



# Nutraceutical effect of Eleusine corcana (Fingermillet) on hyperglycemia in non-insulin dependent diabetes mellitus - A Review

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## Abstract

Diabetes is one of the non-communicable and most challenging disease facing health care professionals which become a major global health problem. Diabetes mellitus is a chronic metabolic disease characterized by hyperglycaemia with defect in insulin secretion. Type 2 diabetes also known as non-insulin dependent diabetes mellitus which is more common being about 90% of all diabetes cases , it was estimated that about 200 million people worldwide suffered from diabetes mellitus in 2010 , and it is expected to reach 300 million by 2025. Nowadays there is an increasing interest among the people for consumption of traditional foods , research shows that ragi is rich in fibre, minerals, amino acids and some research shows it may improve blood sugar and cholesterol effects. Intake of ragi could reduce the blood glucose concentration. Consuming high fibre diet helps to stabilize blood sugar levels. Taking into consideration, the research should be carried out to validate the antidiabetic activity using finger millet extracts.

**Keywords :** Fingermillet , Diabetes, Medicinal values, Traditional foods.

## Introduction

Diabetes is a chronic disease that take place when the pancreas does not produce enough insulin(a hormone that regulates blood sugar) or alternatively , when the body cannot effectively use the insulin it produces. [1].Adult onset diabetes is non- insulin dependent form. Insulin maybe produced by pancreas but action is impaired. This form occurs mainly in the person who is usually obese in nature and due to life style factors[2].

There are 13 types of millets available globally which include pearl millet, finger millet , sorghum , little millet, proso millet, kodo millet, barnyard millet, brown top millet, foxtail millet, guinea millet ,job's tear, fonio and teff. Except for job's tear ,folio and teff the other millets are widely available in India. Fingermillet is widely found in India, China and in some Eastern and southern African countries, whereas fonio, is widely distributed in Western Africa and Job's tears in northeast India, southern and Eastern Asia and southern China. On the other hand, teff is mainly found in Ethiopia [3]. Currently, these crops are mostly grown in Africa and Asia as well as in the USA, which is the wide ranging producer of sorghum. Millets are also occur in the other parts of the world as feed and fodder or as a minor crop. A systematic review of 19 research articles showed that millets help manage diabetes due to their high fibre, polyphenols, and antioxidant content. [4]

Millet grains superior to major cereals with respect to protein, energy, vitamins and minerals. Beside, they are a rich source of dietary fibre, Phytochemicals, non starchy polysaccharides and have a low glycaemic index[5].Hence we aimed to review the effect of elevating the intake of millet based diet for long period in

patients with type 2 diabetes mellitus. It has been accepted explicit consideration in view of its Enriched nutritive and good bio activities such as anti-Inflammatory ,antioxidant and anti-obesity and Cardiovascular diseases [6].Recent studies shows that effective control and management of Diabetes was made on regular intake of finger millet [7].

For diabetic patients in India, it has been demonstrated that wheat-based and millet-based preparations yield Lower glycemic index than rice-based formulations [8]. The important nutrients present in millets include resistant starch, oligosaccharides, lipids, antioxidants such as phenolics, avenanthramides, flavonoids, lignans and phytosterols which are believed to be responsible for many health benefits.

## Types of Millets

Organic millets are gluten-free crops with incredible nutrient-rich composition. They are a rich source of fibre, vitamins, and minerals such as magnesium, phosphorous, calcium, zinc, iron, and potassium. In addition to their nutritional value, different types of millets have different tastes and textures.

### 1.Sorghum Millet

Sorghum, commonly known as Jowar in India, is used to make rotis and other Indian bread. Organic jowar is a rich source of iron, protein, and fibre, and can help lower cholesterol levels due to the presence of policosanols. It is recommended to people with wheat intolerance.

### 2.Finger Millet

Finger millet is a red-coloured grain that is popularly called ragi. A healthy substitute for rice and wheat, it has the goodness of protein and amino acids. Ragi is also used to make cookies and halwa. It is also gluten-free and should be given to growing kids for brain development.

### 3.Foxtail Millet

Foxtail millet is a good source of blood sugar balancing carbohydrates that make it beneficial for sugar and heart patients . It is available in the form of semolina and rice flour. Also known as kakum/kangni, it is a great source of iron and calcium and is believed to boost immunity.

### 4.Pearl Millet

One of the most popular types of millets that you must have tasted is pearl millet or Bajra. With umpteen health benefits, it is prepared in various forms, including roti and khichdi. Bajra contains iron, protein, fibre, and minerals like calcium and magnesium. That is why it should be consumed daily to have a balanced diet.

### 5.Barnyard Millet

Sanwa, or barnyard, is another type of millet that is nutritionally dense with high fibre content. If you are planning to lose weight, then incorporating it into your diet can do wonders for your overall well being. Sanwa is rich in calcium and phosphorous, which helps in bone building.

### 6.Proso/Broomcorn Millet

Proso/Broomcorn millet is good for balancing blood sugar levels and has a low glycemic index. It is popularly called Chena in India and is used as bird feed.

### 7.Little Millet

Little millet goes by several names, including Moraiyo, Kutki, Shavan, and Sama. It is loaded with B-vitamins and minerals such as calcium, iron, zinc, and potassium. It is used in several traditional dishes of South India and is often substituted for rice.

### 8.Amaranth Millet

One of the lesser-known types of millets is Amaranth, also known as Rajgira, Ramdana, and Chola. This millet is high on protein and helps fight hair loss and greying. Amaranth also reduces cholesterol levels and the risk of cardiovascular disease. It is high in calcium, antioxidants, and other minerals.

## 9. Buckwheat Millet

Buckwheat is one of the most popular types of millets in India and is often used during the fasting period of Navratras. Also called Kuttu, it is diabetic friendly and lowers blood pressure. It is beneficial for good cardiovascular health and should be incorporated into your diet if you want to lose weight. Buckwheat also protects against breast cancer, childhood asthma, and gallstones. It is popularly ground into a fine powder to make bread, puris, and cheelas.

## 10. Kodu Millet

Kodu millet or Kodon is easily digestible and contains higher amounts of lecithin. It is vital for strengthening the nervous system. Among other vitamins and minerals, kodu is a fantastic source of B vitamins, especially niacin, B6, and folic acid. It contains minerals such as calcium, iron, potassium, magnesium, and zinc. Since kodu is gluten-free, it is excellent for people who are gluten intolerant. When consumed regularly by postmenopausal women, it can relieve signs of cardiovascular diseases such as high blood pressure and cholesterol levels.

### Antioxidant

Eleusine coracana known as ragi is one of the significant minor cereals is a rich source of several phytochemicals and among them polyphenols are the most important because of their nutraceutical potentials. The seed coat-rich fraction (SCF) of the millet contains over 70% of polyphenols of the millet[9].

Phytochemicals obtained from millets are mostly secondary metabolites with molecular weights ranging from 150 to 30,000 Da in size. Phenolic acids, flavonoids, and tannins are the major polyphenols reported in different parts of the millet grain[10].

Polyphenols are naturally occurring secondary metabolites which are generally characterized by the presence of multiple phenol rings[11]. The major classes consist of phenolic acids (derivatives of benzoic acid and cinnamic acid), flavonoids, lignans, and stilbenes[12]. Polyphenols are abundant in millets and are one of the most marketed dietary supplements[13]. The finger millet seed coat is abundant in polyphenols when compared with many other kinds of cereal such as wheat, rice, barley, and maize [14].

The seed coat of finger millet is known to be rich in many potent antioxidant phenolics mostly benzoic acid derivatives (85%) such as gallic acid, protocatechuic acid, p-hydroxybenzoic acid, vanillic acid, and syringic acid[15] whereas the rest consists of either flavonoid like quercetin or cinnamic acid derivatives such as trans-cinnamic acid, p-coumaric acid, caffeic acid, and sinapic acid followed by condensed tannins [16]. Apart from these bound phenolic acids such as ferulic and p-coumaric acid are also found in abundance in finger millet.

Besides the monomeric compounds, ferulate dimers exhibiting higher antioxidant activity, were present in the millet grains. Antioxidant, exhibited high levels of free radical scavenging as well as anti-inflammatory activity. Besides the monomeric compounds, ferulate dimers exhibiting higher antioxidant activity, were present in the millet grains[17].

Darker colored finger millet varieties had higher phenolic contents and antioxidant properties than the lighter colored ones[18]

The work demonstrates that occurrence of tannins in finger millet grain is a varietal property, as in sorghum.[19]

Synthetic peptides with the same sequence were synthesized and characterized for their antioxidant activity. Molecular docking studies revealed that potential antioxidant activity from both peptides resulted from the interaction of serine and threonine residues with free radicals. The current study suggested that natural peptides identified from finger millet have potent antioxidant activity and regarded as a promising source for a functional food ingredient[20].

The millet polyphenols shows proliferation inhibitory activities. Quercetin exhibited substantial inhibition of the growth of these pathogenic bacteria revealing the potential nutraceutical properties of the millet

polyphenols. From the observation, it could be inferred that finger millet polyphenols could be used as natural source of antioxidants especially for minimizing the risk of diseases arising from oxidative deterioration[21].

## **NUTRACEUTICAL AND ANTIDIABETIC ACTIVITY**

The nutraceutical importance of finger millet lies in its high content of calcium (0.38%), protein (6%–13%), dietary fiber (18%), carbohydrates (65%–75%), minerals (2.5%–3.5%), phytates (0.48%), tannins (0.61%), phenolic compounds (0.3–3%) and trypsin inhibitory factors, and is recognized for its health beneficial effects, such as anti-diabetic, antitumorigenic, anti-diarrheal, antiulcer, anti-inflammatory, atherosclerogenic effects, antioxidant and antimicrobial properties [22], [23], [24].

Moreover, finger millet is also useful in management of various physiological disorders such as diabetes mellitus, hypertension, vascular fragility, hypercholesterolemia, prevention of oxidation of lowdensity lipoproteins (LDLs) and also improves gastrointestinal health [25].

On daily consumption of whole grain of finger millet and its products can protect against the risk of cardiovascular diseases, type II diabetes, and gastrointestinal cancers and other health issues [26]. The dietary fiber, minerals, phenolics and vitamins concentrated in the outer layer of the seed coat form the part of the food and offer their nutritional and health benefits [27].

High dietary fiber and phenolic content makes finger millet very beneficial for diabetic patients. Apart from this it also has low glycemic index (GI) that makes it an ideal snack to prevent late night food thirst and help to maintain blood sugar at a constant ratio. A study on small sample size (n = 6) where finger millet preparations such as chapathi (unleavened flat bread), sevai (rice string hoppers), idli (fermented, steamed rice cake), dosai (fermented rice pan cake), and kozhukattai (steamed rice balls) to type 2 diabetes mellitus (formerly called NIDDM-non-insulin dependent diabetes mellitus) showed a significant decrease in the postprandial blood glucose levels after finger millet administration for a month (28).

Diabetes is a disease is found in millions of people throughout the world. Millets help in prevention of Type II Diabetes 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. [29].

### **Cardiovascular Diseases**

Millets are also a good source of magnesium which is known for the reducing of heart attack. Millets which are known to be rich in phyto-chemicals which contains phytic acid helping in lowering cholesterol and preventing cardiovascular disease by reducing plasma triglycerides[30]

Studies suggested suggested that regular consumption of whole millet grains reduces the risk of CVD. Millets are one of the best possible grains to add to your diet if you want to protect your heart, which is something that everyone can relate to. Millet is a rich source of magnesium, which is an important mineral for reducing blood pressure and the risk of heart attacks of strokes, particularly in the case of atherosclerosis. Millets are also a great source of potassium, which further keeps blood pressure low by acting as a vasodilator. Reducing your blood pressure and optimizing your circulatory system is one of the best ways to protect your cardiovascular health.[31]

### **Conclusions**

This systematic review and meta-analysis confirm that the millets evaluated have strong potential in dietary management and the prevention of diabetes.

Millets have multiple health benefits to include these ancient prized grains-like seed in our regular diet. Most of the civilized people have not even heard about millets and much less understand the benefits of millet nutrition.

The aim of this study is to help the people to recognize the importance of food and to introduce the millets as a nutritious food, fulfilling the nutritional need of global population and to find ways to consume the millets

nutritionally, effectively and to reduce the problems of malnutrition and other health problems. All the millet foods are having significant health benefits, with their rich content of nutrients like fibre which helps in metabolic disorders like Diabetes, Obesity, Cardiovascular diseases etc, their good protein content which helps in child growth and development, with calcium content which helps in the bone development in both children and geriatric people, with good iron content helps in ailing of anaemia.

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