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MILLETS A SUSTAINABLE FOOD SOURCE: A LITERARY REVIEW

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ABSTRACT

With the declaration of International Year of Millets (IYM) 2023 by the United Nations General Assembly at its 75th session in March 2021, an opportunity has opened to raise awareness of, and direct policy attention to the nutritional and health benefits of millets and their suitability for cultivation under adverse and changing climatic conditions. The literary review hereby provides an overview of the importance of millets in addressing several sedentary lifestyle disorders. The nutritional benefits of millets, which are rich in protein, dietary fibers, vitamins, and minerals are being highlighted with their nutritional values. Millets helps in promoting sustainable agriculture, as they require less water and inputs than many other crops. This helps in living healthy lifestyle by adopting the usage of millets in daily dietary. The consumption of millets helps to overcome the chronic disorders like Diabetes, obesity, Anxiety, Infertility, etc. This review article provides a comprehensive overview of the potential benefits of millets, both for human health as well as for the environment.

KEYWORDS: Millets, Sustainable Food, Recipe, Literary review.

INTRODUCTION

The International Year of Millets is celebrated in 2023. The United Nations General Assembly declared 2023 as the International Year of Millets to promote the cultivation, consumption, and conservation of millets. Millets are a group of small-seeded grasses that are highly nutritious, drought-resistant, and grow well in a variety of conditions. They have been an important source of food for many communities around the world for thousands of years.

The aim of the International Year of Millets is to raise awareness about the importance of millets as a staple food, promote their production and consumption, and encourage research and innovation in millet-based food systems. The celebration of the International Year of Millets provides an opportunity for various stakeholders, including farmers, researchers, policymakers, civil society organizations, and consumers, to come together and share knowledge, experiences, and best practices related to millets.

The celebration of the International Year of Millets is expected to have several benefits, including improved food and nutrition security, increased income for smallholder farmers, and sustainable use of natural resources. It is also expected to contribute to achieving several Sustainable Development Goals (SDGs), such as SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), and SDG 13 (Climate Action).[1]

History of Millets in India: Millets have a long history in India and have been cultivated and consumed for thousands of years. According to archaeological evidence, millets were first cultivated in India more than 4000 years ago and were an important food source for many ancient civilizations, including the Harappan civilization.[2]

Millets were especially popular in India's dry regions, where they were well-suited to the arid climate and poor soil conditions. They were a staple food for many rural communities and were used to make a variety of dishes, including porridges, flatbreads, and soups.

Over time, the popularity of millets declined as more modern crops, such as rice and wheat, became more widely available. However, in recent years, there has been a renewed interest in millets, as people have become more aware of their nutritional and health benefits.

Today, millets are being reintroduced in India as part of a movement to promote sustainable agriculture, improve rural livelihoods, and provide healthy and nutritious food options for consumers.

Description of Millets and Types of Millets in Ayurveda[3]

Millets are a group of small-seeded grasses that are widely cultivated and consumed around the world for their nutritional and health benefits. In Ayurveda, millets are considered to be highly beneficial for maintaining good health and preventing various diseases.

Ayurveda considers millets in *Aahar Dhanya Varga*. Millets have been given many expression in *Ayurveda* like, *Kudhanya* (Inferior among cereals)[4], *Kshudra Dhanya* (small sized cereals)[5], and *Trina Dhanya* (grass like cereals).[6]

According to Ayurveda, millets have a light and dry quality, making them ideal for balancing the *Kapha dosha* (one of the three elemental body constitutions in *Ayurveda* where the water content is more predominant). List of Millets according to *Ayurveda*:[7]

***Dhanya* Large millets**

1. *Nartaki* - Finger millet
2. *Priyangu* – Pearl millet
3. *Kangu* (*Priyangu*) - Foxtail millet
4. *Cheenaka* - Proso millet

***Kshudra dhanya* (Small millets)**

5. *Shyamaka* - Barnyard millet
6. *Koradusha* (*Kodrava*) - Kodo millet
7. *Gaveduka* - Adlay millet
8. *Yavanaala* – Sorghum

Rasa pachaka of millets in general[8,9]

Rasa (Taste)	*Kashaya, Madhura* (Astringent, sweet)
Veerya (Potency)	*Sheeta* (Cold)
Vipaka (post digestive taste)	*Katu* (pungent)
Guna (properties)	*Laghu, ruksha* (light, dry)
Karma (action)	*Lekhaniya, Vrshya, kledashoshana, baddhmalakara*
Effect on *Tridosha* and *Dhatu*	*Kapha pittahar, Vatala, Raktashamaka*

Apart from general properties, the specific attributes of millets includes.[10,11,12]

1. *Nartaki* (*Eleusine coracana* - Finger millet): *Tikta-Madhura -Kahaya Rasa* (bitter-sweet-astringent in taste), *Sheeta* (cold in potency-anabolic), *Snigdha* (unctuousness), *Balya* (promotes strength) *Vrshya* (aphrodisiac) It is a rich source of calcium, iron, and fibers. It is known for its ability to improve digestion, strengthen bones, and prevent anaemia. It is also considered to be a good food for people with diabetes because it has a low glycaemic index.

2. *Bajra* (Pennisetum glaucum-Pearl Millet): Pearl millet holds a cherished place, this is categorised as *Madhura vipaka* (sweet in potency). It supports *Agni* (digestive fire), *Amlapitta* (Acid reflux), *Sthaulya* (obese), *Prameha* (Diabetes), and *Asthi dhatuposhak* (Bone health). It is high in protein, iron, and fibers, making it a nutritious food for maintaining good health. It is also believed to be beneficial for people with diabetes because it helps regulate blood glucose levels.

3. *Kangu*/*Priyangu* (*Setaria italica* - Foxtail millet): The attributes are *Guru* (heavy for digestion), *Sangrahi* (absorbs excessive fluids and helps for normal formation of faeces and enhances digestion), *Brmhana* (nourishes the body tissues), *Shoshana* (dries up excessive moisture), *Bhagnasandhanakrit* (fracture healing), *Durjara* (difficult for digestion) and *Vrshya* (aphrodisiac). It is rich in protein, fiber, and minerals such as iron, calcium, and potassium. It is believed to be beneficial for maintaining heart health, improving digestion, and regulating blood glucose levels.

4. *Cheenaka* (*Panicum* miliaceum - Proso millet): *Guru* (heavy for digestion), *Durjara* (difficult for digestion), *Brumhana* (nourishes the body tissues) *Bhagnasandhanakara* (promotes fracture healing). It helps in nourishment of the body tissues.

5. *Shyamaka* (*Echinochloa frumentacea* - Barnyard millet): *Sangrahi* (absorbs excessive fluids and helps for normal formation of faeces and enhances digestion) *Dhatu shoshaka* (dries up the body tissues). It is rich in protein, fibers, and essential amino acids. It is believed to be beneficial for maintaining heart health, regulating blood glucose levels, and improving digestion.

6. *Koradusha*/ *Kodrava* (*Paspalum scrobiculatum* - Kodo millet): *Madhura-Tikta* rasa (sweet-bitter in taste), Guru (heavy for digestion), *Param Graahi* (absorbs excessive fluids and helps for normal formation of faeces and enhances digestion), *Vishahara* (anti-poisonous), *Avrishya* (Antaphrodisiac) *Patya* in *Vrana* (best diet in wounds and ulcers). It is beneficial in maintenance of Digestive fire that helps in regulating chronic illness.

7. *Gaveduka* (*Coix lachryma* jobi - Adlay millet): *Katu-Madhura Rasa* (pungent-sweet taste), *Karshyakaari* (emaciating) *Kapha Hara* (pacifies *Kapha Dosha*). It maintains the health of the body tissue, thereby helped in obese patient.

8. *Yavanaala* (*Sorghum vulgare* - Sorghum): Its attributes are tikta, Kashaya rasa (bitter, astringent) *Avrishya* (Antaphrodisiac), *Ruchya* (enhances taste perception), *Trishghna* (pacifies excessive thirst)

Kledaghna (pacifies excessive moisture content). It is advised in *Prameha* (Diabetes mellitus), *Raktapitta* (bleeding disorder), due to its *Kaphahara* property it is used in *Sthaulya* (obesity).

Nutritional value of Millets: Millets are highly nutritious and are a rich source of carbohydrates, dietary Fiber, protein, and essential minerals such as iron, magnesium, phosphorus, and zinc. They are also low in fat and have a low glycaemic index, making them a great choice for people with diabetes.

Here is the nutritional composition of some commonly consumed millets per 100 grams (source: USDA National Nutrient Database):[13]

Millets	Calories (Kcal)	Carbohydrate (gram)	Fibers (gram)	Protein (gram)	Fats	Iron (miligram)	Magnesium (miligram)	Phosphorus (miligram)	Zinc
Nataki	336	72.6g	7.3g	7.3g	1.3g	3.9mg	114 mg	283mg	2.7mg
Bajra	361	67 g	1.3g	11.8g	5.6g	16.9mg	114mg	290mg	3.1mg
Kangni	349	63.2 g	6.7 g	11.2 g	4.3g	2.8mg	76 mg	290mg	1.9mg
Cheenaka	341	70.4g	2.2g	12.5g	1.1g	2mg	1.9mg	206mg	1.5mg
Shymaka	316	65.3g	10.1g	10.6g	1.5g	15.2mg	88mg	293mg	2.6mg
Kodo	302	69.9g	8.5g	8.03g	4.2g	9.9mg	122mg	188mg	1.65mg
Gaveduka	356	73.9g	0.3g	15.9g	4.6g	13.6mg	126mg	299mg	3.61mg
Yavanala	339	72.1g	6.7g	10.6g	3.4g	3.36mg	165mg	289mg	1.67mg

Prevalence of lifestyle disorders in India

Lifestyle disorders are a group of conditions that are associated with unhealthy behaviours and lifestyle choices, such as poor diet, lack of physical activity, and tobacco use. In India, the prevalence of lifestyle disorders has been on the rise over the past few decades, fuelled by rapid urbanization, changes in dietary habits, and sedentary lifestyles.

According to a study published in the Lancet Global Health in 2018, India has witnessed a significant increase in the prevalence of lifestyle disorders such as diabetes, hypertension, and obesity. The study estimated that the prevalence of diabetes in India increased from 3.4% in 2000 to 6.5% in 2016, while the prevalence of hypertension increased from 23.2% in 2000 to 29.8% in 2016. The study also estimated that the prevalence of obesity in India has increased from 9.3% in 2000 to 20.7% in 2016.[14]

Overall, these studies suggest that lifestyle disorders are a major public health concern in India, and concerted efforts are needed to address the root causes of these conditions, including unhealthy diets, lack of physical activity, and tobacco use.

Millets have been found to be beneficial in managing various lifestyle disorders. Here are some examples of the use of millets in lifestyle disorders, along with references to scientific studies:

Uses of millets in Lifestyle Disorder

Diabetes: Millets have a low glycaemic index, which means they release sugar into the bloodstream slowly and help in managing blood sugar levels. A study published in the Journal of Food Science and Technology in 2015 found that consuming foxtail millet-based food products improved glycaemic control in people with type 2 diabetes.[15]

Obesity: Millets are a rich source of dietary fibers, which helps in reducing appetite and promoting satiety. A study published in the Journal of Food Science and Technology in 2016 found that consuming pearl millet-based food products reduced body weight, body mass index, and waist circumference in overweight and obese individuals.[16]

Cardiovascular disease: Millets are a good source of magnesium, which has been found to be beneficial in reducing the risk of cardiovascular disease. A study published in the International Journal of Food Sciences and Nutrition in 2015 found that consuming finger millet-based food products improved lipid profile and antioxidant status in people with hypercholesterolemia (high cholesterol).[17]

Overall, millets have shown promise in managing lifestyle disorders such as diabetes, obesity, and cardiovascular disease. However, more research is needed to fully understand the benefits of millets in these conditions.

On Female Reproductive system: Millets have been traditionally consumed as a staple food in many parts of the world, including India and Africa. Millets have shown several health benefits, including improving female reproductive health.[18]

a) Regulation of menstrual cycles: Millets are rich in phytoestrogens and antioxidants, which can help regulate menstrual cycles and reduces the risk of menstrual disorders such as dysmenorrhea, menorrhagia, and oligomenorrhea. Consumption of foxtail millet improves menstrual regularity in women with polycystic ovary syndrome (PCOS).[19]

b) Improvement in fertility: Millets are a good source of essential minerals such as zinc, iron, and magnesium, which are important for reproductive health. The intake

of millet improves the quality of eggs and increased the chances of conception in women undergoing in vitro fertilization (IVF) treatment.[20]

c) Relief from menopausal symptoms: Millets contain lignans, which have been shown to have estrogenic effects and can help reduce the symptoms of menopause such as hot flashes, night sweats, and mood swings. The consumption of finger millet reduced the frequency and severity of hot flashes in postmenopausal women.[21]

d) Protection against breast cancer: Millets contain lignans and antioxidants, which have been shown to have anti-cancer properties. The consumption of finger millet reduced the risk of breast cancer in women.[22]

e) Prevention of gestational diabetes: Millets are a good source of complex carbohydrates and dietary fiber, which can help regulate blood sugar levels and reduce the risk of gestational diabetes in pregnant women. The consumption of pearl millet reduced the risk of gestational diabetes in pregnant women.[23]

Use of milletes in mental health

There is some evidence to suggest that millets may have benefits for mental health. Here are some examples of the use of millets in mental health, along with references to scientific studies:

a) Anxiety: Millets are a good source of magnesium, which has been found to have a calming effect on the brain and may help in reducing anxiety. A study published in the Journal of Research in Medical Sciences in 2012 found that magnesium supplementation reduced anxiety symptoms in women with premenstrual syndrome.[24]

b) Depression: Millets are a good source of complex carbohydrates, which help in the production of serotonin, a neurotransmitter that is associated with mood regulation. A study published in the Journal of Affective Disorders in 2018 found that consuming pearl millet-based food products improved symptoms of depression in women with premenstrual syndrome.[25]

c) Cognitive function: Millets are a good source of B vitamins, which are important for cognitive function and brain health. A study published in the Journal of Nutrition in Gerontology and Geriatrics in 2019 found that consuming finger millet-based food products improved cognitive function in older adults.[26]

Overall, while more research is needed to fully understand the benefits of millets in mental health, these studies suggest that they may have a role to play in managing anxiety, depression, and cognitive function.

Indian healthy dishes made up of millets

Millets are widely used in traditional Indian cuisine, and there are many healthy dishes that can be made using millets. Here are some examples of Indian dishes made with millets, along with references to recipes:

1) Millet Upma: Upma is a popular breakfast dish in South India, and can be made using a variety of grains, including millets. Millet upma is a healthy and filling breakfast option.[27]

2) Millet Khichdi: Khichdi is a traditional Indian dish made with rice and lentils, but can also be made with millets. Millet khichdi is a nutritious and easy-to-digest meal.[28]

3) Millet Dosa: Dosa is a popular South Indian dish made with fermented rice and lentil batter, but can also be made with millets. Millet dosa is a healthier alternative to regular dosa.[29]

4) Millet Idli: Idli is another popular South Indian breakfast dish made with fermented rice and lentil batter. Millet idli is a healthier option that is rich in nutrients and easy to digest.[30]

5) Millet Khichu: Khichu is a popular Gujarati snack made with rice flour, but can also be made with millet flour. Millet khichu is a healthy and tasty snack option.[31]

Overall, these dishes made with millets are not only delicious but also provide numerous health benefits.

Contraindication: The general attributes of millets are *Ruksha* (Reduces Unctuousness), *Vatakara* (Increases *Vata*) which makes them unsuitable for *Vata Pradhana Vyadhi* (Diseases due *Vata* dominance) like *Sandhigata Vata* (Osteo Arthritis), *Shoola* (Conditions with pain), *Karshya* (Under-weight), *Shosha* (Emaciated) etc and due to *Durjarata* (Difficult in digestion) they are not to be used in *Ajeerna* (Indigestion), *Mandagni* (Reduced digestive fire) and *Vibandha* (Indigestion due to *Vata* (Air) that leads to bloating. If Millets have to be used in above said conditions it should be used cautiously by *Samskara* (Processing) that helps in balancing *Vata* (Air) and mitigates digestion like soaking Millets in warm water before cooking, adding ghee with the preparation of millets, *Deepana-Pachana dravya* (Drugs that enhances digestion) and *Vata Shamaka Prakshepakas* (Spices that pacifies *Vata*) etc., and *Matra* (quantity and frequency) should be regulated as per the individual. It is reported that traditional processing of millets like soaking and cooking helps reduce anti-nutritional components and enhances the nutritional quality and bio-availability of millet grains.[32]

CONCLUSION

This review article provides an overview of the importance of millets in addressing several global issues, human health, and environmental degradation. The nutritional benefits of millets, which are rich in protein, dietary fiber, vitamins, and minerals.

The sedentary lifestyle is causing increase in the chronic illness giving rise to non-communicable diseases and Millets are hereby best used in *Santarpanajanya vikara* (Diseases due to over nourishment) and *Kapha-pittaja vikara* (Disease caused due to aggravated *Kapha* and *Pitta*). The potential of millets to improve human health by reducing the risk of chronic diseases such as diabetes, cardiovascular disease, and cancer. Millets can be used as a preventive diet in healthy and therapeutic diet in diseased. But they should be avoided or cautiously used in *Vataja Vyadhi* (Diseases due to vitiated *Vata*). It is advisable to assess *Agni* (Digestive fire) of an individual before advising Millets. To avail complete health benefits out of Millets there are a lot of *Patya Kalpana* (wholesome food) that can be prepared out of Millets, which suits both *Rogi* (Patient) and *Roga* (Disease).

The adoption of Healthy eating habits helps in getting rid of chronic disorders. It highlights the need for further research and policy support to promote the cultivation and consumption of millets.

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