# Pharmacological activity of Millets

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**ABSTRACT:**

The description of millets found in the early phase of human civilization is documented as the oldest cereals. Millets are grown in warm seasons and small-seeded crops. They are a potential source of food and fodder in many parts of the world. They need less requirement of water to grow and have more nutrient profile as compared to major cereals. In the current scenario, many lifestyle disorders affect human being because of their food habit. Millets have a rich source of vitamins, minerals, and phytochemical contents. Phytochemical active ingredients reduce the risk of various disorders like diabetes, hypertension, cardiovascular risk, cancer etc .The main aim of review is to highlight the nutritional profile of millets and attention their pharmacological action

**KEYWORDS:** Millets, Nutraceuticals, Pharmacological action, Food, Ayurveda

## INTRODUCTION :

Millets are fast-growing cereals that are more efficient in utilizing moisture and have a higher heat tolerance property than maize. It can be grown in sandy soil in low rainfall areas, although light loams and well-drained soil are preferred. Millets are required high temperatures to mature the crop. All millets are majorly divided into two categories major and minor millets. Minor millets have higher nutritional value compared with major millets. but in India, the production of major millets is more than minor millets[5].Mainly Millets include five genera, like Panicum, Setaria, Echinochloa, Pennisetum, and Paspalum. The different categories of millets are foxtail millet (Setaria italica (L.) Beauv.), finger millet (Eleusine coracana (L.) Gaertn.), Pearl millet (Pennisetum glaucum (L.) R. Br.), Little millet (Panicum sumatrense Roth. ex Roem. & Schult.), Proso millet (Panicum millaceumL.), kodo millet (Paspalum scrobiculatumL.), Sorghum (Sorghum bicolor(L.) Moench), oats (Avena sativa L.) and barley (Hordeum vulgare L.) (Sunil et al., 2016). The millet grains have different shapes, like elliptical, oblanceolate, conospherical, hexagonal, or globular in shape, and different colors, like grayish white, yellow, brown, cream, ivory, light blue, purple, or grey[1-4]. Millets have been used in the world for a long time. In India, millets are used as food and useful for the maintaining of the healthy status of humans and treat of various disease conditions. They grow in adverse conditions like sandy soils, high temperatures, and low water areas. Millets belong to the family Poaceae. Millets are the sixth

rank among the most important cereals grain and feeding one-third of the global population1. Millets provide minerals, vitamins, and energy to the population of China, Africa, and India, specially in dry and semiarid areas2. They are small seeded annual crops grown for food ,feed, and fodder. Millets come in over 20 different varieties like Sorghum (Sorghum bicolor L.), Pearl millet (Pennisetum glaucum), Finger millet (Eleusine coracana), Kodo millet (Paspalum setaceum), Proso millet (Penicum miliaceum), Foxtail millet (Setaria italic), Little millet (Panicum sumatrense), and Barnyard millet (Echinochloa species). Majorly millets are divided into two categories: Major millets and minor millets. Sorghum (Sorghum bicolor L.), Pearl millet (Pennisetum glaucum), Finger millet (Eleusine coracana) are major millets, Kodo millet (Paspalum setaceum), Proso millet (Penicum miliaceum), Foxtail millet (Setaria italic), Little millet (Panicum sumatrense), and Barnyard millet (Echinochloa species) are minor millets[3-5].

## Nutritional contents of millets

Nutritious food is an essential part of healthy life. Various vitamins, minerals, and fibers are essential for the growth and maintenance of health. The absence of these nutritive substances leads to various pathological conditions in the body. Millets have several minerals and vitamins in comparison to rice and wheat. Millets have superior cereals in comparison to major cereals . The macro and micro nutrient content of millets are present in Table 1 and Table 2.

**Table 1(The macronutrient content of millets[27-30])**

| crops | Protein (g/100g) | Carbohydrate(g/100g) | Fats | Crude Fibre | Total energy (Kcal) |
|---|---|---|---|---|---|
| Rice | 4.99-7.9 | 78.2-82.8 | 0.5-1.9 | 0.2-1.63 | 345-369 |
| Wheat | 11.6-13.78 | 69.88-73.9 | 0.9-2.81 | 0.3-1.77 | 348-438 |
| Pearl millet | 11.4-11.8 | 67.0-69.10 | 4.87-5 | 1.2-2.3 | 361-363 |
| Foxtail millet | 11.2-15 | 60.9-67.3 | 3.3-4.3 | 6.7-8.23 | 352-391 |
| Finger millet | 7.3-7.7 | 71.52-72 | 1.3-1.5 | 3.6 | 328-336 |
| Proso millet | 10.0-13.0 | 67.09 | 3.09 | 8.47 | 352.5 |
| Barnyard millet | 6.2-13.0 | 55-65.5 | 2.2-3.9 | 9.8-13.6 | 300-307 |
| Kodo millet | 8.3-10.0 | 63.82-66.6 | 3.03-3.6 | 5.2-8.2 | 349.5-353 |
| Little millet | 6.2-15.0 | 60.9-67 | 4.7- | 7.6 | 329-341 |

| | | | | | |
|---|---|---|---|---|---|
| | | | 5.2 | | |
| Sorghum | 10.4-10.82 | 70.7-72.9 | 1.9-3.1 | 1.6-2.0 | 329-349 |

**Table 2(The micronutrient content of millets[27-29])**

| Crops | Ca (mg) | Fe (mg) | Na (mg) | K (mg) | Mg (mg) | Zn (mg) | Carotene (µg) | Thiamine (µg) | Riboflavin (µg) | Niacin (µg) |
|---|---|---|---|---|---|---|---|---|---|---|
| Rice | Oct-33 | 0.7-1.8 | - | - | 90 | 1.4 | 0 | 0.06-0.41 | 0.04-0.06 | 1.9-4.3 |
| Wheat | 23-30 | 2.7-3.5 | 20 | 315 | 132 | 2.2 | 25 | 0.12-0.41 | 0.07-0.10 | 2.4-5.1 |
| Pearl millet | 42 | 11-Aug | 10.9 | 307 | 137 | 3.1 | 132 | 0.33-0.38 | 0.21-0.25 | 2.3-2.8 |
| Foxtail millet | 31 | 2.8 | 4.6 | 250 | 81 | 2.4 | 32 | 0.59 | 0.11 | 3.2 |
| Finger millet | 344-350 | 3.9 | 11 | 408 | 137 | 2.3 | 42 | 0.42 | 0.19 | 1.1 |
| Proso millet | - | - | - | - | - | - | - | - | - | - |
| Barnyard millet | 20-22 | 5.0-18.6 | - | - | 82 | 3 | 0 | 0.33 | 0.1 | 4.2 |
| Kodo millet | 35 | 1.7 | - | - | - | - | - | 0.15 | 0.09 | 2 |
| Little millet | 17 | 9.3 | 8.1 | 129 | 133 | 3.7 | 0 | 0.3 | 0.09 | 3.2 |
| Sorghum | 25 | 4.1-5.4 | 7.3 | 131 | 171 | 1.6 | 47 | 0.37-0.38 | 0.13-0.15 | 3.1-4 |

## Pharmacological action of Millets

## Antioxidant property

Polyphenols of little finger millets show antioxidant activity on the basis of DPPH reduction capacity as well as reducing power of ferrous to ferric state[6]. In vivo finger millet and kodo millets are given at more than 50 % by weight in the basal diet fed to alloxan-induced diabetic rats over the periods of 28 days show significant role of millets diets on oxidative stress and glucose levels[7]. Finger and pearl millet shows good antioxidant activity on the basis of utilizing 2, 2 diphenyl-1-1 picrylhydrazyl (DPPH) radical scavenging capacity[8]. Various extracts of foxtail millet flour show antioxidant on the basis of total phenolic and flavonoid content, total

antioxidant capacity, ferric reducing antioxidant power (FRAP) assay, and 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity[9].

## Cancer

Bran of foxtail millets have a novel 35 kDa protein named as FMBP.In vivo, antitumor FMBP shows the ability to suppress xenografted growth in mice and is used as an anti-colon cancer[10]. in the BALB/c mice model, foxtail millets significantly decreased AOM/DSS-induced colitis-associated colorectal cancer[11]. Vanillin active compound extracted from Proso and barnyard millets inhibit cell proliferation and apoptosis induction in colon cancer HT-29 cell line[12]. Bound polyphenol extracted from foxtail millet bran increases the drug sensitivity of Colorectal cancer cells to oxaliplatin through the remodeling NEU3- mediated ganglioside GM3 atabolism,OXA[13]. Bound polyphenol extracted from foxtail millet bran also inhibited inhibiting cancer cell proliferation, ferulic acid (FA), and *p*-coumaric acid (*p*-CA). Soluble dietary fiber extracted from foxtail millets has the capacity to inhibit the colony formation ability of HT-29 cells and HCT116 cells and could significantly increase reactive oxygen species (ROS) and apoptosis of HT-29 cells and HCT116 cells[14]

## Obesity

Whole grain and bran of finger millet are given to high-fat diet-fed LACA mice for 12 weeks. As compression of whole grain, bran of finger millet is very effective in obesity, lipid profile and regulates expression of obesity-related genes[15].

## Dyslipidemia

Forty-week-old male Sprague rats are given a high-fat diet for eight weeks to induce hyperlipidemia and divided into four groups and given white rice (control), sorghum, foxtail millet, and proso millet for 5 weeks. The concentration of serum triglycerides is lower in foxtail millets and pro so millies, and serum total HDL, and LDL are higher in sorghum groups[16]. whole pearl millet grain powder and its ethanol extract have dose-dependent anti-obesity, hypoglycemic, hypolipidemic, anti-inflammatory, and anti-steatotic properties in obese rats on high-fat diets. Proso millet-based diet is administered in high-fat diet (HFD) rats and show a beneficial effects on plasma HDL , LDL , total cholesterol, and triglycerides level[17]. Whole flour and hydroalcoholic extract of finger millet (Elusine coracana have a significant role in the reduction of body weight, BMI, fasting blood sugar, and also improved lipid profile in high-fat diet mice[18]. Hydroalcohlic extract of seeds of finger millet (Elusine coracana ) at high dose showed best results as compared to whole flour[19].

## Diabetes

A high intake of foxtail millet-based diet is given to 300 Diabetes type 2 patients and are very effective to manage diet HbA1c , fasting glucose , insulin concentrations, total cholesterol concentrations , triglyceride concentrations , and LDL[20]. In the ,experimental diabetic group,

barnyard millet given 28 days and shows a significant reduction of glucose, LDL-C, VLDL-C, and ratio of TC: HDL and LDL: HDL[21]. 150 diabetic patients are divided into two groups on the basis of consumption of millet. Among the 150 patients, 80 patients are consuming the millet diet (millet items such as finger millet, fox-tail millet, and sorghum ) in the age group of 40-55yrs ,the 70 patients are consuming non-millet diet (wheat chapatis) with the age group of 40-60 yrs. The millet diet group a compression of the non-millets diet group have significantly reduced lipids profile, sugar laves, BMI and weight[22].

## Hypertension

Whole foxtail millet (50 gm) is given to 45 subjects with untreated mild hypertension for 12 weeks. After 12 weeks of a whole foxtail millet diet shows significantly decreased hypertension, BMI, body fat percentage, and blood glucose levels in untreated mildly hypertensive subjects[23]. Protein hydrolysates obtained from foxtail millet have lowered the blood pressure in spontaneously hypertensive rats[24].

## Gut microbiota

Purified millet bran polysaccharide with three different doses (400 mg/kg, 200 mg/kg, and 100 mg/kg) combined with a high-fat diet is given to a streptozotocin (STZ)-induced model of T2DM. After four months of treatment ,the blood lipid levels improved
in the millet bran polysaccharide group and increased the levels of beneficial bacteria, and decreased harmful bacteria in the intestinal tract of rats[25]. Bound polyphenol of inner shell from foxtail millets bran shows increased the relative abundance of commensal bacteria like *Lachnospiraceae* and *Rikenellaceae* on dextran sodium sulfate (DSS)-induced experimental colitis mice[26].

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**CONCLUSION:**

. Millets have various minerals, protein, vitamins, and phytochemical active ingredients to make them superior to major cereals like rice, wheat etc. Millets are founds to be very effective in various pathological conditions like diabetes, hypercholesterolemia, cancer, etc . Millets should be consumed as food in daily routine life for the maintenance of health and to prevent many disease conditions, especially lifestyle disorders.

**CONFLICT OF INTEREST:**

There are no conflicts of interest.

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