshudradhanya</i>
3.	<i>Ashtang Sangraha- Sutrasthana</i>	7- <i>Annaswaroop Vidnyaaniya Adhyaya</i>	<i>Kudhanya</i>
4.	<i>Ashtang Hrudayam- Sutrasthana</i>	6- <i>Annaswaroop Vidnyaaniya Adhyaya</i>	<i>Trunadhanya</i>
5.	<i>Bhavaprakasha Nighantu</i>	8- <i>Dhanya Varga</i>	<i>Kshudradhanya</i>
6.	<i>Raj Nighantu</i>	16- <i>Shaalyaadi Varga</i>	<i>Trunadhanya</i>
7.	<i>Nighantu Adarsha</i>	123- <i>Poaceae Family</i>	<i>Trunaadi varga</i>
8.	<i>Kaiyadeva Nighantu</i>	3- <i>Dhaanya Varga</i>	<i>Trunadhanya</i>
9.	<i>Shodala Nighantu</i>	21- <i>Trunadhanya Varga</i>	<i>Trunadhanya</i>
10.	<i>Madanapala Nighantu</i>	10- <i>Dhanyaguna Varga</i>	<i>Trunadhanya</i>
11.	<i>Shaaligram Nighantu</i>	<i>Dhanya Varga</i>	<i>Trunadhanya</i>
12.	<i>Dhanvantari Nighantu</i>	6- <i>Suvarnaadi Varga</i>	<i>Dhaanya varga</i>
13.	<i>Priya Nighantu</i>	10- <i>Dhanya Varga</i>	<i>Dhaanya varga</i>

### 3.1 General Properties- Ayurveda Perspective

Millets are predominantly *Kashaya* (Astringent) & *Madhura* (Sweet) in taste. But after it gets digested the *Vipaka* (biotransformation) is *Katu* (pungent). [3] Even though it is sweet in nature, it is unable to raise the blood glucose levels due to its transformation post digestion. This also prevents the accumulation of fat and excess fluid in the body. It is light, which makes it easy to digest. Also, it is dry in nature which prevents the *Kleda* (stagnation of water molecules), which is already been considered as a causative factor in Diabetes, Obesity and other inflammatory diseases, according to Ayurveda. [4,5] Different authors have given different opinions regarding the potency of the millets. *Acharya Vagbhata* states that, it has a cooling potency whereas

*Acharya Sushruta* states that it has a heating potency. *Acharya Bhavaprakasha* & *Acharya Kaiyadeva* agree that it is *Anushna* (slightly heat producing). [4,6,7] This might be the reason why it neither creates diseases due to heat nor due to the cold i.e., it is easily accepted by all body types and constitutions. Another special property is its *Lekhana* (scraping) & *Kleda-shoshaka* (drying) property, which scrapes the excessive fat residue from the subcutaneous region & other tissues. It is effective in depleting the visceral fat of the body & and in symptoms like polyuria which is usually seen as a significant characteristic of a Diabetic patient. [4,8,9] Refer to [Table 2](#) for properties of different millets mentioned in *Ayurveda*.

**Table 2: Nomenclature of millets and its properties according to Ayurveda [10, 11, 12, 13, 14, 15, 16, 17]**

Sr. No	Millet	Botanical name & Family	Sanskrit name	Common name	Rasa (taste)	Guna (attribute)	Virya (potency)	Karma (Action)
1.	Finger millet	<i>Eleusine coracana</i> (Poaceae)	<i>Madhulika</i>	<i>Ragi</i>	<i>Madhura, Tikta, Kashaya</i>	<i>Laghu, Sheeta</i> (light, cold)	<i>Sheeta</i> (cold)	<i>Snigdha, Balya, Vrishya</i>
2.	Proso millet/ Indian millet	<i>Panicum miliaceum</i> (Poaceae)	<i>Varaka</i>	<i>Cheena</i> / <i>Barri</i>	<i>Madhura</i>	Guru (heavy)	-	<i>Durjara, Brumhana</i>
3.	Kodo millet	<i>Paspalum scrobiculatum</i> (Poaceae)	<i>Kodrava</i>	<i>Kodon</i>	<i>Madhura, Tikta</i>	<i>Guru, Ruksha</i> (Heavy, dry)	<i>Sheeta</i> (cold)	<i>Param grahi, Vishahara, Avrishya</i>
4.	Foxtail millet	<i>Setaria italica</i> (Poaceae)	<i>Kanguni</i> ( <i>Kangu</i> )	<i>Kakum</i>	<i>Madhura, Kashaya</i>	<i>Guru</i>	<i>Sheeta</i> (cold)	<i>Sangrahi, Brumhana, Shoshana, Bhagnasandhankrita, Durjara, Vrishya</i>
5.	Japanese Barnyard Millet	<i>Echinochloa frumentacea</i> (Poaceae)	<i>Shayamaka</i>	<i>Sanwa</i>	<i>Madhura, Kashaya</i>	<i>Sheeta, Snigdha, Laghu</i>	<i>Sheeta</i> (cold)	<i>Sangrahi, Dhatushoshaka</i>
6.	Sorghum (Great) millet	<i>Sorghum vulgare</i> (Poaceae)	<i>Yavanala</i>	<i>Jowar</i>	<i>Madhura, Kashaya</i>	<i>Laghu, Sheeta</i>	<i>Sheeta</i> (cold)	<i>Avrishya, Ruchya, Trishghana, Kledaghana</i>
7.	Pearl millet	<i>Pennisetum typhoideum</i> (Poaceae)	<i>Vajranna/ Priyangu</i>	<i>Bajra</i>	<i>Madhura</i>	<i>Ruksha, Ushna</i>	<i>Ushna</i> (hot)	<i>Balya, Agnideepaka, Durjara</i>

8.	Bengal wild rice	<i>Hygroryza aristata</i> (Poaceae)	<i>Nivara</i>	<i>Teeni</i>	<i>Madhura, Kashaya</i>	<i>Laghu, Snigdha</i>	<i>Sheeta</i> (cold)	<i>Raktapittahara, Vataraktahara, Pathya, Kaphkarak, Malamutra Rodhak</i>
9.	Adlay millet	<i>Coix lachryma-jobi</i> (Poaceae)	<i>Gavedhuk a</i>	<i>Samkru</i>	<i>Katu</i>	<i>Laghu, Ruksha</i>	<i>Ushna</i> (hot)	-
10.	Safflower seed	<i>Carthamus tinctorius</i> (Asteraceae)	<i>Kusumbh bija</i>	<i>Karra/ Barra</i>	<i>Madhura, Kashaya</i>	<i>Snidgha, Sheetal, Guru</i>	-	-

### 3.2 General Properties- Modern Nutrition Perspective

The whole grain kernel of millet is divided into three main parts- bran, germ and endosperm. The outermost layer, bran of millet, contains many minerals like iron, zinc, copper, magnesium etc and is rich in Vitamin B (Niacin, Folacin, Riboflavin, Thiamine). The embryo of the millet, germ is rich in Vitamin B & E and other unsaturated fats. The endosperm, innermost part of the whole grain kernel, contains starchy carbohydrates and proteins. [2]

Millets are gluten-free cereals that are nutritionally rich with carbohydrates (65%), proteins (9%), fat & crude fibre (7%). They are good sources of essential amino acids except for lysine and threonine and are rich in sulphur containing amino acids like methionine and cysteine. Also, millets are good sources of essential fatty acids like linoleic, oleic and palmitic acids found in their free form and mono- galactosyl, diacylglycerols, di-galactosyl, diacylglycerols etc in the bound form. [18]

**Table 3: Nutritional value of major millets (per 100 gm) [16,18]**

S. No.	Millet	Carbo-hydrates(gm)	Protein (gm)	Fat (gm)	Crude Fibre(gm)	Mineral (gm)	Calcium (mg)	Phosphorus (mg)	Iron (mg)
1.	Finger millet	72.0	7.3	1.3	3.6	2.7	344	283	3.9
2.	Proso millet	70.4	12.5	1.1	2.2	1.9	14	206	0.8
3.	Kodo millet	65.9	8.3	1.4	9.0	2.6	27	188	0.5
4.	Foxtail millet	60.9	12.3	4.3	8.0	3.3	31	290	2.8
5.	Barnyard millet	65.5	6.2	2.2	9.8	4.4	20	280	5.0
6.	Sorghum millet	72.6	10.4	1.9	1.6	1.6	25	222	4.1
7.	Pearl millet	67.5	11.6	5.0	1.2	2.3	42	296	8.0
8.	Maize	66.2	11.5	3.6	2.7	1.5	20	348	2.7
9.	Little millet	67.0	7.7	4.7	7.6	1.5	17	220	9.3

### 3.3 Kangu (Foxtail Millet)

There are 4 varieties of *Kangu*- *Krishna* (black), *Rakta* (red), *Sita* (white) & the *Peeta* (yellow). Amongst these the yellow or white variety is considered best & is consumed worldwide. [19,20] It possesses a sweet & astringent taste. It is believed to pacify *Kapha* [9] & *Pitta* & can aggravate *Vata*. Due to its

cooling properties, it pacifies heat and burns. Also, it has a unique property of healing fractures [21, 22, 23, 24, 25] and helps the growth of healthy tissues. Due to its dry nature, it helps in reducing the urine frequency. [26] It is considered useful in recent miscarriages. *Kangu* can be used in the form of paste on the affected joints in *Aamvata* (Rheumatoid

arthritis). Also, *Rabdi* i.e a thick sweetened milk preparation made by incorporating Foxtail millet is advised in *Amlapitta* (acid reflux). The fine powder of the root of this crop is advised with Kodo millet and curd made out of buffalo milk, in the treatment of wounds with *Nadi Vrana* (sinus tracts). Its *Payasa* (creamy pudding) with the addition of sugar has been advised in *Annadrava Shula* (a conditions of abdominal pain occurring post meals). [12, 27]

### 3.4 *Chinaak* (Proso Millet)

There are 3 principal varieties cultivated that are readily distinguishable by the colour of the seeds- white, yellow & red. The yellow variety can be co-related to quinoa, but there is no solid evidence stating the same. This possesses the same properties as that of *Kangu* but it can aggravate *Pitta*. It is also named as *Varaka*. [9, 21, 28, 29] Proso millet contains high content of Niacin that helps in preventing pellagra. [30]

### 3.5 *Shyamaka* (Barnyard Millet)

*Shyamaka* is known in 3 varieties- *Shyamaka (Toya Shyamaka)*, *Ushtra Shyamaka*, and *Hasti Shyamaka*. It possesses an astringent and a sweet taste. Due to its dry and cooling properties, it dries up the excessive moisture in the body [23,24,31] and can be used in diarrheal condition due to its *Grahi* property. [9,32,33] Also, it aggravates *Vata* and pacifies *Pitta* and *Kapha*. [34,35] Due to its dry properties, it is used in *Urustambh* (stiffness of the thighs), *Udara* rog (ascites) and *Prameha* (Diabetes) in the form of dietary supplement. [11] Its entire crop along with the roots are used in multiple applications in *Pittaja* disorders and in *Vibandha* (constipation).

### 3.6 *Kodrava* (Kodo Millet)

It also possesses a sweet and astringent taste. According to some authors, it also possesses bitter taste. *Kodrava* is cool in nature [31, 34] and light to digest due to which it also dries up the excessive fluids in the body. [34, 36] Also, it possesses dry property that exhibits a scraping action on excessive adipose tissue. [26] It does aggravation of *Vata*, and pacifies *Pitta* and

*Kapha*. [23] It is advised as a treatment modality in poisoning, bleeding disorders and in wounds. [9, 28] It is said that this crop should be consumed after storing it for 6 months as the fresh and unripe crop has poisonous effects and can cause vomiting, dizziness and also convulsions, for which *Kushmanda Rasa* (ash gourd juice) is advised to be taken with honey as a remedy. [10] The hydrous solution of alkali of *Kodrava* crop is advised for scalp wash in the treatment of dandruff. Also, the paste made of burnt *Kodrava* crop is advised to be applied on the scalp for treating dandruff. [37] It is also mentioned as a diet modality for *Urustambh* (thigh stiffness). After the surgical procedure of Abdominal tapping in Ascites, the consumption of *Shyamaka* or *Kodrava* with milk is mentioned. [10] This stimulates better healing of the surgical wound and also prevents further accumulation of fluid in the peritoneal cavity. *Kodrava* is mentioned as the best medicine to create dryness in the body. Hence, this proves as a best medicine in conditions like Diabetes, Ascites, Obesity where the excessive *Kleda* (fluid accumulation) is common. Also, in case of sinus tract wounds, *Kodrava* with curd made out of buffalo milk is advised to be consumed on a regular basis. [10]

### 3.7 *Chaaruk* (*Saccharum munja*)

This millet is a grass that possesses sweet and astringent taste. It has dry and cooling properties which makes it absorb all the excessive moisture in the body. It is also lighter to digest and has aphrodisiac properties. [15, 39] It aggravates *Vata*, but pacifies *Rakta*, *Pitta* and *Kapha*. [39] This millet is mentioned in the ancient texts of Ayurveda, but is not observed to be consumed in today's world.

### 3.9 *Kusumbh Beeja* (Safflower Seeds)

This crop usually cultivated as an oil seed crop has been mentioned as a part of the collection of millets. It is sweet and astringent in taste and possesses unctuous property that makes it a good aphrodisiac. [15] Also, it is heavy to digest and cooling in potency. It pacifies *Vata*, *Pitta*, *Kapha* & *Rakta*.

[39] As per some texts, it reduces excessive *Kapha*, *Pitta* and *Shukra* and aggravates *Vata*. It is advised in the treatment of dysuria.

### 3.10 *Gavedhuka* (Adlay Millet)

This millet possesses pungent taste. [40] It is dry in property and hence can be used in *Shthoulya* (obesity). [41] It aggravates *Vata* and pacifies *Kapha*. [14] The decoction made of *Gavedhuka* aids in the production of urine and hence is advised in dysuria. Its root in powdered form can be used in dysmenorrhoea. For weight loss, dry roasted *Gavedhuka* gruel cooked in 6 parts of water (*Yavagu*) is advised as a dietary supplement. [11] It is considered as the best therapy for losing excessive fat. [42] *Gavedhuka* root decoction is advised in the treatment of emesis. [11, 38]

### 3.11 *Nivara* (*Hygroryza aristata*)

This grass possesses astringent and sweet taste. Its cooling and dry property makes it anti-diarrhoeal in nature. [11, 43] It is also light to digest so is considered wholesome to consume. [19, 44] Also, it scrapes off the excessive fat and reduces the frequency of passing urine and faeces. [26] It aggravates *Vata*, *Kapha* [41, 45, 46] and pacifies *Pitta*. But this crop is not consumed in today's practice.

### 3.12 *Yavanala* (Sorghum Millet)

It is astringent and sweet in taste. It possesses dry property and has cooling potency. [13, 42, 47] But it has *Shukragna* property (destroys the gamete). [46] It aggravates *Vata* and pacifies *Rakta*, *Pitta* and *Kapha*. It is said to reduce the excessive fat hence aids in weight loss [39]. It also has properties to aid in the production of urine. It has been used in celiac diseases and in gluten insensitivity. It aids in weight loss and has a higher proportion of calcium. It also helps in reducing cholesterol levels as sorghum wax is rich in policosanols. [2]

### 3.13 *Madhulika* (Finger Millet)

It possesses astringent and sweet taste and is cooling in potency. Due to which, it increases the physical strength of the body. Also, it is light to digest [35] and is proven as an instant energy giver when given as a dietary supplement. It dries up the excessive fluid in the body and pacifies *Pitta*. [22, 45] It is indicated in bleeding disorders. [9] Also, it has been mentioned that it breaks gall bladder stones (Cholelithiasis) and removes them out of the body. [37] It is one of the ingredients in *Shrungyaadi Ghruta* that is indicated in Bronchial asthma in Ayurveda. [13] Finger millet is used for bone strengthening and also reduces the risk for bone fractures due to its natural source of calcium. Hence, it is ideal for the consumption of infants, elderly and pregnant women. It also helps in producing sufficient breast milk due to which it is advised in lactating women. It also helps in Anaemia as it is also a good source of natural iron. Due to this, it helps to counter malnutrition and degenerative diseases. Consumption of finger millet prevents constipation as it is a good laxative due to its rich fibre content. Also, it aids in slow digestion and slow release of glucose in the blood due to which it is advised in Diabetes. [2]

### 3.14 *Vajranna* (Pearl Millet)

It is sweet in taste and possesses dry property. It is hot in potency and hence kindles digestion. It is a good cardiac tonic and is strengthening in nature. [14] It pacifies *Kapha* and aggravates *Vata* and *Pitta*. Pearl millet helps to reduce the effect of migraine and respiratory problems in asthma patients due to its high magnesium content. It also prevents the production of gall bladder stones due to the rich fibre content. [18]

**Table 4: Health benefits of millets according to *Ayurveda* & various research finding [48, 49]**

S. No.	Millet	Rogadhikara (Therapeutic Indication)	Phytochemicals	Pharmacological activity	Research finding [17,48,50]
1.	Finger millet ( <i>Ragi</i> )	<i>Brihana, Triptikaraka, Balakaraka, Raktpittashamaka</i>	Poly phenols & phenols- gallic, vanillin, syringic, p-hydroxy benzoic, protocatechuic, p-coumaric, ferulic, trans-cinnamic acids and tannin, catechins.	Hypoglycemic, hypocholesterolemia activity, anti-ulcerative, anti-cancer, anti-microbial, inhibits the activity of digestive enzymes.	Prevents tissue damage and stimulate the wound healing in diabetic rats. Reduce plasma triglycerides in hyperlipemia rats and prevents cardiovascular diseases.
2.	Proso Millet ( <i>Varaka</i> )	<i>Bhagnasandhanakara</i>	Phenolic acids ferulic acid, chlorogenic acid, syringic acid, caffeic acid and p-coumaric	cellular antioxidant and antiproliferative activity.	Gluten-free and can prevent humans from celiac disease. Helpful in reducing the risk of type 2 diabetes in humans due to a low glycemic index.
3.	Kodo Millet ( <i>Kodrava</i> )	<i>Vrana, Madhumeha, Vishahara</i>	Catechin, Naringin, <i>p</i> -Coumaric acid, Taxifolin, Ferulic acid, Sinapic acid, Pterin-6-carboxylic acid, Campesterol.	Anti-obesity, anti-inflammatory, Anticancer, Anti-tumor, Anti-oxidant.	Reduces the glycemic index and prevents diabetes in the human female model, also have antioxidant activities.
4.	Foxtail Millet ( <i>Kanguni</i> )	<i>Atisara, Grahani, Sthaulya, Prmeha, Asthibhagna, Aamvata, Prasavapeeda nashaka</i>	Phenolics, carotenoids, flavonoids.	Anti-proliferative, Anti-oxidant.	It prevents colorectal cancer in mice models. Reduces cholesterol level & have an antidiabetic effect on impaired glucose tolerance persons.
5.	Barnyard Millet ( <i>Shyamaka</i> )	<i>Vibandha, Pitta vikaranashaka</i>	alkaloids, steroids, carbohydrates, glycosides, tannins, phenols, and flavonoids, resistant starch	Anti-oxidant, anti-cancer, anti-inflammatory, anti-microbial.	Acts as an inhibitor of cancer by inducing apoptotic cell death in HT-29 human colon cancer cell line. Its phenolic content inhibits the protein glycation and glycooxidation, which plays a crucial role in the progression of diabetes.
6.	Sorghum millet ( <i>Yavanala</i> )	<i>Mutrajanana, Raktpitta, Amlapitta, Twakvikra, Raktashamaka, Trishna, Sthaulya, Prmeha, Kaphahara</i>	Phenolic acids (Protocatechuic acid, Ferulic acid, p-Coumaric acid); Flavonoids (quercetin, kaempferol, naringenin) [53]	Antioxidant activity, anti-inflammatory properties, antidiabetic effects, antibacterial activity, [51]	It inhibits the activity of glucosidase and amylase enzymes; thus, reduced the risk of hyperglycemia. Sorghum extracts exhibited greater DPPH scavenging activity

					than NO radicals. [52]
7.	Pearl Millet (Vajranna)	<i>Balya, Agnimandya, Punsatvahara</i>	Phenolics, flavonoids.	Hypoglycemic, anti-cancer, anti-ulcer and Hypotensive activity.	Prevention of celiac disease in humans due to gluten-free property.
8.	Bengal wild rice (Nivara)	<i>Riktapittahara, Vataraktahara, Pathya, Kaphahara, Malamutra Rodhaka</i>	-	-	Compounds present in it possess free radical scavenging activities and inhibit superoxide anion generation. [56]

#### 4. DISCUSSION

General qualities of millets mainly counter *Pitta & Kapha* along with maintaining homeostasis with *Rakta dhatu*. Nutrients present in millets like starch, lipids, oligosaccharides, antioxidants such as phenolic acids, flavonoids etc. are gives many health benefits. Millets can be indicated in obesity, diabetes, skin disease, lipid disorders and in other *Santarpanajanya Vyadhis* as mentioned in [table 4](#). [2] Millets help in countering Obesity as it is rich in high dietary fibre that slows the process of digestion and absorption levels. [53] Finger millet (*Ragi*) having an amino acid called Tryptophan which reduces the appetite and helps in weight loss. Fibers of Finger and Sorghum millets helps to reach satiety early and thereby reducing the risk of obesity development. [2]

Millets like Finger millets reduces the postprandial hyperglycaemia in Diabetes by reducing the  $\alpha$ -glucosidase and pancreatic amylase. Also, these millets have a low Glycaemic index that reduces the postprandial blood glucose levels. It also helps in reducing the risk of Diabetes induced cataract due to the presence of enzymes like aldose reductase that prevents accumulation of sorbitol. The efficiency of insulin and glucose receptors is increased with the action of Magnesium present in millets. [30, 18]

Research found that many millets for example Proso millet, Pearl millet etc. are free from gluten hence can be advised to patients suffering from celiac disease. Barnyard millets show

anti-cancerous activity by inducing apoptotic cell death in HT-29 human colon cancer cell line. Anti-oxidant activity millets showed by free radical scavenging activity. [52]

Millets like Finger millet contain high levels of magnesium that helps in reducing the risk of heart attacks and also reduces the blood pressure. Also, the vasodilation action of potassium keeps the blood pressure low. Millets also helps in preventing CVD due to the presence of phytic acid that lowers cholesterol and reduces plasma triglycerides. [18]

Millets contain micronutrients like calcium, Iron which helps in bone development and anemia in both children and geriatric population. Its gluten-free profile helps in celiac disease and helps in gluten insensitivity. Millets also contain anti-oxidant properties which protect body cells against the free-radicals.

#### Recent development on Millets

In the recent years, the growing awareness regarding the importance of millets has given birth to international year of millets 2023 (IYM 2023), with the commemoration of Government of India with the United Nations (UN). Also, the need to produce the best hybrids of these nutritionally packed crops is identified. In 2020, 2 varieties of Finger millet were introduced- Gowthami (PR 1045) and Indravathi (CFMV 1). In 2022, another 2 varieties- VR-1099 and CFMV-4 were introduced. These were resistant to leaf and neck blast and were richer sources of Calcium (4280 ppm), Fe (5.79 mg) and Zn (3.62 mg). In 2020, 2 varieties of Foxtail millet were

introduced- Garuda (SiA 3223) and Renadu (SiA 3223). And in 2022, 1 variety was introduced- SiA- 3159. These were resistant to blast, downy mildew and to insect and pests. [54] These varieties have upgraded the nutritional profile as well as shelf life of millets and hence more varieties for hybrids need to be encouraged.

Another pseudo-cereal called Quinoa (*Chenopodium quinoa*) that was popularised in the Andean region, is also considered as the new generation millet. It is rich in protein content- lysine (4.8gm/100gm protein) and threonine (3.7gm/100gm protein) just like the above millets. Also, it is rich in calcium and iron and is gluten-free. [52] These are the newer evolving millets that are gaining popularity. The combination of the *Kudhanya* mentioned in Ayurveda and the newer varieties of millets can be achieved for better nutritional benefit.

#### **Contraindications and limitation of *Kshudra Dhanya***

Though millets having many health benefits, it should never be consumed without assessing the *Prakriti* (body constitution) and current health status of the individual. It aggravates *Vata* when consumed for a prolong period. Hence, Millets contraindicated in *Vataja rogas* (Diseases causes by *Vata* predominance) such as emaciation, osteoarthritis, wasting etc. It also not advised in indigestion, constipation. Excessive consumption of millets can cause constipation or passing of hard stools. Thus, millets should be consumed with unctuous substances that will allow easy bowel evacuation, like ghee, milk etc. Soaking, frying before cooing millets reduce the anti-nutritional factors and enhance the nutritional facts and biological activity. [55]

Due to its heat producing property, people suffering from *Pittaja* disorders like burning, acidity etc. or who possess a *Pitta* dominant constitution can be advised to consume millets with candy sugar, milk, dates, ghee or with black raisins. This will avoid the aggravation of *Pitta* & will also enhance the benefits of millets. Also, during the summer and

autumn season or post-monsoon period, consumption of millets can be avoided due to the heat in the environment.

#### **5. CONCLUSION**

Today's world is facing the epidemic of non-communicable diseases which majorly occur due to sedentary lifestyle result from industrialization and modernization, which sometime known as lifestyle diseases. This review showed that millets are best for *Santarpanjanya Vikaras* and *Kaphapitta Doshajanya rogas*. Millets being a good source of micronutrients and phytochemical shows health benefits in different diseases like obesity, hypertension, diabetes etc. Despite that, care should be taken before including millets in diet of a person. A through *Prakriti* analysis and assessment of *Agni* of the person in needed to prescribe millets to anyone.

#### **Abbreviations:**

IYM – International Year of Millet

UN – United Nation

CFMV 1 - Cocksfoot Mottle Virus (Finger Millet Variety 1)

Fe – Iron

Zn – Zinc

Mg – milligram

Gm – gram

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