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2. Millets: A Boon for Management of Non-Communicable Diseases

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Abstract:

Today, India and many other developing countries are facing double burden of malnutrition i.e under-nutrition and over-nutrition simultaneously. Despite remarkable scientific progress in agriculture and medical sciences, the underlying causes of malnutrition and poverty remain stubborn challenges. According to World Health Organization (WHO) report inappropriate dietary habits, encompassing diets high in sugar, salt, saturated and trans fats, and lacking in ample amounts of fruits, vegetables, whole grains and lean sources of protein, pose a notable risk for a chronic illness often referred as Non-Communicable Diseases (NCDs). In this context, it becomes imperative to understand the traditional and modern farming practices as a key to improve food and nutrition security. Millets are a crucial and economical food crops mainly grown in semi-arid tropical regions of Africa and Asia. Grains are considered nutri-cereals due to their valuable nutritional properties and certain health-promoting attributes. They are regarded as healthy foods that produce a lot of energy and can help alleviate malnutrition. They are rich in protein, vitamin B, essential fatty acids, and minerals such as calcium, iron, magnesium, potassium, and zinc. By acting on multiple molecular targets, a diverse group of phytochemicals found in millets have proved their physiological relevance in the prevention of chronic illnesses. Millets have also shown a variety of biological and medicinal qualities in controlling Non-Communicable Diseases (NCDs) such as anti-hypertensive, anti-cancer, and anti-diabetic. They have been reported to carry out multiple regulatory roles both in vitro and in vivo. The use of millet in conjunction with other basic food crops to create food substitutes has emerged as a new field in the food industry.

Keywords:

Millets, malnutrition, diabetes, glycaemic index, non-communicable Diseases.

2.1 Introduction:

Despite remarkable scientific progress in agriculture and medical sciences, the underlying causes of malnutrition and poverty remain stubborn challenges. This could be attributed to our limited comprehension on the intricate interplay of tradition, culture, and the economy influence various facets of health.

In the past, the sustainable practice of cultivating millets through natural and integrated farming, alongside mixed crop agriculture, played a vital role in maintaining a balanced lifestyle.

Unfortunately, this valuable tradition has been neglected over time, partly due to various reasons and a lack of awareness. Globally in 2022, 149 million children under 5 were estimated to be stunted 45 million were wasted and 37 million were overweight or obese (WHO report, 2023).

Both underweight and overweight in combination with environmental pollution leads to a chronic illness, often referred to as Non-Communicable Diseases (NCDs), present a substantial threat to global public health.

According to the World Health Organization (WHO), NCDs are responsible for 74% of all global deaths, with cardiovascular ailments, cancer, respiratory disorders, and diabetes standing as the primary culprits.

The Global Burden of Disease Study in 2019 noted that Non-communicable Diseases (NCDs) are responsible for 63% of deaths in India and this has emerged as the biggest challenge to health.

Inappropriate dietary habits, encompassing diets high in sugar, salt, saturated and trans fats, and lacking in ample amounts of fruits, vegetables, whole grains and lean sources of protein, pose a notable risk for NCDs.

These diseases including diabetes, cancer, cardiovascular and respiratory diseases account for about 71% of deaths globally. In this context, it becomes imperative to understand the traditional and modern farming practices as a key to improve food and nutrition security of growing population.

The World Health Organization (WHO) recommends a diet abundant in fruits, vegetables, whole grains mainly millets, nuts and seeds high in fibre content, while

avoiding processed foods, sugar and excessive amounts of saturated and trans fats could play and important role to overcome the situation.

Millets are a diverse group of tiny-grained cereals that serve as a staple food for millions of people across the arid and semi-arid regions of the world.

It is a group of small-seeded grasses that have been cultivated as a staple food over thousands of years in many parts of the world.

These are nutri cereals comprising of sorghum, pearl millet, finger millet (major millets) foxtail, little, kodo, proso and barnyard millet (minor millets).

Figure 2.1: Different Kind of Millets

It is also known as “Sri Anna”, “coarse cereals” or “cereals of the poor”. In India, millets are referred to as "Sri Anna" because of their cultural and historical significance which translates to "the honoured grain" or "the mother of all grains".

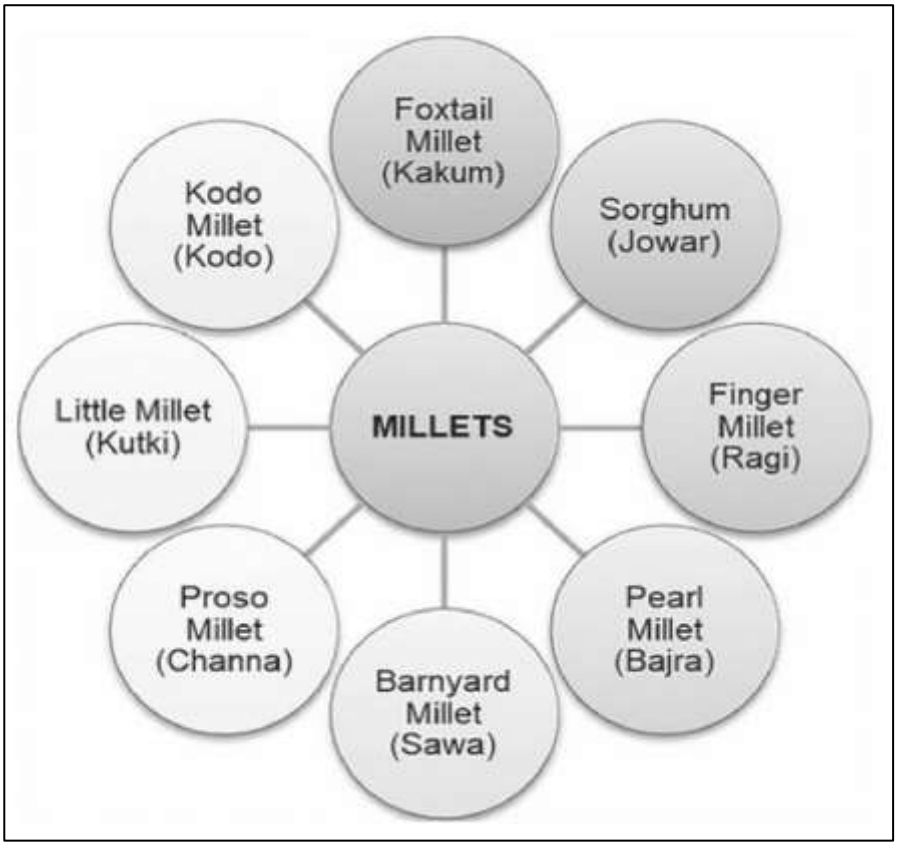

Figure 2.2: Classification of Millets

Source: Adapted from Thakur and Tiwari (2019)

These are one of the ancient foods known to humanity. The grains are highly nourishing, non-glutinous and non-acid forming foods. Hence, they are soothing and easy to digest. Several studies revealed that millets have a huge potential for its utilization into different value-added products. Millets, such as sorghum, foxtail millet, and pearl millet, are nutrient-rich grains high in dietary fiber, B complex vitamins, essential amino acids, and vitamin E.

They also provide significant minerals like iron, magnesium, phosphorous, and potassium. With a slow glucose release, millets promote satiety, potentially reducing the risk of diabetes. These grains are carbohydrate-rich, containing 6 to 11 percent protein and 1.5 to 5 percent fat. Considering a nutritious alternative to common grains, incorporating millets into our diet can contribute to overall health. Besides their nutritive value, millets are abundant sources of bioactive compounds, especially phenolic compounds, with potential human health-promoting attributes.

The predominant phenolic compounds identified in millets include phenolic acids and flavonoids, while sorghums with pigmented testa and some finger millet and buckwheat genotypes also contain condensed tannins. Studies have shown that millet phenolics exhibit potential bioactivities, including antioxidant, antimicrobial, antiproliferative, and antidiabetic effects.

2.2 Biological Activity of Millets:

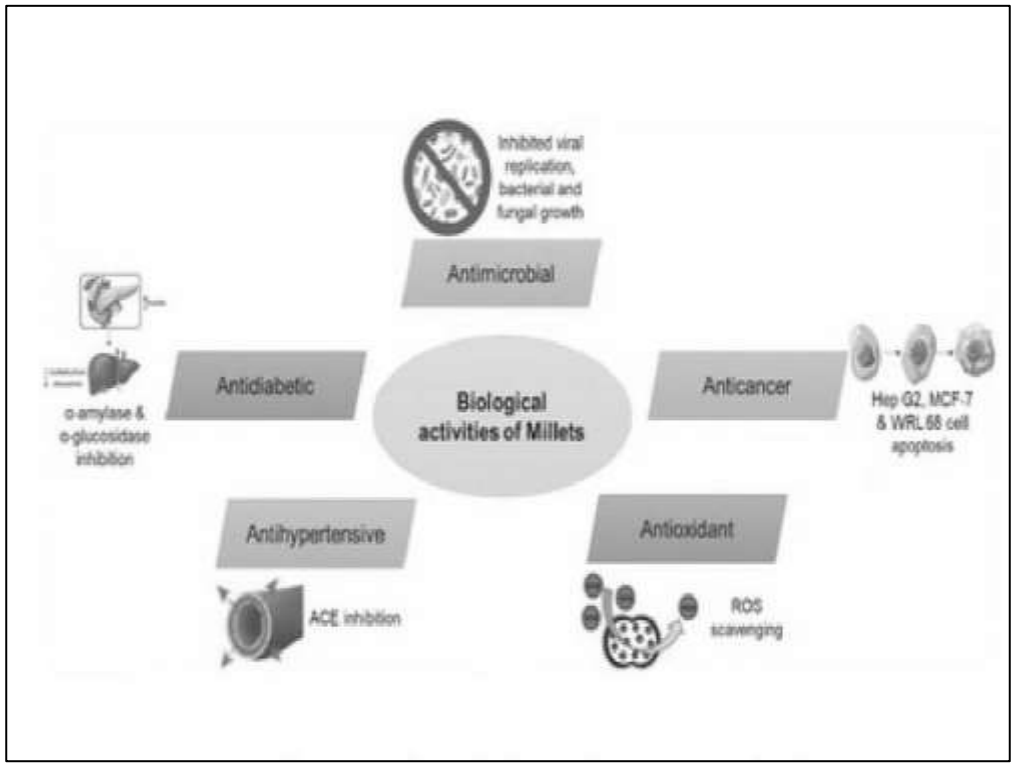

Figure 2.3: Mechanism Of Action of The Biological Activities of Millets

Source: Adapted From Majid and Priyadarshini (2020)

Due to the inherent constituents present in millet seeds such as proteins, peptides, polyphenols, polysaccharides, oil, and isoflavones, millet showcases properties that support well-being of People.

Now this presents an opportune moment to re-evaluate the potential of millets, not only for their health benefits but also for their positive impact on the environment and agricultural resilience. The Government of India (GOI) has taken steps in promoting millets through various programs and initiatives.

Additionally, raising awareness through publications and validating traditional practices with scientific methods will not only facilitate research but also strengthen the bond between people, science, and their cultural heritage. Nonetheless, reintroducing millets into the Indian diet faces considerable challenges, primarily due to the pervasive influence of existing advertisements promoting cereal-based products, internal kitchen politics within households, market-driven agricultural practices, and economic factors. In order to increase the production of nutrient-rich millets and create awareness among people the year 2023 is declared the "International Year of Millets". There are continuous efforts of Government of India (GOI) for improving the consumption and the level of production of millets in India by providing various schemes and policies such as MSPs for major millets, mid-day meal program etc.

Millet-based foods are available in numerous forms, including millet porridge, which is considered as a popular breakfast meal in many nations, particularly in Africa and Asia. It can be prepared by heating millet grains in water or milk and adding honey, sugar, or fruit for sweetness. Millet flour can be used to make roti, chapati, and naan, among other forms of flatbreads. Millet can be used as a base for casseroles, or it can be combined with vegetables, beans, or meat to create a nutritious and full meal. Millet can be popped like popcorn and seasoned with salt, butter, or spices to create a nutritious and delicious snack. Much research has explored the health advantages of millet-based foods, and the following are the most significant findings.

Incorporating millet-based foods with a low glycemic index (GI) into diet can be beneficial for managing blood sugar levels. A study revealed that a low-GI diet is more effective at reducing glycated hemoglobin and fasting blood glucose in individuals with type-2 diabetes when compared to both a high-GI diet and a control diet. In a separate study, an 8-week regimen of millet-based eating contributed to significant weight loss among overweight and obese participants. The inclusion of millet in one's diet holds the potential to lower blood pressure due to its naturally low sodium content; research demonstrated a reduction in blood pressure among hypertensive rats fed millet-based diets.

Millet-based diets are rich in antioxidants, which offer potential for reducing inflammation and providing protection against chronic ailments such as heart disease and cancer. The spectrum of benefits from millet-derived foods includes their antihypertensive, anti-inflammatory, antimicrobial, hypocholesterolemic, hypoglycemic, and anti-oncogenic properties, coupled with their capacity to

positively impact gut health through immunomodulation. A systemic review suggests that, millet consumption over a period of 21 days to 4 months, there is a significant reduction in total cholesterol (TC), triacylglycerol, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and very-low–density lipoprotein cholesterol (VLDL-C).

In four investigations it is also observed that millets ingestion has normalized TC and triacylglycerol levels (<200 and <150 mg/dl, respectively). Millet-based meals also increased HDL-C by 6.0%, lowered blood pressure by 4.0 and 5.0%, and lowered BMI by 7.0%.

Overall, studies suggested that integrating millet-based items into the diet has the potential to support in the control of metabolic disease. It is crucial to emphasize, however, that millet should be consumed in moderation as part of a well-balanced diet, and persons with metabolic disorders should consult a healthcare provider before making dietary adjustments.

In many studies it was reported that millet grains are nutri-cereals due to their valuable nutritional properties and certain health-promoting attributes such as antioxidant, anti-cancerous, anti-diabetic, anti-aging, and anti-hypertensive activities. These grains are also a rich source of protein macromolecules containing novel peptides.

The study also revealed super digestibility, bioaccessibility, bioavailability, and delivery system of the millet-derived peptides while correlating the size and bioactivity of the peptide.

Following are the major medicinal activities of Millets:

A. Antioxidant Activity of Millets:

Millet grains are a rich source of antioxidants due to the abundance of phenolic compounds in them. In addition to xylo-oligosaccharides, insoluble fibre and peptides, millet grains include a variety of naturally occurring phenolic components such as phenolic acids, flavonoids and tannins alongwith micronutrients (carotenoids and tocopherols) which also possess antioxidant capabilities.

These chemicals are primarily found in the bran layers. Additionally, millets can be enhanced with antioxidants by procedures such as germination and fermentation.

In a study it was found that roasting of millets significantly improved their nutrient content and free radical scavenging abilities.

Numerous in vitro studies demonstrated the protective effects of antioxidant against age related issues, chronic degenerative diseases and other contemporary lifestyle disorders such as celiac disease, coronary heart diseases and diabetes.

Another study discovered that a diet rich in millets had a significant impact on lowering blood pressure and concluded that millets anti-oxidative stress effect helps to prevent cardiac damage brought on by high salt ingestion.

B. Anti Cancerous Activity of Millets:

Uncontrolled cell division is a key aspect of cancers growth. In progression cancer therapy includes inhibiting or delaying the first multiplication of tumor tissue which may help to halt the growth of Cancer cells. It has been studied that millets are high in anti-nutrients such as phenolic acid, tannins and phytates and that have been found to diminish the incidence of colon and breast cancer.

C. Anti Diabetic Activity of Millets:

Diabetes is a metabolic condition caused by changes in energy metabolism and is defined by unbalanced glucose homeostasis where insulin secretion is hampered, and insulin resistance develops. Diabetes rates have been found to be lower among the millet eating population. Millets have demonstrated the benefits of lowering Alpha glucose and pancreatic amylase levels, lowering postprandial hyperglycemia and decreasing enzymatic hydrolysis of complex carbohydrates.

The control of glucose induced oxidative stress and inhibition of starch digesting enzymes by millet active biomolecules gives them potential anti diabetic properties. For instance, finger millets antinutrients have been demonstrated to slow down the digestion and absorption of Carbohydrates which reduce the glycemic response similarly the protein concentrates derived from millets have been shown to significantly reduce insulin levels, increase plasma adiponectin and improve glycaemic responses in type-2 diabetic mice. In 2010 the National Institute of Nutrition (ICMR) collaborated with the Indian Institute of Millets Research in Hyderabad to examine the glycaemic Index of Sorghum based meals as part of the National Agriculture Innovation Project.

The findings revealed that meals made from Sorghum had a low GI and were responsible for lower post-prandial blood glucose levels.

Furthermore, due to the presence of considerable amount of magnesium, millets also aid in the prevention of type-2 diabetes. Magnesium is a vital element that enhances the effectiveness of insulin and glucose receptors by creating several carbohydrate digesting enzymes that regulate insulin functions.

D. Anti-Microbial Activity of Millets:

The secondary metabolites found in millet grains exhibit a wide range of biological characteristics. The phenolic and flavonoids compounds found in the bioactive secondary metabolites of some millet cultivars have antibacterial and antifungal properties. According to the authors finger millets phenolic and flavonoid compounds have been discovered to play a significant role against the proliferative inhibitory activity of bacterial pathogens. Another study reported that the addition of finger millet bran extract in gelatin-based films significantly improved the antibacterial and antifungal activity against penicillium nettle. And thus, it can be concluded that millets, recognized as superfoods, are important nutricereals that are climate-resilient and powerhouse of nutrients that hold a prominent place in diet to help reduce the risk of NCDs. Millet-based diets being rich in antioxidants have potential of providing protection against chronic ailments such as heart disease and cancer. The spectrum of benefits from millet-derived foods includes their antihypertensive, anti-inflammatory, antimicrobial, hypocholesterolemic, hypoglycemic and anti-oncogenic properties, coupled with their capacity to positively impact gut health through immunomodulation.

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