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REVIEW OF POTENTIAL THERAPEUTIC EFFECT OF MILLETS IN METABOLIC DISORDERS

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INTRODUCTION

Metabolic syndrome

In this modern era of development and westernization, the major health problem. Metabolic disorders all together contributes to Metabolic syndrome which can be defined as cluster of conditions that occur due to malfunctioning of body metabolism. It increases risk of heart disease, stroke, and type 2 diabetes. Such conditions are characterized by increase in blood pressure, high blood sugar, excess body fat around the waist, and abnormal cholesterol or triglyceride levels.

Dietary modifications in form of calorie restriction and additional fibre supplement for which one can include millets as an important part of our daily diet.

In Ayurveda treatment of *Medhodyusti* and *Upchaya Janayay Roga's* (Metabolic Disorders) can be done as per Achraya Charak–[1] *Guru Aptarpana*, *Vataghan Shleshma-Medhohar Aanpana*, *Ruksha* and *Ushana Aahara*, with the use of several drugs such as *Mushta*, *Triphala*, *Madhu*, *Takraaristha*, *Vidang*, and use of various cereal crops such as *Yava*, *Kudhanaya*, *Trina Dhanahya* etc. All these fall under the category of millets and act as a preventive treatment for all such Metabolic Disorders.

Millets are the cultivated grasses. These are a group of small seeded species of cereal crop. Millets are often known a climate smart crop that are drought resistant.[2] They need low rainfall and can grow in infertile soil. millets can be called as nutritive cereals.

India is the largest producer of millets. World's 41% of total global production of millets in 2020 was done by India.

In ayurveda millet fall under category of *KHUDRA DHANAYA.*

MATERIAL AND METHOD

The aim of the article is to reconstruct the health benefits of millets w.r.t metabolic diosrders. An open accessed full text research papers were searched using following keywords – millets, millets in ayurveda, millet in metabolic disorders. etc. and various relevant Ayurvedic and contemporary literature, web-based literature, published papers were sought to meet the goal and above objective. The following describes the outcome in relation to the same as well as several *Samhita Granthas*, including *Laghuttrayi*, *Brihatrayi*, and others were also considered.

OBSERVATION

0n detailed study of millets and their ayurvedic text literature review following observation can be drawn which are depicted here in the form of various tables as below:

Table no. 1

Millets	SCIENTIFIC NAME	Common name	Colour of cereal	REGION
1. Finger Millet	Eleusine coracana	(Ragi), Finger millet, ragi, bird's foot millet, African millet, tamba	Brown	Africa, India, China
2. Foxtail Millet	Setaria italica	(Kakum/Kangni Foxtail millet, pavane, Italian millet, German millet,	Yellow	China, Near East, Europe

3.Sorghum Millet	Sorghum bicolor L.	(Jowar)	Off white	United States
4.Pearl Millet	Pennisetum glaucum P. americanum P. typhoides	(Pearl millet, bajra, cattail millet, bulrush, spiked millet Bajra)	Greyish	Africa, India
5.Buckwheat Millet	Fagopyrum esculentum Moench.	(Kuttu)	Brown	Russia, China, Ukraine, United State
6.Amaranth Millet	Amaranthus tricolor	(Rajgira/Ramdana/Chola)	Light brown	Mexico and other Andean countries.
7.Little Millet	Panicum sumatrense P. psilopdium	(Moraiyo/Kutki/Shavan**,** Little millet, sama	Light green	India, Nepal, Burma
8. Barnyard Millet	Echinochloa crusgalli E. Utilis E. frumentacea E. colona	(Sanwa)	Brown	Asia
9.Proso Millet	Panicum miliaceum	(Korle)	Light brown	China
10.Kodo Millet	Paspalum scrobiculatum P. commersoni	Kodo millet, varagu	Yellow	Southern Asia

Table No. 2: The *Guna and Karma* of millets are as follows:[3,4] *Rasapanchaka* of Millets is described as.

S NO.	RASPANCHAKA	PROPERTIES
1.	Rasa	Kashaya-Madhura
2.	Guna	Laghu, Ruksha
3.	Veerya	Sheeta
4.	Vikapa	Katu
5.	Karma	Kledashoshana, Baddhamalakara , Lekhana, Vrishya
6.	Effect on Tridosha & Dhatu	Kapha-Pittahara, Vatakar and Rakta Shaamak.

Table No.3: Specific Ayurvedic attributes of millets are[5,6]

S no.	Khudra dhanya	Scientific Name	Comparable to Millet	Ayurvedic Properties- Raspanchak.
1	*Priyangu*	Setaria Italica	Foxtail Millet	*Guru* (heavy for digestion) *Sangrahi* (absorbs excessive fluids) *Brumhana* (nourishes the body tissues) *Shoshana* (dries up excessive moisture) *Bhagnasandhanakrit* (heals fracutre) *Durjara* (difficult for digestion) *Vrishya*
2.	*Shyamaka*	Echinochloa Frumentacea	Barnyard Millet	*Sangrahi* (absorbs excessive fluids *Dhatu shoshaka* (dries up bodily tissues.
3.	*Koradusha/ Kodrava*	Paspalum Scrobiculatum	Kodo Millet	*Madhura-Tikta rasa*, *Guru (he*avy for digestion) *Param Graahi*(absorbs excessive fluids and helps for normal formation of feces) *Vishahara* (anti-poisonous) *Avrishya* (anaphrodisiac) Pathya in Vrana
4.	*Cheenaka*	Panicum Miliaceum	Proso millet	*Guru* (heavy for digestion) *Durjara* (difficult for digestion), *Brumhana* (nourishes the bodily tissues) *Bhagnasandhanakara* (promotes fracture healing)
5.	*Nartaki*	Eleusine Coracana	Finger Millet	*Tikta-Madhura -Kahaya Rasa* (bitter- sweet-astringent in taste), *Sheeta* (cold in potency-anabolic), Snigdha (unctuousness) *Balya* (promotes strength) *Vrishya* (aphrodisiac)
6.	*Gaveduka*	Coix Lachryma Jobi	Adlay Millet	*Katu-Madhura Rasa* (pungent-sweet in taste) *Karshyakaari* (emaciating) *Kapha Hara* (pacifies *Kapha Dosha) Sangrahi* (absorbs excessive fluids *Dhatu shoshaka* (dries up bodily tissues.

TABLE NO. 4

Millets	Nutritive efficiency	Disease and effect on body
1.Finger Millet	Calcium, iron, amino acid	brain growth, nervine tonic
2.Foxtail Millet	High carbohydrate, iron	Immunity, diabetes
3.Sorghum Millet	Iron, protein, fibre,	Cholesterol, improves metabolism of body
4.Pearl Millet	Iron, fibre, protein, minerals, magnesium, calcium.	Type 2 diabetes
5.Buckwheat Millet		Diabetes, cardiovascular disorders, obesity, asthma, gallstones.
6.Amaranth Millet	Protein, dietary fibre, calcium, vitamin, minerals	Cardiovascular disorder, hair loss
7.Little Millet	Calcium, zinc, iron, potassium, vitamin B	
8. Barnyard Millet	High fibre, calcium, phosphorus	Irritable bowel syndrome, increases bone density
9.Broomcorn Millet	Has low glycaemic index	Diabetes
10.Kodo Millet	Vitamin Niacin, folic acid, potassium, magnesium, zinc	Coeliac disease, cardiovascular disease, hypertension, cholesterol

The above table no. 4 highlights the nutritive efficiency of millets and their therapeutic effect on body, their usage in various disorders.

DISCUSSIONS

For the review purposes open accessed full-fledged, 10 paper were selected on the use of millets and their therapeutic effect in various metabolic disorders and analysed and their inference is depicted in the form of following table No. 5 as:

Systemic Review of research work done on millet for metabolic disorder.

Table No. 5

Study	Journal	Sample Size	Parameter	Conclusion
1.Study of millet and non-millet diet on diabetics and associated metabolic syndrome.[7]	International journal of biomedicine	150	BMI, weight Blood sugar levels.	Millet's diet -regulates glucose in diabetic patients
2. Millets in Metabolic Syndrome- Time to tap the Potential.[8]	Journal Of Evidence Based Medicine and Healthcare.	142	_	Millet's diet may help to curb the ever-growing metabolic disorders.
3. Efficacy of value-added foxtail millet therapeutic food in the management of diabetes and dyslipidaemia in type 2 diabetic patients.[9]	Recent Research in Science and Technology	300 patients With type	FBS, HBA1c, Lipid profile, Homocystein .	Daily consumption of 80 gm of foxtail millet diabetic diet by diabetic volunteers lowered the HbA1c, and total cholesterol concentrations in type 2 diabetes patients.
4.Effects of millet based functional foods rich diet on coronary risk factors among subjects with diabetes mellitus: a single arm real world observation from hospital registry.[10]	Medcrave Online Journal of Public Health	65 subjects with type 2 diabetes	FBS, PPBS, HBA1c	Millet-based intervention diet decline in blood glucose, B.P., Lipoproteins and increase in vitamins, calcium, magnesium and Hb.
5. Millet Intake and Risk Factors of Type 2 Diabetes: A Systematic Review[11]	Journal of Food & Nutritional Disorders	-	Blood glucose	Effect of different types of millet on fasting and post-prandial blood glucose in type 2 diabetes.
6.Effects of Dietary Protein of Korean Foxtail Millet on Plasma	Taylor And Francis: A Peer Reviewed	-	HDL-cholesterol, adiponectin, and	Foxtail millet has beneficial effects on plasma concentrations of HDL-

Adiponectin, HDL-Cholesterol, and Insulin Levels in Genetically Type 2 Diabetic Mice.[12]	Journal.		insulin	cholesterol, adiponectin, and insulin.
7.Millet consumption decreased serum concentration of triglyceride and C-reactive protein but not oxidative status in hyperlipidaemic rats.[13]	NUTRITION RESEARCH JOURNAL.	-	Lipoproteins	Foxtail millet and porso millet may prevent cardiovascular disease by reducing plasma triglycerides in hyperlipidaemia
8.Efficacy of value-added foxtail millet therapeutic food in the management of diabetes and dyslipidamea in type 2 diabetic patients	Recent Research in Science and Technology	300 Type 2 diabetic patients	FBS, PPBS, RBS, HBA1c, LIPID PROFILE	A high intake of millet based dietary fibre, improved the glycaemic control and plasma lipid concentrations in patients with type 2 diabetes
9.The Glucose- Lowering Effect of Foxtail Millet in Subjects with Impaired Glucose Tolerance: A Self-Controlled Clinical Trial	Molecular Diversity Preervation International.	70 Patients Of 50-62 Year Diabetic Patients	Blood Glucose (Fbg And 2 H- Glucose), Cytokine Tnf-A (Pg/Ml), Hormones Leptin (Ng/Ml), Adiponectin, (Ug/Ml, Glp- 1 (Pg/Ml) 23.6anthropo metric Indices Weight (Kg), Bmi	The intake of 50 g of foxtail millet per day significantly improved the glycaemic control
10.Human clinical trial to assess the effect of consumption of multigrain Indian bread on glycemic regulation in type 2diabetic participants	Journal Of Food Biochemistry	100 Type 2 Diabetic Subjects.	Serum Insulin, LDL Cholesterol, Hba1c Levels, And Incidentally Blood Pressure Levels	Effect of millets in, reducing insulin, HbA1c, Total cholesterol, and significant decrease in average blood pressure

Benefits of Millets for Health

1. Supports Digestive Health: Eating millet cereal can help control bowel motions since it contains rolled oat-like fibre. Additionally, prebiotics are present, which encourage the formation of probiotics in the microbiome. This supports healthy digestion and a stronger immune system.
2. Great for people who are allergic to gluten since millets are a gluten-free cereal, those who are sensitive to gluten in their diet can confidently consume them. Millets are therefore used in a number of gluten-free oat variations.
3. Encourages Heart Wellness: Magnesium, one of the minerals that supports the cardiovascular system, is found in millet. As a person consumes millet, their levels of the protein adiponectin will rise, ultimately contributing to the protection of cardiovascular tissues.
4. Elevates Mood: Having a high concentration of the amino acid tryptophan is one benefit of millet. Millet's cereal includes fibre that is like rolled oats, thus eating it can help regulate bowel movements. Moreover, it contains prebiotics, which promote probiotic growth in the microbiome. This helps to strengthen immunity and digestive health.
5. For controls weight: Millets can be incorporated in the diet of overweight person to improve their health.

Mode of action of millets

Millet commonly have properties such as, these *are ruksha in guna*, *sheet in virya*, *laghu* and *Madhur - kshaya*. hence with all these properties they aggreviates *vata dosha* and able to pacify *kapha* and *medh* in body.[14] *Ruksha guna*: it is has properties such as *khara* (rough), does *shoshan* karma, is *samirankara (vataakar*) and *param kaphhara*. With *Laghu guna* it does *langhan karma*. It's *Katu vipaka* has *rukha, laghu* properties and with their sheet *virya* it does *harladan* karma. with all these properites millet have *kledshaman karma*, *badhmalakara* and does *lekhan karma* and hence contribute to *medhoroga* and *srotas avrodh*. (metabolic disorders).

CONCLUSION

For *srotoavrodh janyaya vikaras* (metabolic disorders) *shodhan chikitsa* includes *tikshan basti*, *rooksha swedan*, *vaman*, *virechan*, *shirovirechan* etc for purification of bodily toxins.

Shaman Chikitsa

In ayurveda the line of treatment for these *srotoavrodh*

janyaya vikaras (metabolic disorders) includes the use of *lekhaniya Mahakshaya*, use of *Virookshaniya yavagu*, *Aasanadi gana*, and follow of concept of *guru aptarpana* which includes *pathya and avirrudh*, *anabhishyandi ahara* in our day to day life which promotes the use of millets in dietary habits.

1. It can be inferenced from the above studies that the use of millets in daily dietary routine is increasing day to day to prevent the threat to metabolic disorders.
2. Secondly it can be concluded that Foxtail millet is the most used millet and is found to be useful cereal for Metabolic disorders and has effective glucose-lowering effect in body.
3. The effect of these millets are found basically on Diabetes and secondly on dyslipidaemia.

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