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MAGIC OF MILLETS

DR. JYOTI D. VORA

Abstract: This research perspective is an ode to the historical and highly nutritive celebration of agrarian practices by Man... namely Millets. These are botanically, a family of grasses and are physiologically hardy, weather friendly plants. They are native to India, other parts of Asia and even parts of Africa. The UN in a resolution passed in 2021, decided to recognise this priceless gift of Nature by declaring the year 2023 as the International Year of Millets (standard Acronym IYOM). The year long period would be used to bring to the forefront of the world, the nutritional and nutraceutical benefits, the long-term ecosystem related concepts and the sustainable benefits to Holistic Wellness to the Society at large. It is obvious that this ethos has quantum benefits to our own country.

Millets has been declared as a long-term and a food compatible for both food and long-term endeavour is open to value long-term outreach, national level ramification and genomic manipulation. A valuable role has been envisaged for the Indian Embassy as we move towards enhancement of agronomy which is of global stands and contributes to Humankind.

In keeping with the grand celebration of our 75th Anniversary of Independence, "Azadi Amrut Mahotsav", the author has used 75 descriptors of this magic Nutraceutical.... citing only a few, from few, from few, from booster, carbohydrate booster, carbohydrate grain, Unison grain, Inexpensive, Wholesome, Expansive, forage, grazable, digestible, cash crop, cattle feed, Poultry feed, Poultry oriented, logistics friendly and definitely a Winner.

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ROLE OF MILLETS FOR FOOD SECURITY AND CLIMATE CHANGE

DR. ABHAYA R. JOGLEKAR

Abstract: The UN declared the year 2023 as "International year of the Millets". Millets are also called "***Nutri-Cereals "or shri ann***due to their high nutritional content. Millets are a group of small-seeded grasses grown mainly in dry zones of Asia and Africa. Millets are classified in two groups first as ***Major Millets*** which includes sorghum (*Jowar*), pearl (*Bajra*) and finger millet (*Ragi*) and second as ***Minor Millets*** which includes kodo, foxtail millet (*Kangani*), proso millet (*Chena*), little millet (*Kutki*), and barnyard millet (*Sawa*). Millets have served as a traditional staple for hundreds of millions of people in Sub-Saharan Africa and Asia for 7000 years and are now cultivated across the world. However, their cultivation is declining in many countries. More than 90 million people in Africa and Asia still depend on millets in their diets.

Africa is the largest producer of millets, contributing55 percent of global production, followed by Asia with nearly 40 percent, while Europe represents around 3 percent of the world market.

Millets for Population Challenge: With fast growing population, the world needs to produce more food to fulfil these requirements, food requirement is projected to reach 8.5 billion population by 2030 and a staggering 9.7 billion population by 2050. With a deepening climate crisis and aggravating environmental stresses, there is a heightened need for crop diversification by promoting crops suitable for cultivation in the toughest of environments. Millets have proved their importance to achieve SDG-2(zero hunger), SDG-3(good health), SDG-12(sustainable consumption and production) and 13(climate action) and population challenge.

Millets for Boosting Sustainability: As we all know that the excessive use of pesticides and chemical for more production of crop has adverse effects on soil as well as on human health. The prevalence of cancer and other health issues due to pesticides has been increased in over a decade. Millet's cultivation may also help to promote a shift towards sustainable agriculture, diversifying crop rotations and avoiding the promotion of mono-cropping systems. Millets have potential to address climate change and food security. Millets can grow on relatively poor soils and under adverse and arid conditions, as compared to other cereals. Millets can achieve SDG-12(sustainable consumption and production) and help to solve the global hunger issues.

Millets for Zero Hunger and Good Health (SDG-2,3): Millets are rich source of *fibre, protein (essential amino acids), fatty acids, B-complex vitamins, and vitamin-E. They contain high amount of minerals particularly iron, phosphorus, potassium, and magnesium. Millets are gluten free and release less amount of glucose therefore they are helpful in combating diabetes.* They are diversified in taste, recipes, and production. In India millets are cultivated during both kharif and rabi season. Millets can grow in dry land. In Chhattisgarh kodo, kutki and ragi millets are cultivated in northern and southern parts.

The production of kodo and kutki have been increased in Chhattisgarh since last 5years. The government of Chhattisgarh with the help of IGKV is trying to fulfil the requirement, of seeds not only for the state but also for country as well as other countries. Millets are good crop for small farmers particularly women, as they provide job opportunities to them. The super food needs to promote its diversity and health benefits to all stakeholders *i.e.-consumers, producers,*

value chain actors, and decision makers. Millets have proven good and tasty solution to zero hunger, good health and food security challenges. Millets are good for human and animal health (through food and feed).

ICRISAT Assistant Director General for External Relations, Joanna Kane-Potaka, described millets as a smart food – ***good for people, the planet, and farmers***.
"Millets can help contribute to some of the biggest global challenges in unison - nutrition and health needs, mitigation and adaptation to climate change, poverty of smallholder and marginalized farmers in the dry zones - some of the toughest areas that will take longer to reach the sustainable development goals."

Conclusion: It can be concluded that the international year of millets will

a) elevate awareness of the contribution of millets for food security and nutrition
b) inspire stakeholders on improving sustainable production and quality of millets, popularise recipes with local blend among population and inspire stakeholders on improving value added products.
c) draw focus for enhanced investment in research and development and extension services. They can become a key crop within global food systems, with the potential to improve the livelihoods of smallholder farmers, nutrition, and the environment.
d) Provide as good solution to climate changes, particularly drop in average rainfall.

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ROLE OF MILLETS IN FOOD SECURITY

BHAWNA SRIVASTAVA

Abstract: We all know that United Nations accepted India's proposal to announce 2023 as the International Year of Millets. Millets are good for health and the environment as they have a less carbon footprint and survive in less water. Four billion people depend on staple food such as wheat, rice, and maize compared to 90 million people relying on millet in Africa and Asia. In most countries, subsidies are given only to benefit the significant cereals. Still, in India also, to resolve crippling food shortages, the Green Revolution promoted and subsidized the cultivation of high-yielding rice and wheat over indigenous crops such as millet. Millets have been nicknamed "nutri-cereals" for their nutritional value. Now people are waking up to the nutritional benefits of millet as its ability to prevent lifestyle diseases. Millets lower the risk of developing Type-2 diabetes and overall cholesterol levels and reduce iron deficiency. All these qualities of millet provide a solid case for bringing millet back into the mainstream. Apart from nutritional importance, another reason for United Nations countries to take an interest in millet as a future crop is the increase in temperature. World Meteorological Organization indicates that temperature will rise by 1.5 degrees Celsius within the next five years. An increase in temperature by even a degree can severely impact agriculture and the productivity of the major cereals, threatening the food security of billions of people. According to Rajeev K. Varshney, a leading agricultural scientist, millets are resilient to extreme conditions, including high temperatures and drought, and can grow in the harshest, most arid regions.

We can grow most millet varieties within 60 days of sowing so that a farmer can grow at least twice or thrice a year. However, the production is significantly less due to a lack of quality seeds. In India, the demand for millet has grown by 140%. However, the supply is only 50%, so institutes like the Indian Institute of Millets Research (IIMR) and International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) should work together to provide quality seeds through farmer producers organizations and governments. Government should also invest in research on mechanization, cultivation practices, millet production, harvest technologies, value addition and food processing, and millet-based products.

There are also concerns about ethics and sustainability while promoting millet. In India, health-conscious consumers in urban India are taking millet in large quantities, so farmers sell it at high prices instead of personal consumption. So, the government should make a policy for quality seed production of millets and care about its price rise.

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MOSAIC OF MILLETS: A QUALITY CONTROL INSIGHT

DR. DIPAK VORA

Abstract: We are poised to celebrate the year 2023 as the International Year of Millets. In keeping with applauding the nutritional, nutraceutical and Holistic Wellness-oriented properties of this Nutri-cereal, it is important to recognise the need for scale up, educative endeavours, agrarian amplification and above all quality control. In a nut-shell, this is the essence of this research deliberation.

Recognising that food is a global commodity and a societal concern, food safety and regulatory practices have to be understood and then applied uniformly. Good Manufacturing Practices (GMP) and a modular approach to Quality Control (HACCP) are mandatory tools to the small-scale cultivation to scale up of millets.

The need of the hour is to make a global objective of bio amplification, food enrichment and biofortification of a group of botanicals which are well known through history as Wonderfoods.Hence, it is important to address peripheral aspects of the food process science with respect to millets. These include consumer centric practices like accurate food labelling, tamper proof packaging and experimental assessment of risk management. The arena of risk management includes Physical, chemical and microbiological aspects. These have to be governed by standardised research methodology and methods which are certified.

It is only with this 360-degree approach that the World would be able to exploit the potential of this incomparable gift of Nature in a sustainable manner.

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MILLETS AND ENVIRONMENTAL SUSTAINABILITY

PRAHALAD DUBE

Abstract: Millets are coarse grains that are traditionally grown and consumed in the Indian subcontinent for over 5000 years. Millets are a group of cereal grains that belong to the *Poaceae* family, commonly known as the grass family. During the course of evolution these have acquired capacity to face harsh environmental and climatic conditions. Therefore, these are successful in surviving and also in sustaining food crops.Millets are available in a variety of types, and each has its health benefits. Being a C_4 group of cereals, millets convert more carbon dioxide to oxygen. These have important role in mitigating climate change. Millets can endure extremely high temperatures to drought and salinity making it a climate resilient crop especially in arid and semi-arid areas. Rajasthan state's more than half of geographical area falls under this category and nearly 70% is desert. The Thar Desert or the Great Indian Desert encompasses about 70% of total landmass of Rajasthan and therefore, it is identified as the "Desert State of India". The Thar Desert embraces the districts of Jaisalmer, Barmer, Bikaner and Jodhpur. Millets are rich source of nutrients, antioxidants and proteins. Besides that, they have the ability to sequester carbon thereby reducing the release of atmospheric CO_2 thus contribute in mitigating climate change. Millets are thus environmentally, ecologically, economically friendly sources of food and nutrition. Millets require less fertilizer and pesticide, unlike mainstream cereals, for cultivation. Millets supply superior nutrients and possess excellent climate resilience properties. Therefore, promotion of millets could help attain the sustainable developmental goals (SDGs) of the United Nations (UN). The agenda of G-20 countries has also given it preference for discussion, planning and designing strategies. So, in the present paper issues and aspects of millets climate change, food security and environmental sustainability are discussed.

Keywords: Climate Change, Environment, Food Security, Millets, Thar Desert, Sustainability.

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ROLE OF BIOTECHNOLOGYAND GENOMICS TO PROMOTE MILLETS AS FUNCTIONAL FOODS

BHAWNA SRIVASTAVA, REDDY P.B

Abstract: Small millets are less carbon-intensive, drought-resistant, and environmentally friendly. While they are used as feed in Europe, they are widely consumed as food in India, other East Asian nations, and sub-Saharan Africa. Due to their anti-nutrient contents, SMs do not have as high a bioavailability of micronutrients as other cereals. Research institutions are working together to improve the nutritional and processing qualities in an effort to overcome these limitations. They have improved cultivation through the development of high-yielding, micronutrient-enhanced varieties. It is difficult to achieve dramatic changes in crops' ability to withstand stress using traditional breeding methods, but biotechnology makes it possible. It is a practical tool for enhancing agricultural output. Precision and quick genetic modification of plants have been made possible by the development of biotechnological approaches like genetic engineering, genome editing, RNA-mediated gene silencing protected by next-generation sequencing, and genome mapping. Due to successful characterization and evaluation in gene banks, high nutritional profiles within and between varieties have made these activities possible. This article gives a summary of the novel technologies currently in use to maximize the nutritional benefits as well as germplasm characterization to maximize the qualities of small millets and their products. Millets and other historically significant crops can help with the need for a nutritious diet because of the extent of food insecurity among the constantly expanding population and the prevalence of malnutrition and under nutrition among children. In light of this, the current review lists the developments in millet's genetics, genomics, and other omics that have opened the door to improvement through biotechnological and breeding interventions. This review also lays out a plan for enhancing this crop in the conventional cropping system.

Keywords: Biotechnology, Millets, Breeding, Germplasm, Genetic Improvement.

Introduction: Due to the rapid changes in temperature, altered rainfall patterns, floods or drought conditions, and outbreaks of pests and diseases, global warming has a variety of harmful effects on plants. These, in turn, have an impact on crop production, lowering the standard and volume of agricultural output. The demand for food worldwide is significantly increased by climatic extremes and rapid population growth. Consequently, it is crucial to achieve food security for both the present and future generations (Rajasekaran, R. and Francis, N., 2021).

The Food and Agriculture Organization (FAO) predicts that by 2050, there will be nine billion people on the planet, and to feed them, we will need to produce 50% more food than we do Rajasekar an do now. However, it is a difficult task to increase the food production of the current crops on the available land (Béné, C., et al 2015, Bahar, et al 2020, da Cunha Diaset al. 2021). This problem is further complicated by a number of factors, including an overreliance on

a small number of industrialized crops, a reduction in the amount of agricultural land, and climate change. A number of factors, including desertification and the use of agricultural lands for non-agricultural purposes, seriously threaten the world's food production systems (Cattivelli, V., 2022, Sharma, et 2023).

As dietary preferences shifted to staple crops during the green revolution, small millets, also known as nutri-cereals, were driven out of widespread cultivation (Singh, et al 2020, Kaur, et al 2023). Small millets are nevertheless abundant in micronutrients and crucial amino acids for regulatory functions. As a result, recent efforts by national and international organizations have focused on reintroducing these lost crops' desirable characteristics. The main objective of bringing these crops back to life is to strengthen future generations' immune systems so they can combat emerging pandemics and disease infestations in crops.

It is difficult to achieve dramatic changes in crops' ability to withstand stress using traditional breeding methods, but biotechnology makes it possible. It is a practical tool for enhancing agricultural output. Precision and quick genetic modification of plants have been made possible by the development of biotechnological approaches like genetic engineering, genome editing, RNA-mediated gene silencing protected by next-generation sequencing, and genome mapping. Due to successful characterization and evaluation in gene banks, high nutritional profiles within and between varieties have made these activities possible. This article gives a summary of the novel technologies currently in use to maximize the nutritional benefits as well as germplasm characterization to maximize the qualities of small millets and their products. Millets and other historically significant crops can help with the need for a nutritious diet because of the extent of food insecurity among the constantly expanding population and the prevalence of malnutrition and under nutrition among children (Li, X., et al 2020, Noort, et al 2022). In light of this, the current review lists the developments in millet's genetics, genomics, and other omics that have opened the door to improvement through biotechnological and breeding interventions.

This review article discusses the potential use of various advance technologies for understanding the genetic enhancement of small millets and the use of available germplasm information. We further discussed a detailed futuristic outline of integrated use of biotechnology and gene editing technologies for rapid improvement of small millets. Desirable crop cultivars are currently being created with such tough efforts in order to meet the demand for food and to support sustainable agricultural productivity for climate change adaptation.

Crops Improvement Using Traditional Knowledge: Small millets have a significant place in our cultural heritage because our ancestors valued them for their therapeutic and nutraceutical properties. In accordance with the rules established by PPVFRA, 2001, these customs and practices are protected as traditional knowledge (Singh, D et al 2019, Pratima et al 2023). According to some tradition, millet grains are given as wedding gifts and are particularly prepared for cooking during celebrations of puberty and childbirth (Vermander, B., 2021). Regarding the preservation of India's cultural heritage, the Kolli Hill tribes in the Eastern Ghats continue to cultivate and preserve Malayali millets; these traits point to the presence of novel alleles for upcoming breeding programs. Findings from records of the use of small millets in Chhattisgarh, India, showed that Kodo millet straw is used in mud to make termite resistant walls.

Breeding Objectives and Prospects: Millets only need a minimal amount of input, including irrigation, fertilizer, and pesticides. They can survive in challenging environments and are therefore a dependable smart crop in the future (Umesh, M.R et al 2019, Numan, M., et al 2021, Pankaj, Y.K. and Wani, S.H., 2023). In small millets, cultivation and post-harvest methods are the main breeding goals. Higher yields are the primary focus of the initial goal. Smaller grain size results in poor milling recovery, which is a major goal of the post-harvest technique; therefore, breeding for larger seeds would help reduce post-harvest losses. Enhancing the color, nutritional profile, fodder yield, flour quality, and reducing antinutritional traits should be the main goals of future small millet breeding.

Although small millets have a lot of potential, there are not as many research initiatives as there are for other crops. The limitations imposed by the smaller inflorescence and spikelets are to blame for this. These characteristics limit the potential for producing desirable recombinants. Recombinants have successfully developed because of recent hot water emasculation techniques. Novel alleles in small millets have been separated thanks to improvements in mutation breeding with MutMap+ and genotyping tools. Therefore, a greater emphasis on small millet genetics and genomics using cutting-edge omics approaches are required (Singh, R.K et al 2020, Sonah, H., et al 2022, Pramitha, et al 2023).

Recent Advancements of Crop Improvement in Small Millets: Due to their adaptability in harsh and arid environments, few farmers completely relied on this cropping pattern even though these crops lost their economic value. As a result, tribal populations and traditional farmers have always preserved these crops as a cultural heritage over generations. After overcoming the barriers to crossing, mutation breeding for varietal development in small millets later emerged. In small millets, mutation breeding began in the 1970s using EMS and gamma rays. Early in the 1950s, when pureline selection and pedigree breeding, two forms of conventional breeding, dominated crop varietal releases, efforts to improve small millet started (Pratima et al 2023). Successful lines created through recombination breeding include varieties of small millets like CO 6 and CO (7) thenai in foxtail, CO (PV) 5 in proso millet, CO (samai) 4 in little millet, and CO 9, CO 13, CO 14, and Paiyur 2 in finger millet. By employing standardized emasculation procedures, such as hot water treatments, Tamil Nadu Agricultural University was able to release these varieties (Ravikesavan et al., 2022).

The germplasm of the following 11 crops is stored in the ICRISAT Gene bank, which was founded in 1979 and is located in Patancheru, India: sorghum, pearl millet, chickpea, pigeon pea, groundnut, finger millet, foxtail millet, little millet, kodo millet, proso millet, and barnyard millet. It is one of the biggest international gene banks, with 129,935 germplasm accessions gathered from 144 countries through donations and collection missions (http://genebank.icrisat.org/).

In comparison to the major staples, only fewer molecular studies are published in small millets. Foxtail millet was used to create the first linkage map in the small millets, and later, SSR and SNPs were employed to map the QTLs in a high-density linkage map (Pratima et al, 2023, Loni, F et al.2023). Later, Rajput et al. (2016) created linkage maps in proso millet using SNP markers. Pendergast et al. (2022) recently created finger millet's high-density linkage map with SNPs.

In order to genotype the diversity, molecular markers including EST, RAPD, and AFLP were used to study the calcium dynamics in finger millet, while CAP, miRNA, EST, ISSR, and SRAP were used to genotype the diversity in proso millet (Habiyaremye et al., 2017). Fukunago et al. (2002b) and Desai et al. (2021), respectively studied chloroplast and mitochondrial diversity in foxtail millet and barnyard millet. SSRs were primarily used in small millets among all molecular markers, and they were used in comparative genomics to examine their lineages. Therefore, Bonthala et al. (2014) created a separate marker database for SSRs in foxtail. In small millets, QTL mapping and trait mapping are still in their infancy.

Genomics in Small Millets in Relation to Climate Change: Innovative breeding techniques can be used to accelerate breeding progress and identify the genes in small millets that are responsible for improved nutritional quality and stress tolerance. Additionally, by utilizing this information, susceptible major cereal crops can have these traits improved. Whole-genome sequencing has completely changed crop improvement breeding and biotechnological methods. Small millets' genome sequences have produced genomic resources that can be used to locate desirable traits' genes, select them, and introduce them into different cultivars, species, or crops. We run the risk of overlooking many significant variations present in crop genetic diversity if we use the genome sequence of a single person as our reference genome.

Small millets have a natural resistance to abiotic stresses like salinity, low soil fertility, high temperatures, drought, and extremes in temperature. Due to these qualities, small millets stand out as the best smart crops to cultivate in the face of climate change. Therefore, it is essential to comprehend the genetic and molecular mechanisms regulating stress tolerance in millets. To quickly analyze and make use of these intricate mechanisms, modern and conventional breeding should collaborate. Next-generation sequencing technologies (NGS) have revolutionized genomics and generated a wealth of important molecular data. The genome sequences of foxtail millet, finger millet, proso millet, teff, Japanese barnyard millet, and white fonio are now available, though the advantages of this technology were delayed in small millets due to limited funding and research.

The ML-365 finger millet genome underwent whole-genome sequencing and annotation, revealing TFs (transcription factors) and genes associated with drought resistance and the C4 photosynthetic pathway. WRKY, MYB, MYC, ZFHD, NAC, ABF, AREB, GRF, and NF-Y transcription factors were linked to 2,866 drought-responsive genes (Hittalmani et al., 2017). 180 NAC TFs were found in proso millet, and their expression changed in response to different drought treatments. Proso millet NAC) genes showed up regulated expression levels in the roots, highlighting the crucial role of root characteristics in drought tolerance (Shan et al., 2020).

In finger millet, drought stress activated a number of enzymes, including the signal recognition particle receptor, farnesyl pyrophosphate synthase, calcineurin B-like interacting protein kinase 31, serine-threonine protein phosphatase 2A, and others. Drought also activated several housekeeping and basal regulatory genes. Pentatricopeptide repeat proteins and tetratricopeptide repeat proteins were two novel drought-associated genes found in the crop (Feng, C et al 2016). Finger millet genotypes that are salt-tolerant exhibit up regulation of numerous genes involved in cell growth and differentiation. Genes involved in flavonoid biosynthesis were selectively down regulated in the salinity-tolerant strain (Chantre Nongpiur,

R.,). Increased antioxidant enzyme activity and non-enzymatic antioxidant content were seen in the tolerant Yugu2 strain.

Conclusions and Road Map: Our thorough analysis of studies in small millets revealed their enormous potential for using cutting-edge omics techniques to tap the genetic causes of nutrient content and climate resilience. Foxtail has been used as a model crop system and has greater research potential among small millets. Small millets may therefore serve as a model crop for novel genes and mechanisms that can be manipulated by comparative genomics in common cereals to increase stress tolerance and therapeutic traits. In this context, processed foods, new recipes, and multigrain products with value-added ingredients all show a recent trend in the public's eating habits toward small millets.

The status of crop production provides insight into improving the productivity of small millets, which is influenced by a variety of factors. Increased cultivation of small millet is the top priority. Small millets have traditionally only been grown by marginal and rainfed farmers who use them as cover crops to protect arable lands from harsh weather. Additionally, these farmers have limited access to high-quality seeds for planting, and pure small millet varietal seeds must be painstakingly prepared from seed production plots. Second, accelerating market demand is necessary to expand the cultivation area. Crop diversification follows food diversification, and this has the potential to bring back neglected and lost crops for widespread cultivation.

Additionally, public communities have recently placed an emphasis on physical fitness, with trainers in urban areas advising their trainees on dietary practices. These initiatives involve nutritional supplements, and diet plans have begun to feature well-known advertisements for manufactured health supplements. Small millet-based supplements could soon take the place of these schedules. Small millets are a good source of phytochemicals that control cellular metabolic processes, including folic acid, flavonoids, terpenoids, resistant starch, and others. Therefore, thorough investigation into the therapeutic benefits of small millets and their enrichment could displace artificial supplements in exercise regimens.

The use of breeding techniques to produce desirable traits is a significant stream in small millets that needs to be taken into account. Small millets need to be improved through selection in areas where they are weedy. When creating crop ideotypes for small millet breeding, distinctive traits like shattering, lodging, small seeds, spined shoots, bristles, and awns must also be taken into account. To increase yield and productivity, additional breeding goals must be focused on nutritional stability, bioavailability in processed foods, multigrain products, phytochemical expression, uniform maturity, fertilizer responsiveness, and biotic stress tolerance. Small millets could therefore replace other sources of nutrition and health benefits in our daily diet.

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MILLETS IN FOOD AND NUTRITION SECURITY: WITH SPECIAL REFERENCE TO INDIA

POOJA SHARMA

Abstract: Food security has been a target in India since its independence; the primary aim of food security is to ensure enough staple food for the entire population. Although substantial progress was made through the adoption of green revolution (GR) technologies and implementation of the food public distribution system (PDS), desirable food and nutrition security, as defined by the food and agriculture organization (FAO), is far from being realized. This paper scrutinized the potential contribution of millets in achieving food and nutrition security in India. Methods: The present study was conducted based on the secondary data obtained from FAO Corporate Statistical Database and published literature on food and nutrition security. The impact of the GR technologies and the PDS on food and nutrition security was examined using 58 years of acreage, production, and yield of rice, wheat, and millet, as well as comprehensive information on relevant issues including climate. Results: Both GR technologies and PDS unduly favored two principal crops, namely rice and wheat, marginalizing all other crops cultivated for thousands of years to meet the food and nutrition requirement of mostly developing countries including India. Millets constitute one such neglected group of crops in India, which have tremendous potential for contributing to food and nutrition security. Conclusions: Millets are to be included in the PDS alongside rice and wheat so that they receive an appropriate Minimum Price Support. Appropriate implementation of relevant regulations, continued research and development, and adequate support for cultivation and marketing of millets are necessary in this regard.

Keywords: Millet; Nutrition Security; India

Introduction: Food security was a target in India since its independence in 1947 and perhaps even before the Great Bengal Famine in 1943-44. The Public Distribution System (PDS) was started as a system of managing food security in the 1940s, which eventually has become an important policy instrument to combat food security in India after independence. Later, the worldwide effort of Green Revolution (GR) to produce cereal foods, especially rice and wheat, to combat the calorie requirement of the increasing population played a significant role in combating food security. Despite considerable improvement in increased food production and improved distribution, ensuring enough food with appropriate nutrition remains elusive for all people at all times. Hunger and malnutrition continued in the world, including India. Although considerable progress has been made in India in improving food and nutrition security, there is still a long way to go. Given the increase of population, climate change, and nutrition requirement, India is faced with a need for new direction and policy to achieve food and nutrition security. On one hand, as a policy perspective, India introduced. The National Food Security Act (also Right to Food Act) in 2013. The Act aims to provide subsidized food grains to approximately two-thirds of India's 1.3 billion people. On the other hand, for

diversification of food production and grain-mix in the PDS, India has given importance to millets. Millets, a group of hardy and drought-resistant cereal crops, have been incorporated in the cropping system to improve food and nutritional security. In this study, the potential of millets to combat food and nutrition insecurity was explored in India with special focus on what determines its contribution and what policy actions are necessary.

Millets and Food Security: The United Nations (UN) has declared 2023 as 'the international year of millets' and has called all stakeholders to provide support to draw policy attention to the nutritional and health benefits of millet consumption, and their suitability for cultivation under adverse and changing climatic conditions. Millets have the potential to help achieve the sustainable development goals (SDGs)—mainly SDG 2 (Zero Hunger), SDG3 (Good Health and Well-being), SDG 12 (Sustainable Consumption and Production), and SDG 13 (Climate Action). Growing millet has many advantages: Being a rain-fed crop with minimal use of fertilisers; no pesticide as they are less vulnerable to insect attack; seeds of millet can be stored for years making it advantageous in drought-prone areas.

According to The International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), more than 90 million people in Africa and Asia depend on millets in their diet. Although the global millet consumption has declined at a rate of 9 percent, the Millet Market forecast for 2022-27 shows promising trends. India dominates the global production at 41 percent, whereas the consumption has been receding over the years. On the other hand, Africa has become the largest consumer of millets at 40 percent. Millets are multipurpose: They consume 70 percent less water than rice; grow in half the time of wheat; and require 40 percent less energy in processing. They are one-stop solution in the wake of climate change, water scarcity, and drought conditions along with high nutritive value to provide sustainable food security. Millets are an excellent source of antioxidants and help enhance capability of probiotics with potential health benefits. They play a role in body immune system, a solution to tackle childhood undernutrition and iron deficiency anaemia. Evidence indicates higher nutritive value of millets as compared to other cereal crops.

Millets can thrive at relatively high temperatures and reproduce in limited water supply (xerophilic). A review indicates the positive effect of millet cultivation in the reduction of stress on environmental resources, especially in regions affected by climate change. Looking at the water security, millets require almost six times less water for growth (20 com) as compared to rice that requires average rainfall of 120-140 cm. The maturation time for certain millets is 45-70 days, half to that of rice (120-140 days). Being a C4 group of cereals, millets convert more carbon dioxide to oxygen, contributing in mitigating climate change. Millets can endure extremely high temperatures to drought to salinity making it a climate resilient crop. The world needs to produce more food to feed a rapidly growing global population, which is projected to reach 8.5 billion by 2030, and a staggering 9.7 billion by 2050. With a deepening climate crisis and aggravating environmental stresses, there is a heightened need for crop diversification by promoting crops suitable for cultivation in the toughest of environments.

Acknowledging the role of millets in responding to nutritional, agrarian and climate challenges, the UN resolution considers the urgent need to raise awareness of the climate-resilient and nutritional benefits of millets and to advocate for diversified, balanced and healthy diets through the increased sustainable production and consumption of millets. They

are rich in vitamins and minerals, including iron and calcium; are high in protein, fibre, resistant starch, and have a low glycaemic index, which can help prevent or manage diabetes.
The International year of millet gives a thriving opportunity to:

1. Increase the contribution of millet to food security.
2. Increase the global production of millets
3. Ensuring efficient processing, transport, storage, and consumption.
4. Sustainable production and quality of millet with the involvement of the stakeholder.

Millets and Food Security in India: India is among the top 5 exporters of millets in world. World export of millet has increased from $400 million in 2020 to $470 million in 2021 (ITC trade map) India exported millets worth $64.28 million in the year 2021-22, against $59.75 million in 2020-21. Share of Millet based value added products is negligible. India is the largest producer as well as the largest exporter of cereal products in the world. India's export of cereals stood at Rs. 96,011.42 Crore / 12,872.64 USD Millions during the year 2021-22. Rice (including Basmati and Non-Basmati) occupy the major share in India's total cereals export with 75% (in value terms) during the same period. Whereas, other cereals including wheat represent only a 25 % share of total cereals exported from India during this period.
India is one of the leading producers and suppliers of millet, and there are a number of millet sourcing points located throughout the country. The main millet-growing states in India are Rajasthan, Maharashtra, Karnataka, Andhra Pradesh, and Madhya Pradesh These states have a large number of millet farmers who grow the grain for both domestic and international markets. In addition to the major millet producing states, there is also a number of smaller millets producing regions located throughout India. These regions include the states of Uttar Pradesh, Bihar, and Madhya Pradesh. The Indian government had suggested to the united nation for declaring the year 2023 as the International Year of Millets (IYOM). India got the support of 72 other countries, on 5th March 2021, United Nations General Assembly (UNGA) declared 2023 as the International Year of Millets. The initiative of the Indian government is of celebrating IYOM 2023, it is done by making the population aware of the millet benefits and increasing the acceptability of the value added of millet across the country and world.
Millet is a type of grain that is popular in many parts of the world, especially in Africa and Asia. It is a staple food in many parts of the world, particularly in Africa and Asia. According to the World Food Programme, there are an estimated 1.2 billion people who consume millet as a part of their diet. Millet production has remained relatively stable over the past few years, with an estimated production of 28 million metric tons in 2020. The majority of millet is produced in Africa, followed by Asia. India is the largest producer of millet, followed by Niger and China. Other major millet-producing countries include Burkina Faso, Mali, and Senegal. While millet is not a major food crop in the developed world, it plays a vital role in the diets of many people in developing countries. Millet is a drought-tolerant crop that can be grown in dry, arid climates where other crops would fail. It is also a nutritious grain that is high in fiber and essential minerals. For these reasons, millet will continue to be an important food crop in the years to come.
In India, millet production has been on the rise in recent years. India is one of the largest producers of millets &Indian farmers have been increasingly planting millet as a drought-resistant crop. The Indian government has also been promoting millet production as part of its

National Food Security Mission. As a result of these factors, millet production in India is expected to continue to grow in the coming years. The graph below depicts the production trends of millets in India. Growing millets is a step towards sustainability and food security, according to several experts. India is making some efforts not only nationally, but globally in this direction. At India's behest, the United Nations approved 2023 as the International Year of Millets. The move was supported by 70 nations.

Large majority of the consumers in India and other countries prefer consuming paddy because of the ease of cooking and also because of their habits. However, it is to be noted that millets have a short shelf life depending on humidity, temperature, and small market size. This calls for more awareness creation drives on the nutritive values and setting up better storage facilities for the crop for increasing its longevity. The states of Karnataka and Odisha set an example by promoting millets and including it in the mid-day meal for schools and distributing them in anganwadis to combat malnutrition and the Public Distribution System (PDS). Even though millets have been traditionally consumed in past decades, showing improved micronutrient intake and reduced anemia prevalence in women, of late, barriers of cost, taste, perception, and availability have led to decline in consumption of millet.

There is ample evidence on nutritive value of millets being a good source of energy, carbohydrates, fats, proteins, soluble and insoluble fibre, antioxidants, iron, zinc, and vitamins and can help eliminate micronutrient deficiency for India and other developing nations. It helps lower cholesterol, as it is rich in polyunsaturated fatty acids and omega-3 fatty acids. A white paper on 'Mainstreaming Millets for Nutrition Security' in India launched in 2021 provides a detailed framework for strengthening the entire value chain by addressing the gaps and calls for replicating scalable models across states for millet promotion in the country. It is time to unleash the potential of millets by creating awareness of the nutritional values to encourage a shift in consumer choices.

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HISTOPATHOLOGICAL CHANGES INDUCED BY ORGANOCHLORINE (ENDOSULFAN), ORGANO-PHOSPHORUS (MALATHION) AND CARBAMATE (CARBARYL) PESTICIDES IN THE INTESTINE OF RATTUS NORVEGICUS (BERKEN).

ARUN KUMAR TEWARI

Abstract: The present study includes histopathological changes due todifferent pesticides as investigated. The experiment has been evaluated in male ***Rattusnorvegicus*** using various parameters. This study has been carried out to investigate the normal histology of intestine and histopathological changes due to under stress to three group of pesticides (**organochlorine** - endosulfan, carbamate-carbaryl and Organophosphorus-malathion). The study has drawn few possible correlations and conclusions to understand the effects of above pesticides with relation to their age in laboratory rats. The present study includes the percentage increase or decrease in different layers of intestine with relation to days (age) under the stress full effect of above three categories of hazardous Chemical.

Keywords: Histopathological, Organochlorine (Endosulfan), Organophosphorus (Malathion), Carbamate (Carbaryl), Pesticides, Intestine, Rattus Norvegicus (Berken).

Introduction: Green revolution changes the economical pattern of our crops up to a great extent. As the generation advances, we have more requirement of food for their sustainable life. This more requirement has to be fulfilled by two ways one by applying fertilizer and second by using pesticide.

The use of these pesticide has given excellent results in many cases but there is introduction of many serious problems arising from their large-scale use and accumulation in food chain. These also include, hazards to human health, environmental pollution, undesirable side effects on non-target animals and plants, and disruptive impacts on ecosystem as well as whole biosphere. Pesticides vary greatly in toxicity. Toxicity depends on the chemical and physical properties of a substance and may be defined as the quality of being poisonous or harmful to animals or plants. Pesticides have many different modes of action, but in general cause biochemical changes which interfere with normal cell functions.

The importance of this study need not be emphasized since most of the urban rural populations in the developing countries are the victims of various ailments due to different health condition. The study will help in knowing the toxicity of pesticides in animal and human. The results of this study are thought to provide necessary baseline data on blood chemistry, histopathology and hematology in experimental rats under normal

and abnormal conditions. These observations will certainly provide. the necessary inputs for future researches opening up newer avenues to prove into specific causative factors of tissue damage (intestine, intestine, intestine, gonads etc.) with pesticide intoxications among occupational workers. So, the present study is attempted to gather more information's on three

of the most extensively used insecticides in agriculture viz. Endosulfan, Carbaryl and Malathion.

Aim/Purpose:

1. To calculate the histopathological changes due to the effect of various pesticide.
2. To study the changes in histopathology of intestine during the specific gap of days.
3. To study the physiological changes in intestine as the age advances under the effect of pesticides.
4. To study the percentage degeneration in intestinal layer functioning at various stress parameter.
5. To calculate the changes in blood during the stress full condition of various pesticide due to malfunctioning of intestine.

Materials and Methods:

1. Pesticides:

(A) Endosulfan is an organochlorine biocide used for controlling pests and mites by generating neurotoxic effects (i.e., hyper stimulation) (Benteen et al., 2017). Upon application, receiving soils act as a primary reservoir of endosulfan in the environment; because of its hydrophobic properties, endosulfan has shown high mobility across environmental compartments. Classified as a semi-volatile compound, endosulfan is prone to evaporation; subsequent atmospheric transportation may occur, resulting in wide dispersion and remote deposition from application sites. Endosulfan transfers to water bodies through runoff and favours accumulation onto sediments once in the water column (Weber et al., 2010). Both microbial and abiotic processes transform endosulfan in the environment: bacteria oxidize endosulfan to the respective sulfate, whereas endosulfan diol forms after alkaline hydrolysis. These intermediates exert similar toxic effects on biota and humans. Chronic exposure to endosulfan leads to bioaccumulation in fish; acute exposure results in neurotoxicity (hyperactivity and convulsions) in animals and humans; severe poisoning can lead to organ failure and death.

(B) Carbaryl: (chemical name 1-naphthyl methyl-carbamate) is sold under many trade names, the most common being Seven. It is widely used in agriculture, in horticulture, and in residential settings. The primary mechanism of action is reversible inhibition of acetyl cholinesterase and it is generally regarded as being safe with respect to human health.

(C)Malathion: Malathion is a broad-spectrum oregano phosphorus insecticide for agricultural, industrial, and outdoor home uses, and for treating ectoparasites. It has low persistence in the environment. Humans are exposed through inhalation, dermal contact, diet, and water. Oxidative deculturation converts malathion to haloxon, which inhibits acetylcholine esterase in nervous tissues. Acetylcholine accumulation at synapses results in toxicity from cholinergic hyper stimulation. Alternate toxicity mechanisms are possible. Detoxification through carboxyl esterase's converts malathion to carboxylic acids for further metabolism. Reproductive, developmental, and immunological toxicity are possible under some circumstances. Malathion exhibits moderate to high toxicity in non-target organisms.

2. Test Animals: The experiments were carried out using male albino rats (*Rattus norvegicus,* wistar strain). Two hundred eighty-five (285) male albino rats (average body weight 145 gm ± 10 gm) were housed under uniform animal husbandry conditions in department of zoology D.A.V. Collage Kanpur.

3. Vehicle and Route: Samples of insecticides name endosulfan, carbaryl and malathion were dissolved in refined peanut oil (postman brand) and administered orally to all the animals of both experiment in predetermined doses for a period of 56 to 90 days.

4. Doses: The following dose schedules in both the experiments were used for the treatment of animals

I. **Endosulfan** - Two dosage of endosulfan were selected for the study
   (i) 0.011 g/kg/day i.e., 1/10th of LD_{50} for 56 days
   (ii) 0.0055 g/kg/day i.e., 1/20th of LD_{50} for 90 days.

II. **Carbaryl** - Two dosage of Carbaryl were selected for the study
   (i) 0.085 g/kg/day i.e., 1/10th of LD_{50} for 56 days
   (ii) 0.0425 g/kg/day i.e., 1/20th of LD_{50} for 90 days.

III. Malathion - Two dosage of Malathion was selected for the study
   (i) 0.280 g/kg/day i.e., 1/10th of LD_{50} for 56 days
   (ii) 0.140 g/kg/day i.e., 1/20th of LD_{50} for 90 days.

5. Treatment schedule All the 285 animals were divided equally into 15 groups with 30 animals for 56d, 35 animals for 80d. 10 animals for blood sugar experiment of 56d & 90d and 10 animals for control group i.e., 95 animals for one insecticide and total 285 animal for all the three insecticides. The treatment schedule is fix for different groups.

Methods:

1. Clinical signs of toxicity
2. Haematological and blood chemistry studies as it is mostly regulated by intestinal nutrient absorption
3. Physiological studies of intestine
4. Histopathological changes in intestine
5. Statistical analysis

Climate and Temperature: Kanpur experiences mainly three seasons i.e., Summer {March, April May, June), Rainy (July, August, September, October) and Winter {November, December, January, February) in summer the average maximum temperature goes up to 47.5°c, accompanied by dust storms and heat-waves. Temperatures during cold weather drop down with minimum of almost 12-140C. Kanpur experiences severe fog in December and January almost every year.

Result and Discussion:

Histopathological Studies of Intestine: The small intestine, which extends from the pylorus of the stomach to the colon, is commonly divided into three regions an upper, the duodenum a middle, the jejunum, and a lower the ileum. The mucosa is further carried up into finger like projections, the villi, which not only cover the surface of the valvulae but the entire surface of the small intestine. The wall of the intestine consists of some four coats which constituted the wall of the stomach - mucosa, submucosa, muscularis externa and serosa. The mucosa is composed of its lining epithelium, a lamina propria with its glands, and a limiting muscularis mucosa. The most characteristic feature of the small intestinal mucosa is the villus. Each villus consists of a core of delicate loose connective tissue and an epithelial covering. During absorption of fat from the intestinal lumen, the lacteals become distended with fat droplets, and are then clearly visible.

The epithelium covering the villi is a single layer of columnar cells attached to a delicate basement membrane. The epithelium consists of two quite different kinds of cells, columnar absorbing cells and goblet cells. The nucleus is ovoid and is usually situated in the lower half of the cells. One of the most striking and distinguishing features of the columnar absorbing cells is their striated free border (cuticular border, brush border). The low magnification is seen as a nearly homogeneous, refractile membrane covering the apical surface of the cell, but with greater magnification it appears finely striated. The section of mucosa of jejunum shows a short plica circularis in the center of the field, and on either side of it part of a taller plica. The entire lumen surface is covered with villi. Submucosal connective tissue forms the core of each plica. The specialization in the cytoplasm beneath the striated border is known as the terminal wedge.

Histopathological study of intestine in male *Rattus norvegicus* (Berken)

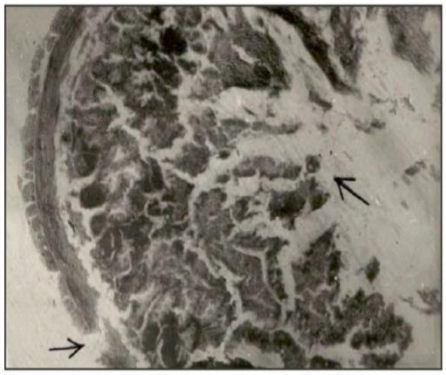

Fig. 1 Intestine of male rat given endosulfan (0.011 g/kg/day) for 56 days showing damaged serosa lining and mucosa layer. H & E stain × 100

Fig. 2 Intestine of male rat treated with carbaryl (0.085 g/kg/day) for 56 days showing damaged intestine. H & E stain × 100.

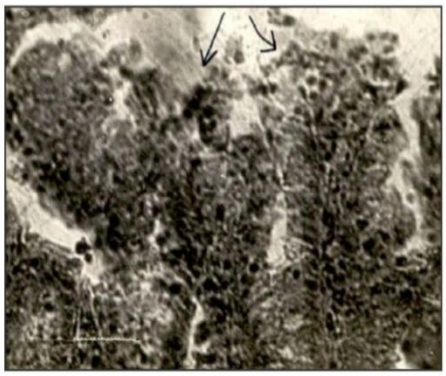

Fig. 3 Intestine of male rat treated with carbaryl (0.085 g/kg/day) showing mucosa (villi) layer. H & E stain × 400 -

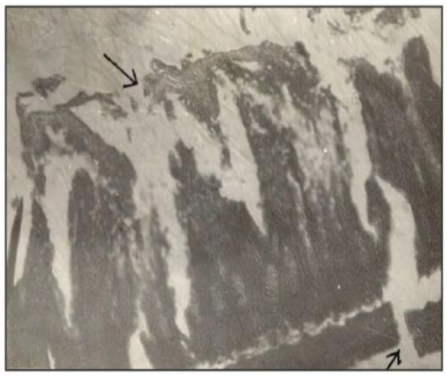

Fig. 4 Intestine of male rat given malathion (0.28 g/kg/d) for 56 days showing highly damaged mucosa layer. H & E stain × 100.

Brunner glands are the most distinguishing characteristic of the upper duodenum and they are often spoken of as the duodenal glands. The muscular coat consists of two well defined layers of smooth muscle, an inner circular and an outer longitudinal. The serous coat, as in the stomach, consists of loose connective tissue covered by a layer of mesothelium. The large intestine is divided the colon, rectum and anal canal. The mucous membrane of the colon has a comparatively smooth surface, for there are no plicae or villi as in the small intestine. The

submucosa is composed of loosely arranged connective tissue. The muscularis externa in the colon shows some variation from its usual structure. The serous coat is composed of a thin connective tissue layer covered by mesothelium. The large lymphoid development frequently makes it difficult to follow the muscularis mucosae and to separate the mucosa from the submucosa. The rectum is usually divided into two parts. The upper measuring 5 to 7 inches in length, is the colon. The crypts of Liberkuhn are longer in colon by goblet cells. The bases of columns are connected by transverse folds of the mucosa the anal valves.

Animals treated with endosulfan (0.011 g/kg/day) showed the structure of intestine damaged at many parts. The serosa lining was observed broken at few places while other structures e.g., sub-mucosa and muscularis mucosa were seen less damaged but the mucosa lining was interrupted at many places. It is presumed that normal absorption of digested food is severe affected along with ulceration.

Animal treated with carbaryl (0.085 g/ kg/day) also showed interrupted serosa layer along with highly damaged mucosa lining. Outer striated border and columnar absorbing cells are not properly arranged. However, the lamina propria seems to be intact.

Malathion (0.28 g/ kg/day) treatment also induced an appreciable damage in the intestine of male rats. All the four layers i.e. serosa sub-mucosa, Muscularis mucosa and mucosa seemed to abnormal inner mucosa wall was observed to be extremely damaged. Most of the layers seemed to degenerated. However, serosa layer also punctured at few places.

The straight segment of the proximal tubule forms the proximal portion the descending arm of Henle's loop. They also show an abundance of cytoplasm around the nuclei and extremely attenuated regions elsewhere. The segment forms the entire crest of the loop and continues a considerable distance up the ascending limb in the short loops it begin in the lower part of the proximal limb. At one point, it comes in direct contact with the afferent glomerular arteriole. The arched (initial) collecting tubules are still in the cortical labyrinth and empty into the straight collecting tubules. Treatment of animals with endosulfan (0.011g/kg/day) produced mild degenerative changes in the tubular structure of the intestine contained intact epithelial cells.

Table 1: Treatment schedule of Endosulfan, Carbaryl and Malathion in male Rattusnorvegicus (Berken)

S.NO.	*Treatment (mg/kg/day)*	Period of Exposure (days)	Number of animals treated	Died	Survived	Sign. of Toxicity	Remarks
1	*Peanut oil**	90	10	10	-	-	Total number of animals used are 285. Numbers of animals survived till the completion of the experiment 217
2	*Endosulfan* (0.011 g/kg/day)*	56	40	8	32	Watering eyes and changed skin colour i.e., light creamish	
3	*Endosulfan* (0.0055 g/kg/day)*	90	45	9	36	Mild sign of toxicity appeared for a brief period	
4	*Carbaryl* (0.085 g/kg/day)*	56	40	12	28	Dyspnea, tremore & salivation	
5	*Carbaryl* (0.0425 g/kg/day)*	90	45	15	20	Salivation and tremor diarrhoea, dyspnea	

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6	*Malathion* (0.28 g/kg/day)*	56	40	11	29	Tremor, salivation and very slight paralysis	
7	*Malathion* (0.14 g/kg/day)*	90	45	13	32	Mild sign of toxicity observed	

** Indicates administration of insecticides in g/kg/day i.e., 1/10th and 1/20th of the LD_{50} respectively.*
** All the test chemicals were administered by gavage.*

Animal treated with carbaryl (0.085g/kg/day) alone showed tubular degenerative changes as well as of glomerulus most of the tubules were devoid of epithelial linning and were filled with oedematous fluid.

Malathion treatment induced an appreciable degenerative change of the tabular epithelium as well as the capillaries of the glomeruli. Most of the tubules showed signs of congestion and loss of nuclei, of the epithelial cells.

Conclusion: Different layers of intestine were observed to be damaged in all the three pesticide treated animals. Mucosa lining was seen interrupted with degenerative changes showing severely affected absorption capacity of digested food. Broken serosa layer shows ulceration in the intestinal wall.

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ROLE OF THE FORGOTTEN FOODS FOR MODERN WELL BEING

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Abstract: Forgetting their origins, millets have been disregarded as low social status and being too primitive to be useful. In recent times, a significant decrease in millet production and consumption was observed because of these changes and state policies that favor rice and wheat. Historically, millets served as a poor farmers' protection from the insurance of the Indian monsoon. Millets may serve as our protection from the effects of climate change in the future. Millets, which were once a mainstay in traditional Indian cuisine, have been slowly making a comeback in India and other parts of the world. The United Nations General Assembly has proclaimed 2023 to be the International Year of Millets, and the Food and Agriculture Organization (FAO) approved the designation in 2018. We hope that this initiative will set free the potential of this neglected super food.

In the present review, we highlighted the importance of wealth of nutrients, such as protein, antioxidants, vitamins, and minerals in the whole grain and their amazing health benefits, which were earlier ignored by the people all over the world. We recommend speeding up its production to solve nutrient and food security of the nation. This encourages sustainable cropping practices and the growth of crops that are best suited to the respective regions. It needs to be promoted and accepted more widely as a cereal that belongs in the typical food basket. In order to improve the sustainable growth of the agri-food sector, the majority of recent Indian government policies pertaining to the agriculture and food sectors at the national and sub-national (State) levels have focused on incorporating strategies, innovations, technologies, and funding mechanisms. These initiatives are under the control of the "National Mission on Sustainable Agriculture," one of the eight missions of the "National Action Plan on Climate Change."

Incorporating small millets with legumes and pulses into a child's or adolescent's diet has been shown to reduce stunting, wasting, and under nutrition as well as improve height, weight, body mass index (BMI), and hemoglobin levels. Small millets can be used in the dietary management of degenerative diseases like obesity, diabetes, and cardiovascular diseases (CVDs) because of their dietary fiber properties. Due to their phytochemical content and lack of gluten, these grains have anti-cancerous properties that are very beneficial to celiac disease patients. As a result, these super foods may help people achieve nutritional and food security.

Keywords: Millets, Nutrients, Climate Crisis, Modern Living, Super Foods.

Introduction: This ancient, common cereal has gained recognition for being climate resilient, having the potential to address issues with global nutritional security, and being a sustainable alternative to other major cereals. Nutri-cereals are packed with nutrients, including iron, folate, calcium, and zinc, magnesium, phosphorous, copper, vitamins, and antioxidants, and are high in dietary fiber. Yajurveda Texts in India make mention of millets. Until about fifty years ago, millet was widely grown. Nevertheless, India has neglected its traditional knowledge

because of the Western development model. Millets are criticized as being too primitive and coarse. It was only considered the food of farmers or ancestors. Additionally, millet production suffered because of the Green Revolution. Prior to the Green Revolution, millets accounted for 40% of all grain production. Millet production in India totals 170 lakh tons, or 20% of global production. The average yield of millets in India is higher than the global average, at 1,239 kg per hectare (https://www.indiascienceandtechnology.gov.in/listingpage/millets).

To feed the 800 million people on the planet today, a significant transformation in the food and agricultural systems are required which can be achieved by concentrating on millet production and promotion. Around 40% of the earth's land surface is dry land. The best crop for dry land agriculture is millets. (Haileslassie, et al 2016)

By 2030, the SDG2 seeks to eradicate hunger. However, in many regions of the world, climate extremes like floods, tropical storms, and droughts continue to be important factors that caused disruptions in agricultural productivity. High domestic prices are a result of persistently high food, fuel, and fertilizer prices on a global scale that are related to the crisis in India and other parts of the world. The problem is exacerbated by the lack of access, security concerns, administrative and bureaucratic roadblocks, physical barriers to access, and others. The recent FAO publication, Hunger Hotspots Outlook (2022-23), contains warnings about severe food insecurity. According to the report, from October 2022 to January 2023, acute food insecurity is likely to get worse in 19 countries (hunger hotspots) (Gavrilescu, C., 2022). Nevertheless, India continues to dominate the production of wheat, rice, and coarse grains, exerting significant control over the world's food markets and supply chains (FAO 2022, https://www.fao.org/india/fao-in-india). Numerous factors, including favorable physiographic and edaphic conditions, a sizable rural workforce supported by reliable technology, and program administration strategies focusing on farmer welfare, productivity, and environmental sustainability, are responsible for the agri-food sector's ongoing success. Government-formulated policies and decisions have had a significant impact on the agri-food industry's innovations, inputs, investment, productivity (https://www.fao.org).

In order to improve the sustainable growth of the agri-food sector, the majority of recent Indian government policies pertaining to the agriculture and food sectors at the national and sub-national (State) levels have focused on incorporating strategies, innovations, technologies, and funding mechanisms. These initiatives are under the control of the "National Mission on Sustainable Agriculture," one of the eight missions of the "National Action Plan on Climate Change."

The "National Mission on Sustainable Agriculture," one of the eight missions of the "National Action Plan on Climate Change," is in charge of these initiatives. It is focused on issues related to sustainable agriculture, including water use efficiency, soil health management, nutrient management, and livelihood diversification (https://nmsa.dac.gov.in).

Millet foods for Modern Well-being: Natural food sources are abundant in nutrients and endowed with virtues that are beneficial to health. Recently, a number of fusion and experimental foods have appeared and are popular for a number of reasons, including their capacity to promote immunity, control lipid levels, and promote weight loss. People started to adopt healthy eating habits and maintain good health due to outbreak of covid-19. People all

over the world have endorsed leading healthy lifestyles, whether it is a plant-based diet, foods with fewer carbohydrates and fats, or including millet in one's regular diet. Most importantly, it has reworked our food choices and taken us back to our roots to indulge in traditional foods and practice mindful eating behaviours (https://www.netmeds.com/health).

With the aim to bring awareness among the people and increase the production and consumption of millets, the Food and Agricultural Organization (FAO) of the United Nations, at the request of the Government of India, has acknowledged 2023 as the International Year Of Millet (IYOM). This will offer an opportunity globally to increase cultivation and production, proper processing, and efficient use of crop rotation, and encourage millets as a key component of the food basket.

Prime Minister Narendra Modi organized a special "millet only" lunch for the members of Parliament to celebrate the "Millet Year" and encourage millet consumption. The delectable lunch featured appetizers of pearl millet salad and millet fritters, a main course of healthful rotis made from ragi and jowar, protein-rich kichadi made from bajra, and jowar, as well as delicious and guilt-free desserts like millet chocolate pudding and big apple millet bundt cake (https://indianexpress.com/article/india/pm-modi-parliament-lunch-2023).

Since ancient times, millets, which are tiny coarse grains, have been grown and primarily consumed in the Indian subcontinent. They contain an abundance of nutrients, such as proteins, vitamins, minerals, and dietary fiber. Millets require less water and fertile soil to grow than other grains. Millets are also referred to as "poor man's food grain" due to this characteristic. People all over the world due to their enormous benefits are now consuming these tiny grains. Millets come in a number of varieties, each with its own special benefits. Since it is continuously grown throughout the year, it is always available. (Netmeds.com).

These crops are rain-fed, do not attract pests, and can grow well without the use of pesticides, making their cultivation advantageous for the environment as well. Ragi, jowar, and bajra are examples of naked grains because they lack the thorny, inedible husk. Millets can be broadly divided into two varieties. Following harvest, these grains do not require processing; they can be put to use right away. Consequently, they are now widely cultivated. Husked grains include kodo millets, little millets, and foxtail millets required to remove the sead coat before consumption.

Types of Millets and Their Health Benefits:

Foxtail Millet: (*Setalica italia*)

- Also known as magical millets or miracle grains are natively known as Kangni, Kang and kakum
- The cultivation of foxtail millets began in 8700 BC in China. In India, these are widely grown in Karnataka, Andhra Pradesh, Maharashtra and Tamil Nadu.
- Foxtail millets are packed with the plenty of proteins, carbohydrates, vitamins like A, E, and minerals like phosphorus, calcium, magnesium, sodium, etc.
- It may have antioxidant properties, show glucose-lowering properties, gastro-protective (managing or reducing injuries to the gastrointestinal tract) properties, anti-carcinogenic properties and have the potential to manage fungal infections (Suma, P.F. and Urooj, A., 2012, Lin, H.C., et al 2014, Shan, S et al 2014).

Finger Millet/Ragi (Eleusine coracana)

- It is an annually cultivated healthy fibre rich and gluten-free cereal crop, found in the tropical regions of Africa and Asia, such as in Ethiopia, India And Sri Lanka.
- They are drought-resistant and tolerant of slightly acidic to alkaline soils. This makes it possible to propagate these plants throughout the year in India's various geographical terrains, including the plateaus and mountains.
- Grains are easy to process and store. Being densely packed with a host of nutrients, ragi confers valuable health benefits such as enhancing digestion, reducing the risk of heart disease, slowing down ageing and managing diabetes.Ragi has made a significant comeback as a frontrunner for preserving optimal health over the past three to four decades. The UN FAO has pushed this grain to include millets in the daily diet to combat malnutrition and a variety of other frequently occurring ailments (https://millets.res.in/m_recipes/Nutritional_ health_ benefits).
- It has negligible levels of cholesterol and sodium and rich in Vitamin B complex to promote heart wellness.

Pearl Millet/ Bajra:

- Bajra/ pearl millet and one of the oldest cultivated grains and known as millennium food as it is rich in fibre and essential amino acids. Being nutritious, bajra is resistant to drought, heat, and some forms of contamination that affects other grains (Kumar, A., et al 2016).
- **It help in reducing the risk of developing type 2 diabetes, cardiovascular disease, Reduces your risk of dying from inflammatory diseases, reduces** Rheumatoid arthritis, gout, and neurodegenerative diseases (Malik, S., 2015).
- Radhai Sri, S. and Sindhu, S., (2020) and Anand, et al (2020) reported nutritional and antioxidant potential of pearl millet while Mounika et al. (2022) reported protective role of Bajra against different diseases like diabetes, CVD, cancer, inflammation, gastric and other disorders.

Barnyard Millet (Echinochloa Esculenta)

- Also called as shyama in Bengali, moraiyo in Gujarati, sanwa in Hindi, oodalu in Kannada, kuthiraivolly in Tamil and udalu in Telugu. It is less susceptible to biotic and abiotic stresses and hardiest multipurpose crop with wide adaptability to adverse climatic conditions (Sood, S et al 2020).
- The millet is tiny, white, round grain, bigger in size than semolina (rawa) and smaller than sago (sabudana). Barnyard millet grain is a good source of protein, carbohydrate, fiber, and, most notably, contains more micronutrients (iron and zinc) than other major cereals. Despite its nutritional and agronomic benefits (Kumari, P et al 2021).
- Antony, et al (2023) reported the protective role of high fibrous protein of this grain in the treatment of heart and diabetes.

Minor Cereals: Kodo Millet (*Paspalum scrobiculatum*) and Little Millet (*Panicum sumatrense*):

- Minor millets are high energy, nutritious foods comparable to other cereals, as they are low in phytic acid and rich in dietary fibre, iron, calcium and B vitamins. Minor millets can thus

act as a shield against nutritional deficiency disorders and provide nutritional security (Bhat, S. et al 2018, Amadou, I., 2022, Tomar, A. et al 2023).

- Kodo millet is indigenous to India, and it is believed to have been domesticated some 3000 years ago.
- Little Millet is gluten free rich in tannins, flavonoids which helps against diseases like diabetes, cardiovascular diseases, cataract, cancer, inflammation, Gastrointestinal problems and delay ageing (Saini, S et al 2021, Netmeds.com). Little millet is known to be a low glycemic index food and high in dietary fibre. Little millet is rich in Magnesium, which helps improve heart health. It is also rich in Niacin, which helps lower cholesterol and weight loss and detoxification process (Sanjay, A.N et al 2022).
- Kodo millet has the highest free radical quenching potential, indicating possible useful antioxidant activity (Hedge and Chandra, 2005).
- Little Millet is very healthy. It contributes to the prevention of stomach problems, constipation, cataracts, breast cancer, and fat accumulation in the body (https://nativefoodstore.com/product/samai).

Conclusions: A whole grain of millets is packed with vitamins, minerals, antioxidants, protein, and other nutrients. This everyday grain has incredible health advantages and is now well known throughout the world. In contrast to other crops, millet can be grown all year long and is highly sustainable. They offer a host of health advantages, including lowering cholesterol and blood sugar, promoting weight loss, and boosting the immune system. They are worth trying because of their distinct flavor, texture, and ease of preparation.

Despite having tremendous potential, the millet crops have not become widely accepted. Instead of forcibly altering the cropping pattern, modern genomic tools combined with the conservation of traditional biodiversity can speed up its production and fill yield gaps. This encourages sustainable cropping practices and the growth of crops that are best suited to the respective regions. It needs to be promoted and accepted more widely as a cereal that belongs in the typical food basket. The nutritional value, stress tolerance, and antimicrobial properties of various millets are proven worthy.

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ROLE OF MILLETS IN NUTRITIONAL AND ECONOMIC SECURITY OF INDIA

PRERNA MITRA, ABHA RAJ SINGH

Abstract: Millets have become a topic of increased discussion in recent years. Millets are hailed as "super crops" all over the world. The Food and Agriculture Organization (FAO) has just declared 2023 to be the "Year of the Millets" on India's recommendation, despite the fact that millets have been produced and consumed for centuries.

Millets are underutilized despite having high nutritional value and producing well in challenging conditions. According to the size of the grain, millets are divided into two categories: major millets and small grain millets. Sorghum and pearl millet are considered major millets, whereas finger millet, foxtail millet, kodo millet, proso millet, barnyard millet, and little millet are considered small grain millets. Compared to rice and wheat, millets are higher in minerals and vitamins, and they have a huge potential to improve health, nutrition, fodder, fiber, livelihood, and the environment. Given all of these remarkable qualities, millets can only be referred to as Miracle Grains or Nutria-Cereals.

Despite having a high nutritional value and producing well in difficult circumstances, millets are underutilized. Millets are separated into two groups based on the size of the grain: major millets and small grain millets. Major millets include sorghum and pearl millet, while small grain millets include finger millet, foxtail millet, kodo millet, proso millet, barnyard millet, and little millet. Millets have a greater potential to improve health, nutrition, fodder, fiber, livelihood, and the environment than rice and wheat because they are higher in minerals and vitamins. Millets can only be referred to as Miracle Grains or Nutria-Cereals given all of these extraordinary characteristics.

Introduction: Millets are often referred to as Super food and its production can be seen as an approach for **sustainable agriculture** and a healthy world. Multidimensional benefits associated with millets can address the issues related to nutrition security, food systems security, and farmers' welfare. Further, many unique features linked with millets makes them a suitable crop which is resilient to India's varied agro-climatic conditions. Citing these factors, the year 2018 has already been declared as the National Year of Millets and India has called for declaring 2023 as the "**International Year of Millets** (Erler, M., et al 2022).

However, in spite of acknowledging their significance as a superfood, general perception is that the millets are increasingly seen as "poor person's food". Therefore, it is necessary to re-brand coarse cereals/millets as nutri-cereals and promote their production and consumption (Green, P. and Hemming, C., 2014).

The Ministry of Agriculture & Farmers Welfare reports that due to changes in consumption patterns, the conversion of irrigated land for the cultivation of wheat and rice, the lack of millet, low yields, dietary habits, and decreased demand, the area under the cultivation of millet decreased with 60% less coverage area (14.72 million hectares) in 2016–17. This caused

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the levels of vitamins A, protein, iron, and iodine in women and children to drop, which resulted in malnutrition(https://agricoop.nic.in).

Around 700 million people worldwide suffer from hunger, with African and Asian nations being the most severely affected. All of the continents are experiencing problems with food security. Millets' high nutritional profiles address these deficiencies and hold potential as solutions for creating wholesome dietary patterns (https://impactentrepreneur.com/the-global-impact-economy-of-millets).

Increasing Demand: Worldwide Millets ranked 3,641st in terms of global trade in 2019 with $201M in total trade. The demand for millets has significantly increased over the past few years, with global exports rising by 44.8% between 2018 and 2019 (https://pib.gov.in).

Prominence on the World Market: By 2025, it is anticipated that the millet market will reach a value of over 12 billion USD. Millets are a growing industry in the Asia-Pacific region, with pearl millets ranking among the most sought-after products due to their significant volume in international trade. India is a major player in terms of its capacity to meet global demand because it accounts for close to 20% of the value of millets exported globally. In addition to the fact that millet has been grown in China for many years, the country is currently showing a gradual increase in millet yields (https://economictimes.indiatimes).

The United Arab Emirates, Nepal, Saudi Arabia, and Germany are the top export destinations. The number of millets exported to Nepal and the UAE has increased by more than 50%, indicating a growing demand for these grains. Kenya and Oman, two nations that receive a smaller proportion of millets exported from India, have experienced even greater growth in recent years (https://apeda.gov.in/milletportal/files/Saudi_Arabia).

With several creative chefs reimagining traditional dishes to make millets the preferred cereal for an urban population, Bengaluru, India is quickly becoming a center for millets. Given the diversity of millets produced around the world, it is important to investigate such innovations using locally accessible cereals that also help to strengthen the "farm-to-table" relationship for local farmers (https://timesofindia.indiatimes).

Way Forward: There is still a lot of room for ecosystem-level interventions in millet farming. From the point of cultivation to the point of consumption, there are a number of issues that must be resolved. These issues include, but are not limited to, paying farmers a living wage, educating consumers, streamlining the supply chain, establishing processing, and developing value-adding capabilities, especially in developing nations. However, targeted initiatives, teamwork, and the exchange of knowledge among stakeholders on a global scale could increase the popularity of millets for a sustainable future.

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PROMOTING NEGLECTED AND UNDERUTILIZED MILLETS TO STRENGTHEN FOOD SECURITY

BHAWNA SRIVASTAVA, REDDY P.B

Abstract: Millets are a gift from nature to humanity that significantly contributes to food and nutritional security. As part of its initiative for the UN's International Year of Millets in 2023, India has identified "Covid, conflict, and climate" as the three biggest threats to global food security and has positioned the cultivation and spread of millets within the broader goal of "de-risking the global economy.

By making extra efforts to address the issues encountered in the millets value chain, the challenges can be lessened. The issues are not just a problem in India; they exist everywhere. Growing millets is a step towards sustainability and food security. However, millets are not the first choice for either despite their nutritional benefits for consumers and hardiness (including resistance to drought) for farmers. India is making some efforts both locally and globally in this direction. The UN granted India's request to make 2023 the International Year of Millets and this initiative was supported by 70 nations. A proposal to start a global campaign to promote millet consumption and production has been made by India. On February 13–15, 2023, in Indore, Madhya Pradesh, during the first Agriculture Deputies. Meeting under the Agriculture Working Group (AWG), the draft of the proposed initiative MIIRA (The acronym MIIRA stands for 'Millet International Initiative for Research and Awareness) was presented. According to sources in the Agriculture Ministry, the MIIRA will be responsible for coordinating millet research initiatives around the world. It is consistent with the UN's decision to designate 2023 as the International Year of Millets, which was proposed by India and backed by 72 nations.

The current review discusses the initiatives the government and civil society are taking to encourage millets-based farming systems in India to improve the quality and productivity of these crops in order to feed the nation as these small millets have the ability to withstand the situation of current climatic irregularities.

Keywords: Millets, MIIRA, Niti Ayog, India.

Introduction: A family of small-seeded grasses known as millets is widely cultivated as a cereal crop or grain for human and animal food all over the world. More than half a billion people in Asia and Africa still eat millets as their primary source of nutrition today. Millets are now grown in more than 130 countries. Sorghum (jowar) is the largest millet crop grown worldwide. United States, China, Australia, India, Argentina, Nigeria, and Sudan are the top jowar producers. Another important millet crop is called bajra, and some African nations as well as India produce a lot of it. The global millets market is projected to register a CAGR of 4.5% during the forecast period between 2021-2026 (Horue, M., et al 2021). When large grains such as wheat and rice cannot be grown, millets can thrive with 300 mm of rain and are usually

grown under rain-fed conditions. Millets thus serve as a supplement to the livestock and human nutritional security in such areas (Alemu, E.A., 2020).

The United Nations General Assembly (UNGA) at its 75th session in March 2021 declared 2023 the International Year of Millets (IYM 2023).The PM of India has also shared his vision to make IYM 2023 a 'People's Movement' alongside positioning India as the 'Global Hub for Millets'. Recognizing the enormous potential of Millets, which also aligns with several UN Sustainable Development Goals (SDGs), the Government of India (GoI) has prioritized Millets. In April 2018, Millets were rebranded as "Nutri Cereals", followed by the year 2018 being declared as the National Year of Millets, aiming at larger promotion and demand generation (Poshadri, et al 2023).

India has stepped up its efforts for a global campaign to increase millet production and consumption in order to combat the threats to food security posed by Covid-19, conflicts, and climate change. The disruption of the wheat supply, first during the Covid era and currently because of the war in the Ukraine, has highlighted how crucial it is to generate domestic and international demand for millets in order to address the twin issues of supply uncertainty and climate change (https://www.hindustantimes.com/india-news). Despite significant advantages, the millets industry has suffered from a number of issues that can be linked to a lack of demand stimulation and declining or stagnant small millets cultivation. Given the increasing importance of millets around the world and Due to the UNGA's declaration of IYoM 2023, India must take the initiative in bringing millets onto the menus of the public. Building a sustainable millet value chain will help advance millet exports and increase demand both domestically and abroad. This knowledge document offers information on the millet situation in India and initiatives to mainstream millets there.

At its 75th session in March 2021, the United Nations General Assembly (UNGA) proclaimed 2023 the International Year of Millets (IYM 2023). The PM of India has also shared his vision to make IYM 2023 a 'People's Movement' alongside positioning India as the 'Global Hub for Millets (https://journalsofindia.com/international-year-of-millets). The Government of India (GoI) has given millets priority because of their enormous potential and alignment with several UN Sustainable Development Goals (SDGs). In order to increase promotion and demand generation, millets were rebranded as "Nutri Cereals" in April 2018, and 2018 was subsequently named the National Year of Millets (Raina, R et al. 2022, Poshadri, A., et al 2023).

It has been revealed that millet cultivation is drastically decreasing in India. When compared to the current situation, the area covered by millets in the 1960s has decreased by more than 50% (Naresh et al.2023). The production of millet can significantly increase if the wastelands and bare areas are used for cultivation. Additionally, it is necessary to provide incentives for millet farmers to encourage them to grow millets. In order to mainstream millets in Asia and Africa, NITI Aayog and the World Food Programme (WFP), India, introduced the "Mapping and Exchange of Good Practices" on 19th July 2022 as initiative (https://www.niti.gov.in/sites/default/files). They will compile best practices for expanding millets production and consumption in India and abroad. Central ministries, State governments and Indian embassies will hold events throughout the year to promote and

spread awareness about the benefits of millets for the "cultivator, consumer and climate". A government report has said millets will also be an integral part of G-20 meetings.

Millets are also supported by the government through other programs like Macro Management in Agriculture (MMA) (Rao, B.D et al 2021), which supports the organization of demonstrations of better packages of practices, the provision of certified seeds, seed minikits, and the provision of micronutrients, gypsum, and farmers' training for improving production and productivity of coarse cereals, including millets. For the control of disease and pest management, millets are grown as trap crops in oilseed and pulse crops because they are hardy against diseases. Therefore, they require lesser support for chemicals, fertilizers and pesticides. The operational guidelines of INSIMP provide flexibility to the States, to modify the contents of the input kits as per local situations in consultation with their State Agriculture Universities/lCAR institutions (Ramprasad, V., 2021).

The current review discusses the initiatives the government and civil society are taking to encourage millets-based farming systems in India to improve the quality and productivity of these crops in order to feed the nation as these small millets have the ability to withstand the situation of current climatic irregularities.

Methodology: The period covered by this descriptive review was from January 2015 to March 2023. The studies were found using the following keywords: millet, climate crisis, health advantages, and government initiatives. The search process was carried out on Pub Med, Elsevier, Ovid, Springer, Google Scholar, Research Gate, SAGE Publishing, Pro Quest, the WHO website, Net meds, WebMD, and news sources. The language of the literatures was English. Similar to primary data, the enormous amounts have been gathered, compiled, archived, and systematically analyzed using procedural steps.

Results and Discussion: After assessing the quality of published articles, the results of the present study showed that the millets are important and super foods to combat the climate change and food security in India and other tropical countries. The cultivation, production and export of millets are also supported by the Indian government through various programs.

- It is estimated that the millets market is set to grow from its current market value of more than USD 9 -13824 to over USD 12 -13824 by 2025. It was in 2018 that the government of India decided to mark the National Year of Millets. In the same year, the government also notified millets as nutri-cereals and included them under the POSHAN Mission Abhiyan (https://wcd.nic.in/sites/default).
- To promote delivery of nutri-cereals, the Ministry of Commerce and Industry through its apex agricultural export promotion body, Agricultural and Processed Food Products Export Development Authority (APEDA) has prepared a broad strategy to promote Indian millet exports across the globe commencing December 2022.APEDA has also signed a Memorandum of Understanding (MoU) with IIMR to boost value-addition and farmers' income (https://apeda.gov.in/).
- The government has also begun developing a five-year strategic plan in collaboration with the ICAR-Indian Institute of Millets Research (IIMR), Hyderabad, the ICMR-National Institute of Nutrition, Hyderabad, the CSIR-Central Food Technological Research Institute

(CFTRI), Mysore, and Farmer Producer Organizations (FPOs) for the promotion of millets and value-added millet products in the international market (https://agricoop.nic.in).

- Prime Minister Narendra Modi had also highlighted the benefits of Millets to both farmers and consumers in one of the editions of his monthly radio programme 'Mann ki Baat (https://www.republicworld.com/india-news).
- Finance Minister Nirmala Sitharaman described millets as 'Shree Anna' (the mother of all grains) during her Budget speech and announced that the Indian Institute of Millets Research in Hyderabad would be converted into a centre of excellence (https://www.business-standard.com/article).
- Joining the Centre's efforts to promote millets, the Kashi Vishwanath temple in Prime Minister Narendra Modi's parliamentary constituency Varanasi will now offer devotees 'prasad' made from millets. (https://www.outlookindia.com).

Other Initiatives taken by the Government

- **National Millets Mission (NMM)**: NMM was launched in 2007 to promote the production and consumption of millets.
- **Price Support Scheme (PSS)**: Provides financial assistance to farmers for the cultivation of millets.
- **Development of Value-Added Products**: Encourages the production of value-added millet-based products to increase the demand and consumption of millets.
- **Promoting Millets in PDS**: The government has introduced millets in the Public Distribution System to make it accessible and affordable to the masses.
- **Promotion of Organic Farming:** The government is promoting organic farming of millets to increase the production and consumption of organic millets.

Challenges

- Farmers still have trouble finding high-quality millet seeds today. Sorghum and pearl millet, however, are not problematic because private players have entered this market and made these crops available to Indian farmers. It is possible to provide minor millets with high-quality seeds by setting up seed hubs for seed production and breeding. To improve the seed value chain, all stakeholders must work together to drive demand-driven seed production.

Challenges in Millet Processing:

- The millet processing machines available in India have a low recovery of 70-80% of grains and this becomes a challenge for the millet processors. Due to less efficiency, the output has more un-hulled and broken grains. Dehulling efficiency of millets is affected by the impeller speed. As you know, millet grains differ in size, shape, and husk content, so it becomes difficult to handle. Depending upon one dehuller for dehusking all types of millets is not suitable rather it requires two types of dehuller. As Kodo and Barnyard Millet contain multiple seed coats, it requires a double-stage dehuller to remove the husk.
- Separation of the husk of millets and its collection is quite difficult as it causes spillage all over the processing unit and often is mixed with the final product. Even many millet processors are facing difficulty in handling and disposing of the husk of the millets. If the

husk of millets could be used in making value-added products, then the issue could be solved.

Challenges in Millet Consumption: Despite their health benefits, millet consumption faces several challenges. We will discuss some of the challenges in millet consumption.

1. **Lack of Awareness**: Despite offering high benefits to both the consumer and producer, millets are not very popular mainly due to a lack of awareness. Many people are unaware of the nutritional and health benefits of millet particularly true for younger generations who may not have grown up with millet as a staple food.
2. **Availability:** In many parts of the world, millets are not readily available, and even if they are available, they are often expensive. This can discourage people from incorporating millet into their diet.
3. **Processing and Storage**: Due to short life span, processing and storage of millets can also pose challenges. Furthermore, processing millets can be time-consuming, as they require thorough cleaning and milling before they can be consumed.
4. **Taste:** Millets have a slightly nutty flavor, which some people may find unattractive. Additionally, millets can have a slightly coarse texture, which may not be to everyone's liking.
5. **Culinary Tradition:** Finally, millets may not have a significant cooking tradition in many parts of the world. People may not be familiar with how to cook and incorporate millets into their diet, which can be a significant barrier to consumption.

Looking into the challenges faced in the Millet sector, MIIRA is a wonderful initiative by India. Definitely, it will resolve many of the issues.

Objectives of MIIRA:

- Coordinating Millet Research Programme at the International level. Research on nutritional benefits of millet.
- To develop new millet varieties which are resistant to pests and diseases as well as performing well in yield.
- To increase the production of millet through scientific practices.
- To increase the consumption of millet through mass awareness.

Funding of MIIRA: As India takes the lead in this initiative, India will support with the seed money to initiate MIIRA and subsequently, G20 members will contribute to its budget in the form of membership fees. Food and Nutritional Security are among the important top priorities during India's G20 Presidency.

Government Efforts to Promote Millets Production:

- Millets are being promoted through technology dissemination, quality seeds through millet seed hubs, awareness generation, minimum support price and inclusion in PDS.
- Efforts are now being done to include the nutrient-rich smaller millets in the mid-day meal schemes in government and government-aided schools in Karnataka and Telangana.
- Millet awareness is catching up fast in the urban centres such as Kolkata, Mumbai and Delhi among others.
- The Union Agriculture Ministry, in April 2018, declared millets as "Nutri-Cereals", considering their "high nutritive value" and also "anti-diabetic properties".

  - 2018 was observed as the 'National Year of Millets" and The UN General Assembly adopted an India-sponsored resolution to mark 2023 as the "International Year of Millets".
- The Government of India's Millet Mission comes under the National Food Security Mission (NFSM), launched in October 2007.
- The Centre's Millet Mission will focus on developing farm-gate processing and empowering farmers through collectives while focusing on value-addition and aggregation of the produce.
- Now this Initiative of sharing the good practices will go a long way. Further, to provide a steady market for the produce, the government has included millets in the public distribution system.

Input Support: The government has introduced provision of seed kits and inputs to farmers, building value chains through Farmer Producer Organisations and supporting the marketability o

- As per the latest *State of Food Security and Nutrition in the World* report, the world is moving backwards in its efforts to end hunger, food insecurity and malnutrition.
- The Union government promoted millets under the Initiative for Nutritional Security through Intensive Millets Promotion (INSIMP), as a sub-scheme of Rashtriya Krishi Vikas Yojana (RKVY) between 2011 and 2014.
- In the following years, NITI Aayog worked on a framework to introduce millets under the public distribution system for "nutritional support".
- In 2021, the Centre approved the Pradhan Mantri Poshan Shakti Nirman (PM POSHAN), earlier known as the mid-day meal scheme, in government and government-aided schools and advised State governments to include millets in the midday meal menu to enhance the nutritional outcome.

Conclusions: At a time when the world is battling a pandemic and climate change, and faces a significant challenge of food security, the nutri-cereal can play a significant role if marketed well, focusing on their high nutritional value, low input and maintenance requirements and climate-resilient nature. Problems of unavailability of good quality seeds, restricted cultivation, the low shelf life of grains, lack of research, absence of machinery for processing and market gaps need to be addressed to tap into their true potential to increase farmers' income, generate livelihoods and ensure food and nutritional security.

India's efforts to promote the consumption and production of millet got a boost when the UNGA accepted the country's proposal and dedicated 2023 to spreading awareness about these grains. Mission focuses on PM's vision to make IYM 2023 a 'people's movement' and positioning India as the 'global hub for millets.

To overcome all the challenges in the millet sector, there is a need for constant efforts from all the stakeholders and institutions toward mainstreaming millet. Hope MIIRA will play a critical role in resolving the challenges faced in the Millet sector and address food and nutritional security.

Way Forward: Small farmers in hilly regions and dryland plains who are among the poorest households in rural India will cultivate millets only if it gives them good returns. Adequate

public support can make millet cultivation profitable, ensure supply for the PDS, and, ultimately, provide nutritional benefits to a wide section of the population. Lack of awareness about millets and their health benefits can be addressed through education and promotion.Improving the availability of millets in markets and making them more accessible to consumers can encourage consumption. Millets are often more expensive than other staple grains, making them less accessible to low-income consumers. Addressing affordability through government subsidies or market interventions can increase consumption. The perception of millets as a poor man's food needs to be changed through marketing and promotion. Improving processing techniques and increasing the availability of value-added millet-based products can make them more appealing to consumers. Collaboration between farmers, processors, and marketers can help increase the supply and demand of millets.

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MILLETS: THE SUPER CROPS FOR A HEALTHIER FUTURE

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Abstract: A growing population means an ever-increasing demand for food. Climate change can directly influence the quality and availability of resources, adversely affecting our food system and crop productivity. Millets are high on nutrition and have many advantages over wheat and rice, which are the commonly consumed food grains. Millets have been consumed as staple food crops for centuries in many parts of the world, particularly in Asia and Africa. Recently, there has been renewed interest in millets as a sustainable and versatile ingredient in the food industry due to their unique nutritional profile, environmental benefits, and versatility in culinary applications. Millets need to be promoted for their high nutritional and ecological value. Malnutrition is a worldwide problem now, especially in poor and developing countries, including India. Here are some of the key reasons why millets are gaining popularity as a sustainable and versatile ingredient in the food industry:

Nutritional benefits: Millets are rich in nutrients such as protein, dietary fibre, vitamins, and minerals. They are also gluten-free and have a low glycaemic index, making them a suitable food for people with celiac disease and diabetes. Millets are particularly rich in minerals such as iron, calcium, magnesium, and zinc, which are essential for maintaining good health. Millets are considered as nutri-cereals, because they are rich in carbohydrates, dietary fibres, proteins, fat and minerals.

Environmental benefits: Millets are drought-tolerant and require less water and fertilizers than other cereal crops such as rice and wheat. They can also grow in a variety of soil types and are less prone to pest attacks, making them a sustainable and resilient crop for small-scale farmers. By promoting millets, we can support sustainable agriculture practices and reduce the carbon footprint of the food industry.

Versatility in culinary applications: Millets have a unique flavour and texture that can be incorporated into a variety of food products such as bread, pasta, snacks, and breakfast cereals. They can also be used as a gluten-free alternative to traditional grains such as wheat and rice. By promoting the use of millets in the food industry, we can offer consumers a wider range of healthy and sustainable food options.

In conclusion, the potential of millets as a sustainable and versatile ingredient in the food industry is significant. By promoting the use of millets, we can support sustainable agriculture practices, offer consumers healthier and more eco-friendly food options, and support small-scale farmers and rural economies. Millets need to be promoted for their high nutritional and ecological value.

Keywords: Versatile, Malnutrition, Sustainable.

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MATHEMATICAL ANALYSIS AND DYNAMICAL SYSTEMS: MODELLING OF BURULI ULCERS IN WEST AFRICAN COUNTRIES, INCLUDING GHANA

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Abstract: Buruli ulcer (BU) is considered a re-emerging disease in West Africa, including Ghana, where it has suffered neglect over the years, though children below the age of 16 are the worst affected in most endemic regions. It is caused by *Mycobacterium ulcerans* (MU). BU is the third most common bacterial disease after tuberculosis and leprosy. In this research article, we investigated an incipient non-linear mathematical model on the transmission dynamics of *Mycobacterium ulcerans* infection over humans as well as water bugs. This vector-borne model performs with horizontal transmission. This model is a combination of two epidemic models. The first one is an SIR model for the human population, and the second one is a SI model for the water bug population. We have treated the contamination of the water due to the arsenic as a variable in the model. We show that the disease-free equilibrium point is both locally and globally asymptotically stable when $R_0 < 1$. There exists a unique positive endemic equilibrium when $R_0 > 1$. For as long as the disease persists, the endemic equilibrium is asymptotically stable, both locally and globally, when $R_0 > 1$. Furthermore, where the stable disease-free equilibrium co-exists with a stable endemic equilibrium, it is found that the model exhibits the phenomenon of transcritical bifurcation. Finally, numerical simulations are carried out to investigate the influence of the key parameters on the spread of the vector-borne disease, to fortify the analytical conclusion, and to illustrate possible behavioral scenarios of the model.

Keywords: Arsenic, Water Bugs, *Mycobacterium Ulcerans,* Buruli Ulcer, Basic Reproduction Number, Local Stability Analysis, Bifurcation Analysis, Global Stability Analysis.

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स्वास्थ्यऔरपोषणमेंमिलेट्सकामहत्व– एकसमीक्षा

डॉशिप्राबैनर्जी , डॉशिखामित्रा

सारांश: इस समय तेजी से बढ़ रही जीवनशैली से जुड़ी बीमारियों की रोकथाम में मोटे अनाजों की अहम भूमिका हो सकती है। मोटे अनाज पोषक तत्वों से भरपूर होने के कारण स्वास्थ्यवर्धक तो हैं ही साथ ही ये हमें कई बीमारियों से बचाते हैंदरअसल, आधुनिकता की दौड़ में न सिर्फ जीवनशैली बदली, बल्कि हमारा खान–पान भी पूरी तरह से बदल गया। पांच दशक पहले हमारे खाने की आदतें पूरी तरह से अलग थीं। मोटे अनाज हमारे आहार का मुख्य घटक थे। हरित क्रांति के दौरान गेहूं और धान की खेती को सबसे अधिक महत्व दिया गया और इसके परिणामस्वरूप हमने गेहूं और चावल को अपनी भोजन की थाली में सजा लिया तथा मोटे अनाज को खाद्य श्रृंखला से बाहर कर दिया। जिन अनाज को हमारी कई पीढ़ियां खाती आ रही थीं, उनसे हमने मुंह मोड़ लिया और आज पूरी दुनिया उसी मोटे अनाज के महत्व को समझते हुए उसकी ओर वापस लौट रही है।

यह समीक्षा मोटे अनाज के पोषक गुणों भोजन के रूप में तैयार खाद्य पदार्थों के रूप में उनके उपयोग का आकलन करती है । ये अनाज है दरअसल से लदे होते हैं जिनमें हैं दरअसल एस, टिन, टिन, टिन, टीना और टीना शामिल हैं । वे मुख्य अनाज और फलों की तुलना में उच्च के मुख्य गुण रखते हैं । कुछ पोषण-विरोधी कारक भी है जिन्हें कुछ वे मुख्य उपचारों द्वारा कम किया जा सकता है। कई महामारी विज्ञान के अध्ययन से पता चलता है किये अनाज कई प्रकार की पुरानी बीमारियों जैसे कैंसर, हृदयरोग, टाइप ॥ मधुमेह और विभिन्न वे मुख्य संबंधी विकारों को कम करने में सहायक होते हैं। प्रकृति मेंमोटे होने के कारण, वे हमारे मुख्य अनाज को प्रतिस्थापितन हीं कर सकते हैं, लेकिन विभिन्न पोषक उत्पादों को तैयार करने केलिए चावल और गेहूं केसाथ अलग-अलग अनुपात में उपयोग किया जा सकता है। उनका उपयोग दलिया, बिल्कुल, केकी, कुकजी, कुकजी, ग्रेड, ग्रेडपेय, लड्डू, ग्रेड और कई कि ण्वित खाद्यपदार्थ बनाने के लिए किया जा सकता है। मोटे अनाज सेग्रेड, कागज, तेल और बायफिल्मके निर्माणकी भी अच्छी संभावना है।

मूलशब्द: मूलशब्द, टिन, टिन, हैंदरअसलएस, हृदय रोग, कैंसर

इतिहास: भारत में 60 के दशक के पहले तक एस की खेती की परम्परा थी। कहा जाता है कि हमारे पूर्वज हजारों वर्षों से कन्नड़ अनाज का उत्पादन कर रहे हैं। भारतीय हिंदू परंपरा में आयुर्वेद में कन्नड़ अनाज का जिक्र मिलता है। 50 साल पहले तक मध्य और दक्षिण भारत के साथ पहाड़ी क्षेत्रों में मोटे अनाज की खूब पैदावार होती थी।एक अनुमान के मुताबिक देश में कुल खाद्यान्न उत्पादन में कन्नड़ अनाज की हिस्सेदारी 40 फीसदी थी। कन्नड़ अनाज को मोटा अनाज भी कहा जाता है क्योंकि इनके उत्पादन में ज्यादा मशक्कत नहीं करनी पड़ती। ये अनाज कम पानी और कम उपजाऊ भूमि में भी उग जाते हैं।आज भी भारत में कुछ क्षेत्रों में कन्नड़ फसलों में ज्वार (सोम), बाजरा (पर्वमिले), रागी (फिरकरमिले), कंगन (कंगनमिले), कटकी (लिपटिएमिले), चीना (परोसोमिले), कूदो (कूदो), साठवां (साठवांमिले) तथा भूराशीर्षकन्नड़ (कन्नड़मिले) आदि की खेती की जाती है।

मोटे अनाज एवं पोषक तत्व: मोटे अनाज पोषक तत्वों का भंडार हैं। चावल और गेहूं की तुलना में इनमें 3.5 गुना अधिक पोषक तत्व पाए जाते हैं। मोटे अनाजों में मिले, मिले, विटामिन-बी6, फलक एस, एस, एस, जस्ता आदि खनिज लवण और विरामित प्रचुर मात्रा में पाए जाते हैं। स्वास्थ्य की दृष्टि से बेहद फायदेमंद डायरी फबकर भरपूर मात्रा में पाए जाते हैं पोषण और स्वास्थ्य की दृष्टि से इसके फायदों के कारण ही इन्हें **हैं पोषण** भी कहा जाता है। इनका सेवन वजन कम करने, शरीर में उच्च रक्तचाप और अत्यधिक हैं पोषण को कम करने, हृदय रोग, मधुमेह और कैंसर जैसे रोगों के जोखिम को कम करने के साथ-साथ कब्ज और अपच से भी निजात दिलाने में मदद करता है।

मोटे अनाज पोषक तत्वों से भरपूर होने के कारण स्वास्थ्यवर्धक तो हैं ही, साथ ही ये हमें कई बीमारियों से बचाते हैं। मोटे अनाजों का हमारे भोजन की थाली से गायब होने का प्रभाव दिखने लगा है। भरपेट भोजन के बावजूद कुपोषण या अल्प पोषण की समस्या आ रही है। ऐसा भोजन के रूप में गेहूं और चावल पर अत्यधिक निर्भरता के कारण है।भोजन में खनिज लवणों और डायरी फबकर की अपर्याप्त मात्रा के कारण मधुमेह, एनीमिया, हृदय और गुर्दे से संबंधित गैर-संक्रामक बीमारियों का प्रकोप बढ़ा है। मोटे अनाज में मौजूद पोषण एवं औषधीय गुणों के आधार पर इन्हें भविष्य के भोजन के रूप में देखा जा रहा है। मोटे अनाज खाद्य सुरक्षा और पोषण सुरक्षा की दृष्टि से महत्वपूर्ण हैं।

बढ़ती आबादी की पोषण जरूरतों को पूरा करने और तेजी से बढ़ रही जीवनशैली से संबंधित बीमारियों मधुमेह, कैंसर, हृदय रोग, उच्च रक्तचाप आदि के रोकथाम में मोटे अनाजों की महत्वपूर्ण भूमिका हो सकती है। उनके इस महत्व को देखते हुए अपनी थाली में उन्हें शामिल करना आवश्यक हो गया है। ऐसा करना हर प्रकार से लाभदायक होगा।

सेहत के लिए फायदेमंद है मोटा अनाज: ज्वार, बाजरा और रागी जैसे मोटे अनाज में पौष्टिकता की भरमार होती है. रागी भारतीय मूल का उच्च पोषण वाला मोटा अनाज है. इसमें पोषण की भरपूर मात्रा होती है. प्रति 100 ग्राम रागी में 344 मिलीग्रामपोषण होता है.रागी को पोषण के रोगियों के लिए फायदेमंद होता है.

उसी तरह से बाजरा में प्रोटीन की प्रचार मात्रा होती है. प्रति 100 ग्राम बाजरे में 11.6 ग्राम प्रोटीन, 67.5 ग्राम प्रचार, 8 मिलीग्राम लौह तत्व और 132 मिलीग्राममिलीग्राम होता है. मिलीग्राम हमारी आंखों को सुरक्षा प्रदान करता है.

ज्वार दुनिया में उगाया जाने वाला 5वां महत्वपूर्ण अनाज है. ये आधी अरब लोगों का मुख्य आहार है. आज ज्वार का ज्यादातर उपयोग शराब उद्योग, आधी के उत्पादन के लिए हो रहा है. बेबसीफूट बनाने में भी ज्वार का इस्तेमाल होता है. बढ़ती आबादी के लिए खाद्यान्न की जरूरतों को पूरा करने में ज्वार अहम भूमिका निभा सकता है.

केंद्र सरकार मोटे अनाज की खेती पर जोर दे रही है क्योंकि बढ़ती आबादी के लिए पोषण युक्त भोजन उपलब्ध करवाने में यही अनाज सक्षम हो सकते हैं. मोटे अनाज पोषण का सबसे बेहतरीन जरिया हैं. सरकार इसके पोषक गुणों को देखते हुए इसे मिल डेढ मील स्कीम और सार्वजनिक वितरण प्रणाली में भी शामिल करने की सोच रही है.केंद्र सरकार ने मोटा अनाज की खेती के लिए प्रेरित करने के लिए साल 2018 को मोटा अनाज वर्ष के रूप में मनाया था. उस वक्त कृषि मंत्री रहे राधा मोहन सिंह ने संयुक्त राष्ट्र संघ खाद्य एवं कृषि संगठन को पत्र लिखकर 2019 को मोटा अनाज वर्ष के रूप में मनाने की अपील की थी.छत्तीसगढ़ और डिगा के कुछ इलाकों में मोटा अनाज की खेती बढ़ी है. दक्षिण भारत में भी मोटा अनाज का चलन बढ़ा है. आंध्र प्रदेश, तेलंगाना और डिगा में रोज के खान-पान में मोटा अनाज को शामिल किया जा रहा है.

मिलेट्सकेप्रकारः ICRISAT की एक रिपोर्ट के मुताबिक, मिलेट्स को उसके बीजों के आकार और उगने के तरीके के आधार पर दो व्यापक श्रेणियों में बटा गया हैं–

- मेजर या मोटे मिलेट्स और
- मानकर या छोटे मिलेट्स

बाजरा, ज्वार, रागी और कंगन मोटे मिलेट्स की श्रेणी में आते हैं. और कटकी, समा, कूदो, चिनना इत्यादि को छोटे मिलेट्स माना जाता है.

हर एक मिले का अपना महत्व है. जैसे कि बाजरा, पोषण से भरा होता है, ज्वार में एस और एस होता है, और कंगन में फबकर होता है जबकि कूदो आयरन से भरपूर होता है इसलिए हमें सभी तरह के मिलेट्स खाते रहना चाहिए. इनमें अधिक पौष्टिक तत्व पाए जाते हैं । यही कारण है कि लोग वापस इन अनाजों की ओर रूख करने लगे है । वर्तमान में बाजार में उपलब्धता इस प्रकार है :

ज्वार (शर्त) / Jowar (Sorghum)
बाजरा / Bajer (Pearl millet)
रागी / Ragi (Finger millet)
अंगोरा / Phangura (Barnyard millet)
कंगन / Kangni (Foxtail / Italian millet)
कटकी / uptake (Little millet)
कूदो / Kodo (Kodo millet)
चेतना / Chena (Proso millet)

वैसे तो दुनिया में मिले की 13 तैरायी मौजूद है, लेकिन अंतर्राष्ट्रीय पोषक अनाज वर्ष 2023 के लिए 8 अनाजों– बाजरा, रागी, कटकी, संवाद, ज्वार, कंगन, चेतना और कूदो को शामिल किया गया है.

भारत के प्रस्ताव पर 72 देशों के समर्थन के बाद संयुक्त राष्ट्र संघ ने साल 2023 को अंतर्राष्ट्रीय पोषक अनाज वर्ष घोषित किया है. अब पूरी दुनिया में मोटे अनाजों से जोड़कर कई आयोजन किए जा रहे हैं. भारत में भी इसको लेकर कई तरह की तैयारियां चल रही हैं. एक तरफ राज्य सकारें किसानों को मोटे अनाज उगाने के लिएप्रेरित कर रही हैं तो वहीं लोगों को थाली तक इसे पहुंचाने के लिए भी जागरूकता किया जा रहा है, क्योंकि लोगों को अभी तक इनके बारे में जानकारी नहीं है. खासतौर पर शहरों में गेहूं और चावल ज्यादा प्रचलन में है.

ऐसे में लोगों की थालियों तक 8 प्रकार के पोषक अनाजों को पहुंचाना अपने आप में चुनौतीपूर्ण काम है. इस चुनौती को आसान बनाने के लिए मिले के मिलेफूट यानी प्रसंस्कृत खाद्य उत्पादों को बढ़ावा दिया जा रहा है.

'हैंपोषण' और 'हैंपोषण' हैं मिलेट्स

कम पानी, उर्वरक और कीटनाशकों के साथ कम उपजाऊ मिट्टी में भी मिलेट्स को उगाया जा सकता है. उच्च तापमान में भी ये अच्छा ग्रसो करते हैं और इसी कारण इन्हें 'ग्रसो' अनाज कहा जाता है. मिलेट्स सेहत के लिए भी बहुत फायदेमंद होते हैं. मिलेट्स में प्रोटीन, फबकर, विरामितबीत, पोषण, आयरन, मैंगनीज, एस, एस, जिंस, एस, कॉपी और सेलनियम सहित बहुत से पोषक तत्व होते हैं. मिलेट्स मूलशब्द, मूलशब्द, टिन, टिन और टिन का एक पावरहाउस भी हैं जो आपके स्वास्थ्य के लिए बहुत फायदेमंद हैं. इसलिए इन्हें हैंपोषण कहा जाता है.बाजरा में पाए जाने वाले पोषक

तत्व : बाजरा में पाए जाने वाले पोषक तत्वों की सूची लंबी हैं। इसलिए मिले को अपने भोजन के रूप में लेने से अनगिनत फायदों की प्राप्ति होती हैं, विज्ञान के अनुसार निर्धारित पोषक तत्वों पर एक नज़र डाले । मिलेटस में पाए जाने वाले खनिज (minerals) हैं–

- पोषण / Calcium
- लोहा / Iron
- जस्ता / Zinc
- / Zinc / Phosphorus
- / Zinc / Magnesium
- एस / Potassium
- फबकर / fibre
- विरामित बी-6 / Vitamin B-3
- विरामित बी-3 / Vitamin B-6
- मिलीग्राम / Carotene
- मिलीग्राम / lecithin आदि समृद्ध मात्रामें पाए जाते हैं।

गजब का फायदेमंद है बाजरा (**Health Benefits of Millet)**

- वजन घटाने में फायदेमंद: मिलेट्स खाने से वजन कम करने में मदद मिलती है. जैसे बाजरे का आटा नियमित आहार में शामिल करना या नाश्ता के लिए मिलेट्स को शामिल करने से मोटे लोग अपने बीएमआई को कम कर सकते हैं. बाजरे से शरीर को कई जरूरी मिनरल्स जैसे कैल्शियम, आयरन, मैग्नीज आदि मिलते हैं. इसके अलावा इसमें एंटीऑक्सीडेंट, फाइबर और प्रोटीन भी पाए जाते हैं. बाजरा चूंकि गर्म होता है इसलिए यह शरीर से पानी को सोखता है, जिससे वजन नियंत्रित रहता है.
- आयरन की कमी को दूर करता है: बाजरे में आयरन भी पाया जाता है, जो शरीर में आयरन की कमी को पूरा करता है. जिन लोगों को आयरन डेफिशिएंसी और एनीमिया की दिक्कत है, उन्हें बाजरे का सेवन जरूर करना चाहिए.
- हड्डियां बनाता है मजबूत: बाजरे में कैल्शियम, मैग्नीज, मैग्नीशियम, जिंक, पोटेशियम, कॉपर आदि पाए जाते हैं. जिनसे हमारी हड्डियां मजबूत होती हैं.
- दिल को रखता है सेहतमंद: मिलेट्स, एंटीऑक्सिडेंट्स का अच्छा स्त्रोत हैं जिसमें बीटा-ग्लूकेन्स, फ्लेवोनोइड्स, एंथोसायनिडिन, टैनिन, लिग्नन्स और पोलिकोसैनोल शामिल हैं. ये एंटीऑक्सिडेंट एलडीएल कोलेस्ट्रॉल, को कम करने में महत्वपूर्ण भूमिका निभाते हैं और आर्टरीज को स्वस्थ बनाए रखने में मदद करते हैं. जिन लोगों को गेहूं नहीं पचता है, उनके लिए बाजरा खाना फायदेमंद है. इसके सेवन से गैस नहीं होती और जिंक व विटामिन ए होने के चलते यह आंखों के लिए भी अच्छा है.
- ब्लड ग्लुकोज लेवल को मेंटेन करते हैं: मिलेट्स, गेहूं और मक्का की तुलना में, पोषक तत्वों से भरपूर होते हैं, और ग्लूटेन-फ्रीहोते हैं. इनका फेरीहोते इंडेक्स कम होता है. इनमें उच्च मात्रा में डाटी फाइबर, सभी आवश्यक अमीनएस, विटामिन और मिनरल्स के साथ प्रोटीन भी होता है और इसके कारण ये ब्लड एस लेवल को मेंटेन करते हैं.
- कैंसर सेल्स से करते हैं फाट:कंगन और परोसोतैरायी के मिलेट्स कैंसर सेल्स के विकास को रोकने में प्रभावी साबित हुए हैं. मिलेट्स में हैंदरअसल सामान्य कोशिकाओं को कोई नुकसान पहुंचाए बिना कोली, कोली और लिवा में कैंसर सेल्स के निर्माण को कम करते हैं. बाजरे में अंटी कैंसर प्रोपर्टी भी पाई जाती हैं. इस तरह बाजरे के सेवन से कैंसर दूर रहता है.

- प्रोपर्टी अच्छा होता है: मिलेट्स में अच्छी मात्रा में डाटी फाइबर होने से डाटीसिट्टा अच्छा होता है. इससे कब्ज, पेट फूलना, सूजन, ऐंठन जैसी परेशानियां कम से कम होती हैं. लिवा और किडनी जैसे अन्य महत्वपूर्ण अंगों के स्वास्थ्य में सुधार होता है और लिवासिट्टा मजबूत होता है.

भारत में उगाई जाने वाली प्रमुख कन्नड़ (सपरफूट) फसलें/फूटमेटने
बाजरा–बाजरा उत्तर भारत में, विशेषकर ठंड में इस्तेमाल किया जाता है। इसमें प्रोटीन, लौह तत्व, कैल्शियम, कार्बोहाइड्रेट आदि अच्छी मात्रा में पाए जाते हैं। इसमें कुछ मात्रा में कैरोटीन (विटामिन ए) भी पाया जाता है। प्रोटीन से भरपूर बाजरा हमारी हड्डियों को मजबूत बनाता है। फाइबर की अधिकता के कारण यह पाचनक्रिया में सहायक होता है और वजन कम करने में भी मदद मिलती है।
इसमें एण्टी-ऑक्सिडेंट्स की भी अच्छी मात्रा होती है, जो नींद लाने और पीरियड्स के दर्द को कम करने में मदद करते हैं। यह कैंसररोधी भी है व कोलेस्टेरॉल के लेवल को रोकने में मदद करता है. अफ्रीका मूल के इस अनाज में अमीनो एसिड, कैल्शियम, जिंक, आयरन, मैग्नीशियम, फॉस्फोरस, पोटैशियम और विटामिन बी 6, सी, ई जैसे कई विटामिन और मिनरल्स की भरपूर मात्रा पाई जाती है।प्रति 100 ग्राम बाजरे में लगभग 11.6 ग्राम प्रोटीन, 67.5 ग्राम कार्बोहाइड्रेट, 8 मिलीग्राम लौह तत्व और 132 मिलीग्राम कैरोटीन होता है. कैरोटीन हमारी आंखों को सुरक्षा प्रदान करता है।बाजरे की सबसे बड़ी खासियत यह है कि इसके सेवन से कैंसर वाले टॉक्सिन नहीं बनते हैं। बाजरे में कुछ अल्प मात्रा में पाइटिक एसिड, पोलीफिनोल, जैसे कुछ पोषण विरोधी तत्व भी होते हैं। बाजरे को पानी में भिगोकर, अंकुरित करके, माल्टिंग की विधि द्वारा इन पोषा विरोधी तत्वों को कम किया जा सकता है।
ज्वार –ज्वार दुनिया भर में उगाया जाने वाला पांचवां सबसे महत्वपूर्ण अनाज है। यह फाइबर से भरपूर वजन कम करने और कब्ज को दूर करके पाचनक्रिया को दुरुस्त रखने के लिए ज्वार बढ़िया ऑप्शन है। इसमें मौजूद कैल्शियम हड्डियों की मजबूती देने का काम करता है, जबकि कॉपर और आयरन शरीर में रेड ब्लड सेल्स की संख्या बढ़ाने और खून की कमी यानी अनीमिया को दूर करने में सहायक होते हैं।छोटे बच्चों को (विशेषकर दो वर्ष से छोटे) पारंपरिक तौर पर रागी की लप्सी बनाकर खिलाई जाती है। मधुमेह के रोगियों के लिए वह ज्यादा लाभदायक होता है। इसमें मौजूद एण्टी–ऑक्सिडेंट्स नींद की परेशानी और डिप्रेशन से निकलने में भी मदद करते हैं.
ज्वार दुनिया भर में उगाया जाने वाला पांचवां सबसे महत्वपूर्ण अनाज है। यह फाइबर से भरपूर वजन कम करने और कब्ज को दूर करके पाचनक्रिया को दुरुस्त रखने के लिए ज्वार बढ़िया ऑप्शन है। इसमें मौजूद कैल्शियम हड्डियों की मजबूती देने का काम करता है, जबकि कॉपर और आयरन शरीर में रेड ब्लड सेल्स की संख्या बढ़ाने और खून की कमी यानी अनीमिया को दूर करने में सहायक होते हैं।गर्भवती महिलाओं और डिलिवरी के बाद के दिनों के लिए इसका सेवन फायदेमंद है। इसके अलावा इसमें पोटैशियम और फॉस्फोरस की भी अच्छी मात्रा होती है। ज्वार का उपयोग बेबी फूड बनाने में भी होता है। ज्वार मुख्यतः बच्चों के भोजन में इस्तेमाल किया जाने वाला अनाज है। इसमें कार्बोहाइड्रेट, प्रोटीन, लौह तत्व मुख्य रूप से जाए जाते हैं।
यह अनाज पाचन में हल्का होता है। पोषक तत्वों से भरपूर इस अनाज को देहाती भोजन में रोटी के रूप में इस्तेमाल किया जाता है।ज्वार के आटे से बना काजल आंखों को ठंडक देता है और कई रोगों को भी दूर करता है. खांसी –जुकाम होने पर ज्वार के दानों को गुड़ में मिलाकर खाया जाता है.

रागी -रागी को देसी भाषा में नचनी भी कहते हैं. इस अनाज का रंग लाल–भूरा और स्वाद अखरोठ जैसा होता है. रागी को भी सूखा और कम पानी वाले इलाकों में उगाया जा सकता है. यह अनाज हर तरह की मिट्टी में पैदा होकर भी प्रोटीन विटामिन, आयरन, कैल्शियम और विटामिन–बी जैसे कई गुणों से भरपूर होता है.इसके नियमित सेवन से डायबिटीज और ब्लड प्रैशर जैसी बीमारियों को कंट्रोल कर सकते हैं.

आज भारत के साथ-साथ पूरे एशिया, अफ्रीका और दक्षिण अमेरिका में रागी (Fingure Millet) की खेती की जा रही है.

इसे भारतीय मूल का मोटा अनाज माना जाता है इसका पोषण मान उच्च होता है इसमें 345 मिलीग्राम प्रति 100 ग्राम केल्शियम ,3.9मिलीग्राम प्रति 100 ग्राम आयरन पाया जाता है।रागी में पाये जानेवाले केल्शियम की मात्रा किसी भी अन्य अनाज में पाए जानेवाले अनाज की तुलना में कहीं अधिक होती है।इसमें पाया जानेवाला लौह तत्व भी बाजरे को छोड़कर अन्य सभी अनाजो से अधिक है।इसे मधुमेह (शुगर) के रोगियों के लिये बेहतरीन आहार के रूप मे माना जाता है क्योंकि इसका ग्लाइसेमिक इंडेक्स काफी कम होता है।इसे आजकल इंस्टेंट (तुरंत) खिचड़ी के रूप में प्रायः सभी प्रकार के रोगी ,बालक एवं बुजुर्गों को दिया जा सकता है।30 ग्राम रागी(मडुवा) शरीर को 100 किलो कैलरी ऊर्जा देता है। रागी में 113.5%रेशा पाया जाता है जो पेट को साफ रखता है।रागी में लौह तत्व भी अच्छी मात्रा में पाया जाता है, जो रक्त का मुख्य घटक है। रागी के आटे से हम रोटी, चिल्ला, इडली बना सकते हैं। रागी की खीर भी बनती है। छोटे बच्चों को (विशेषकर दो वर्ष से छोटे) पारंपरिक तौर पर रागी की लप्सी बनाकर खिलाई जाती है। मधुमेह के रोगियों के लिए वह ज्यादा लाभदायक होता है। इसमें मौजूद एण्टी-ऑक्सिडेंट्स नींद की परेशानी और डिप्रेशन से निकलने में भी मदद करते हैं.

कंगनी-कंगनी को एशियाई देशों में उगाया जाता है. इस मिलेट का दाना पीला होता है, जिसे दलिया से लेकर पुलाव जैसे कई व्यंजन बनाने में इस्तेमाल किया जाता है. कम बारिश वाले इलाकों में उगने वाली कंगनी (Foxtail Millet) प्रोटीन, फाइबर, आयरन, पोटेशियम और मैग्नीशियम से भरपूर होती है.कंगनी का स्वाद भी काफई हद तक अखरोठ की तरह ही होता है.

चेना-चेना एक ऐसा मोटा अनाज है, जो पूरी दुनिया में उगाया जाता है. भारत के साथ-साथ यूरोप, चीन और अमेरिका में इससे सूप, दलिया और नूडल बनाए जाते हैं. यह मिलेट फैट और कोलेस्ट्रॉल फ्री होता है. साथ ही, चेना (Proso Millet) प्रोटीन, फाइबर, विटामिन-बी, आयरन और जिंक समेत कई विटामिन और खनिजों का मेन सोर्स है.

सांवा-सांवा को देश के अलग-अलग इलाकों में ऊडालू या झंगोरा के नाम से भी जानते हैं. सांवा का इतिहास भी बाकी मोटे अनाजों की तरह हजारों साल पुराना है. इसमें मौजूद पोषक तत्व- फाइबर, प्रोटीन, आयरन, कैल्शियम और विटामिन-बी आदि शरीर को खास एनर्जी देते हैं. इसके नियमित सेवन से सूजन, हार्ज डिजीज और डायबिटीज का खतरा भी कम होता है. किसान भी सावां उगाना बेहद पंसद करते हैं, क्योंकि इसमें कीट या बीमारियां लगने का खतरा नहीं रहता.

कुटकी- कुटकी के ज्यादातर गुण चेना से मिलते हैं. इसकी खेती करना किसानों के लिए जितना आसान है, इसके सेवन से भी उतने फायदे होते हैं. कुटकी की फसल 65 से 75 दिनों में पक जाती है. कैंसर जैसी गंभीर बीमारियों से लेकर डायबिटीज को कंट्रोल करने में कुटकी (Little Millet) को असरदार माना जाता है. इसमें कार्बोहाइड्रेट और प्रोटीन की मात्रा भी अधिक होती है.

कोदो- इसे प्राचीनपारंपरिक अन्न भी कहा जाता है। औषधीय गुणों से भरपूर कोदो के दाने काफी छोटेहोते है, लेकिन इसकी फसल धान की तरह ही लगती है. लाल भूरे रंग के कोदो के दानों में कैंसर, मधुमेह और पेट के रोग दूर करने की शक्ति है. इसमें मौजूद वसा, प्रोटीन, फाइबर और कार्बोहाइड्रेट शरीर को हेल्दी रखने में मदद करते हैंइसका 'ग्लाइसेमिक इंडेक्स' कम होने के कारण मधुमेह के रोगियों को चावल के स्थान पर उपयोग करने के लिए कहा जाता है। इसकी फसल मुख्यतः छत्तीसगढ़ में होती है। वहां के वनवासियों का यह मुख्य भोजन है।

शोध दर्शाते हैं कि कदन्न पोषण से भरपूर आहार हैं तथा ये स्वास्थ्य को बढ़ावा प्रदान करने वाले फाइटो रसायनों के सुरक्षात्मक प्रभाव के कारण असंक्रामक (गैर-संचारी) रोगों जैसे-मधुमेह, कैंसर तथा हृदय धमनी रोग के प्रति संभाव्य सुरक्षा प्रदान करते हैं।

कदन्नों के अंतर्गत सबसे ज्यादा क्षेत्र में बाजरे की और इसके बाद ज्वार, रागी व अन्य लघु कदन्नों की खेती की जाती है। इन फसलों की खाद्य व चारा, दोनों प्रयोजनों के लिए खेती की जाती है। इन अनाजों का अधिकांश भाग घरेलू स्तर पर प्रयुक्त किया जाता है तथा शेष भाग कुक्कुट आहार, खाद्य प्रसंस्करण एवं अल्कोहल हेतु औद्योगिक रूप में प्रयुक्त होता है।

इन अनाजों की कुछ मात्रा बीज पक्षियों के दाने तथा प्रसंस्करित खाद्य पदार्थों के रूप में निर्यात भी की जाती है। दुनिया के अत्यधिक वंचित क्षेत्रों को एक महत्वपूर्ण उप-उत्पाद के रूप में कदन्नों से चारा प्राप्त होता है, जो कि पशुओं के लिए पोषण से भरपूर होता है।

पौष्टिक गुणों से भरपूर कदन्न अनाज: कदन्नों को पौष्टिक धान्य भी कहा जाता है, ये खाद्य तथा पोषण सुरक्षा में काफी योगदान करते हैं। कदन्न फसलें सीमांत (शुष्क) पर्यावरण में अच्छा प्रदर्शन करती हैं तथा ज्यादा सूक्ष्म पोषक तत्वों एवं कम रसाइसेमिक सूचकांक के साथ पौष्टिक गुणों में श्रेष्ठ होती हैं।

कदन्न जलवायु लचीली फसलें भी हैं। इनमें अद्वितीय पौष्टिक गुण विशेषकर जटिल कार्बोहाइड्रेट, पथ्य रेशे की प्रचुरता के साथ-साथ पौष्टिक-औषधीय गुणयुक्त विशिष्ट फिनॉलिक योगिक तथा फाइटो रसायन भी पाए जाते हैं। कदन्न भारत में कुपोषण की समस्या को दूर करने के लिए आवश्यक आयरन, जिंक, कैल्शियम तथा अन्य पोषक तत्वों के प्राकृतिक स्रोत भी हैं।

सारणी : गेहूँ ,चावल की तुलना में कदन्न अनाजों का पोषक मान (प्रति 100 ग्राम)

कदन्न अनाज	प्रोटीन (ग्राम)	कार्बोहाइड्रेट (ग्राम)	वसा (ग्राम)	ऊर्जा (किलो कैलारी)	रेशा (ग्राम)	कैल्शियम (मि.ग्रा.)	फास्फोरस (मि.ग्रा.)	मैग्नीशियम (मि.ग्रा.)	जिंक (मि.ग्रा.)	आयरन (मि.ग्रा.)	थायमिन (मि.ग्रा.)	राइबोफ्लेविन (मि.ग्रा.)	नियासिन (मि.ग्रा.)	फोलिक अम्ल (मा.ग्रा.)
ज्वार	09.97	67.68	1.73	334	10.2	27.6	274	133	1.9	3.9	0.35	0.14	2.1	39.4
बाजरा	10.96	61.78	5.43	347	11.5	27.4	289	124	2.7	6.4	0.25	0.20	0.9	36.1
रागी	07.16	66.82	1.92	320	11.2	364.0	210	146	2.5	4.6	0.37	0.17	1.3	34.7
कोदो	08.92	66.19	2.55	331	06.4	15.3	101	122	1.6	2.3	0.29	0.20	1.5	39.5
चीना	12.50	70.40	1.10	341	-	14.0	206	153	1.4	0.8	0.41	0.28	4.5	-
कगंनी	12.30	60.10	4.30	331	-	31.0	188	81	2.4	2.8	0.59	0.11	3.2	15.0
कुटकी	8.92	65.55	3.89	346	7.7	16.1	130	91	1.8	1.2	0.26	0.05	1.3	36.2
सांवां	06.20	65.55	2.20	307	-	20.0	280	82	3.0	5.0	0.33	0.10	4.2	-
गेहूँ	10.59	64.72	1.47	321	11.2	39.4	315	125	2.8	3.9	0.46	0.15	2.7	30.1
चावल	07.94	78.24	0.52	356	02.8	07.5	96	19	1.2	0.6	0.05	0.05	1.7	9.32

स्रोत -न्यूट्रीटिव वैलयू ऑफ इंडियन फूड्स- डा. सी. गोपालन, राष्ट्रीय पोषण संस्थान, हैदराबाद (2018)

सेहत के लिए कितना फायदेमंद है कदन्न अनाज:

- ज्वार, बाजरा और रागी जैसे मोटे अनाज में पौष्टिकता की भरमार होती है। रागी डायबिटीज के रोगियों के लिए फायदेमंद होता है I
- ज्वार दुनिया में उगाया जाने वाला 5वां महत्वपूर्ण अनाज है। ये आधे अरब लोगों का मुख्य आहार है। आज ज्वार का ज्यादातर उपयोग शराब उद्योग, डबलरोटी के उत्पादन के लिए हो रहा है।
- कदन्न रेशे का मुख्य स्रोत है तथा परिष्कृत अनाज में केवल भ्रूणपोष की अपेक्षा इनमें बीजाणु (जर्म), भ्रूणपोष इंडोस्पर्म तथा चोकर (ब्रॉन) में पाए जाते हैं। इसके अलावा साबुत अनाज या आंशिक रूप से कदन्न कई विटामिनों, खनिजों तथा फाइटो-रसायनों के मुख्य स्रोत होते हैं, जिनमें कैंसर प्रतिरोधक गुण पाए जाते हैं।
- ग्लूटेन संवेदी लोगों को गेहूं के आटे का सेवन नहीं करने की सलाह दी जाती है और कदन्न, ग्लूटेनरहित होने के कारण ऐसेलोगों हेतु सुरक्षित अनाज है। सीलिएक रोगियों के लिए ग्लूटेन मुक्त आहार वैकल्पिक नहीं है, बल्कि इसे आवश्यक पोषण चिकित्सा माना गया है
- टाइप-2 मधुमेह रोगियों के लिए कदन्न, चावल का अच्छा विकल्प है। कदन्नों में मौजूद रेशे की उच्च मात्रा पाचन को धीमा करती है तथा रक्त प्रवाह में शर्करा को धीमी गति से छोड़ती है। ये मधुमेह रोगियों को रक्त शर्करा की खतरनाक स्थितियों-ग्लूकोसोरिया से बचाने में सहायता करते हैं। कदन्न विटामिन 'बी' का भी अच्छा स्रोत है, शरीर द्वारा कार्बोहाइड्रेट के पाचन के लिए इसका उपयोग किया जाता है।
- शारीरिक भार (मोटापा) कम करने तथा समग्र स्वास्थ्य हेतु गेहूं के आटे, सफेद चावल या पैक किए हुए स्नैक्स के स्थान पर कंदन अथवा अन्य साबुत अनाज खाने की सलाह दी जाती है। कदन्नों में रेशे प्रचुर मात्रा में पाए जाते हैं तथा इनमें चिपचिपाहट, जल धारण, जल अवोषण जैसी अनुपम भौतिक तथा रसायनिक विशेषताएं होती हैं, ये शारीरिक क्रिया व्यवहार को निर्धारित करती हैं।
- गठिया के रोगी दवा के बिना शोथ (इनफ्लमेशन) का प्रबंधन कर सकते हैं। ऐसे लोगों के लिए शोथ को नियंत्रित करने व उसकी रोकथाम करने में कदन्न प्रकृति का दिया हुआ वरदान है। कदन्नों में इस रोग के निवारण हेतु सक्षम ग्लूटेनमुक्त प्रोटीन पाया जाता है।
- कदन्न, माइग्रेन व हृदयाघात के प्रभाव को कम करने में सक्षम मैग्नीशियम के बहुत अच्छे स्रोत हैं। कदन्नों में कोलेस्ट्रॉल कम करने में सहायक फाइटिक अम्लयुक्त फाइटो रसायन प्रचुर मात्रा में पाए जाते हैं। इनमें उपस्थित टैनिन भी कोलेस्ट्रॉल कम करने में लाभदायक है।
- कदन्न किण्वन योग्य कार्बोहाइड्रेट (प्रतिरोधी स्टार्च) के समृद्ध स्रोत हैं, जिनका आतों के जीवाणुओं द्वारा लघु-शृंखला वसीय अम्लों में परिवर्तन किया जाता है और ये पेट के कैंसर से रक्षा करने में सहायता करते हैं। ज्वार में उपस्थित 3-डिऑक्सी एथॉक्सिनिन (3-डीएक्सए) के संबंध में यह माना जाता है कि ये पेट की कैंसर कोशिकाओं के प्रसार की रोकथाम करते हैं। यह पाया गया कि कदन्न कैंसर की शुरुआत व प्रसार की रोकथाम में प्रभावी हो सकते हैं।
- कदन्नों में रेशे बहुतायत से पाए जाते हैं तथा इनका सेवन कब्ज को कम करता है। प्रतिदिन लगभग दो से तीन बार साबुत अनाज /कदन्न तथा करीब पांच बार फल व सब्जियों का सेवन करके पर्याप्त पथ्य रेशे प्राप्त किए जा सकते हैं।
- पशुओं के प्रोटीन में संतृप्त वसा अम्ल उच्च मात्रा में पाए जाते हैं, जबकि कदन्न वसा-मुक्त प्रोटीन प्रदान करते हैं। इनमें उपस्थित अमीनो अम्ल एवं ट्रिप्टोफेन भूख को नियमित करते हैं, जिससे मोटापे का नियंत्रण होता है।

निष्कर्ष - कदन्न हमारी पोषण तथा स्वास्थ्य संबंधी समस्याओं (आयरन, जिंक, फॉलिक अम्ल, कैल्शियम तथा अन्य की कमी) को दूर करने में सहायता कर सकते हैं।स्वास्थ्य संबंधी समस्याओं से निपटने में सहायकः कदन्नों के अनेक स्वास्थ्य लाभ हैं। अध्ययनों से यह सिद्ध होता है कि कदन्नों के सेवन से हृदय रोगों का खतरा कम होता है, मधुमेह की रोकथाम होती है, पाचनतंत्र अच्छा होता है, कैंसर का खतरा कम होता है, शरीर विषैले पदार्थों से मुक्त होता है, ऊर्जा का स्तर बढ़ता है तथा मांसपेशियां व तंत्रिका तंत्र मजबूत होता है। इसके अलावा मेटाबॉलिक सिंड्रोम, पार्किंसन्स रोग जैसे कई अपक्षयी रोगों की रोकथाम होती है।डाइट में मिलेट का उपयोग महत्वपूर्ण स्वास्थ्य लाभ प्रदान कर सकता है क्योंकि यह फाइबर, खनिज, विटामिन, सूक्ष्म और मैक्रोन्यूट्रिएंट्स और फाइटोकेमिकल्स से भरपूर होता है।पॉजिटिव मिलेट को एक नियमित आहार का हिस्सा बनाने से एक किफायती, पूर्ण और स्वस्थ भोजन मिल सकता है और पुराने विकारों से लड़ने में भी मदद कर सकता है।

हालांकि भारत पोषक तत्वों से भरपूर मिलेट के उत्पादन में पहले स्थान पर है, लेकिन स्वास्थ्य जागरूकता की कमी के कारण बाल कुपोषण की सबसे अधिक घटनाओं के साथ यह दूसरे स्थान पर है।भारत सरकार ने 2018 को राष्ट्रीय बाजरा वर्ष के रूप में चिह्नित किया था।संयुक्त राष्ट्र ने वर्ष 2023 को मिलेट का अंतर्राष्ट्रीय वर्ष (International Millet Year) घोषित किया है। इस संकल्प का उद्देश्य मिलेट के स्वास्थ्य लाभों के बारे में जन जागरूकता बढ़ाना है।हाल ही में, यह अनाज धीरे–धीरे पोषक तत्वों से भरपूर भोजन की उपलब्धता में सुधार लाने और रोजगार सृजित करने के लिए एक व्यवसायिक स्टार्ट–अप क्रांति को बढ़ावा दे रहा है।

वर्तमान समय में खाद्य एवं पोषण सुरक्षा तथा जीवनशैली संबंधी रोगों का सामना करने हेतु कदन्न अत्यधिक महत्वपूर्ण हैं। आज विविध प्रकार के प्रसंस्करण हेतु उपयुक्त कदन्नों की कई किस्में उपलब्ध हैं। इसके अलावा कदन्नों के स्वास्थ्य लाभ संबंधी वैज्ञानिक आंकड़े भी मौजूद हैं। हम दैनिक आहार में पौष्टिकता से भरपूर कदन्नों को शामिल करके जीवनशैली संबंधी रोगों/विकारों का सामना करने के लिए अपनी प्रतिरक्षा शक्ति बढ़ा सकते हैं। अतः आज कदन्नों का उपयोग वैकल्पिक नहीं, बल्कि आवश्यक खाद्य के रूप में करने की आवश्यकता है।

संदर्भ:

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मोटा अनाज स्वास्थ और पोषण – एक समीक्षा

शिखा शमत्रा, डॉ शिप्रा बैनजी

सारांश

इस समय तेजी से बढ़ रही जीवनशैली से जुड़ी बीमारियों की रोकथाम में मोटे अनाजों की अहम भूमिका हो सकती है। मोटे अनाज पोषक तत्वों से भरपूर होने के कारण स्वास्थ्यवर्द्धक तो हैं ही साथ ही ये हमें कई बीमारियों से बचाते हैं। दरअसल, आधुनिकता की दौड़ में न सिर्फ जीवनशैली बदली, बल्कि हमारा खान-पान भी पूरी तरह से बदल गया। पांच दशक पहले हमारे खाने की आदतें पूरी तरह से अलग थीं। मोटे अनाज हमारे आहार का मुख्य घटक थे। हरित क्रांति के दौरान गेहूं और धान की खेती को सबसे अधिक महत्व दिया गया और इसके परिणामस्वरूप हमने गेहूं और चावल को अपनी भोजन की थाली में सजा लिया तथा मोटे अनाज को खाद्य शृंखला से बाहर कर दिया। जिन अनाज को हमारी कई पीढ़ियां खाती आ रही थीं, उनसे हमने मुंह मोड़ लिया और आज पूरी दुनिया उसी मोटे अनाज के महत्व को समझते हुए उसकी ओर वापस लौट रही है।

यह समीक्षा मोटे अनाजों के पोषक गुणों, भोजन के रूप में तैयार खाद्य पदार्थों के रूप में उनके उपयोग का आकलन करती है। ये अनाज फाइटोकेमिकल्स से लदे होते हैं जिनमें फेनोलिक एसिड, टैनिन, एंथोसायनिन, फाइटोस्टेरॉल, एवेनेनेथ्रामाइड्स और पोलिकोसानॉल शामिल हैं। वे मुख्य अनाज और फलों की तुलना में उच्च एंटीऑक्सीडेंट गुण रखते हैं। कुछ पोषण-विरोधी कारक भी हैं जिन्हें कुछ प्रसंस्करण उपचारों द्वारा कम किया जा सकता है। कई महामारी विज्ञान के अध्ययन से पता चलता है कि ये अनाज कई प्रकार की पुरानी बीमारियों जैसे कैंसर, हृदय रोग, टाइप II मधुमेह और विभिन्न जठरांत्र संबंधी विकारों को कम करने में सहायक होते हैं। प्रकृति में मोटे होने के कारण, वे हमारे मुख्य अनाज को प्रतिस्थापित नहीं कर सकते हैं, लेकिन विभिन्न पोषक उत्पादों को तैयार करने के लिए चावल और गेहूं के साथ अलग-अलग अनुपात में उपयोग किया जा सकता है। उनका उपयोग दलिया, बिस्कुट, केक, कुकीज़, टॉर्टिला, ब्रेड, प्रोबायोटिक पेय, लड्डू, फ्लेक्स और कई किण्वित खाद्य पदार्थ बनाने के लिए किया जा सकता है। मोटे अनाज से बायो एथेनॉल, कागज, तेल और बायोफिल्म के निर्माण की भी अच्छी संभावना है।

मूल शब्द : एंटी ऑक्सिडेंट, फाइटो स्टेरॉल, एवेनेनेथ्रामाइड्स, फेनोलिक एसिड, हृदय रोग, कैंसर

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खाद्य सुरक्षा और पोषण में बाजरा के योगदान के बारे में जागरूकता बढ़ाना

डॉ. निधि चौहान

भारत दुनिया के खाद्य उत्पादकों में से एक है। भारत खाद्य प्रसंस्करण कम्पनियों के लिए उपयुक्त एक बड़े और विविध कच्चे माल का आधार है। भारत विशाल वैज्ञानिक और अनुसंधान के मध्य प्रतिभा का पुल है। तेजी से बढ़ते शहरीकरण, बढ़ती साक्षरता, बदलती जीवनशैली, प्रति व्यक्ति बढ़ती आय से खाद्य प्रसंस्करण का क्षेत्र भी तेजी से बढ़ रहा है। भारतीयों द्वारा घरेलू खर्च का 50 प्रतिशत खाद्य प्रसंस्करण से निर्मित वस्तुओं पर किया जाने लगा है खाद्य प्रसंस्करण की कला प्राचीन काल से प्रचलित है। सबसे पहले मानव ने अपने अनुभव के आधार पर इसे सीखा और अपनाया। संस्कृति और सभ्यता के क्रमिक विकास और वैज्ञानिक खोज के साथ–साथ खाद्य प्रसंस्करण का रूप अलग–अलग तरह से विकसित होता है। वर्तमान समय में खाद्य प्रसंस्करण व्यवसायिक और घरेलू स्तर पर विज्ञान और कला के मिश्रण के रूप में विद्यमान है। इसलिए खाद्य प्रसंस्करण क्या है? क्यों किया जाता है? और कैसे किया जाता है इसकी जानकारी होना बहुत आवश्यक है।

व्यावसायिक क्षेत्र में अनेक परिवर्तन आते रहते है। जो उपक्रम के लिए विकास एवं प्रगति का मार्ग ही नहीं खोलते है, वरन् अनेक जोखिमों एवं अनिश्चितताओं को भी उत्पन्न कर देते है। प्रतिस्पर्धा, प्रौद्योगिकी, सरकारी नीति, आर्थिक क्रियाओं, श्रम पूर्ति, कच्चा माल तथा सामाजिक मूल्यों एवं मान्यताओं में होने वाले परिवर्तन के कारण आधुनिक व्यवसाय का स्वरूप अत्यन्त जटिल हो गया है। ऐसे परिवर्तनशील वातावरण में नियोजन के आधार पर ही व्यावसायिक सफलता की आशा की जा सकती है। आज नियोजन का विकास प्रत्येक उपक्रम की एक महत्त्वपूर्ण आवश्यकता है। व्यावसायिक बर्बादी, दुरूपयोग व जोखिमों को नियोजन के द्वारा ही कम किया जा सकता है।

- योजना बनाते समय योजना के पूरी होने का समय अवश्य निश्चित कर देना चाहिए ताकि विभिन्न कार्यक्रमों के पालन में समय का ध्यान रखा जा सके।
- नियोजन लोचशील होना चाहिए क्योंकि यह भविष्य में पूर्वानुमानों पर आधारित होता है। नियोजन इतना लोचशील होना चाहिए कि अनिश्चित घटनाओं के कारण होने वाली हानियों को न्यूनतम किया जा सके। लोचशीलता से इकाई में आसानी से परिवर्तन किया जा सकता है तथा नए मार्गों को अपनाया जा सकता है।

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मिलिट्स :- भारत के लिए भविष्य का सुपर फूड

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मिलेट बहुत ही ज्यादा पौष्टिक आहार होता है मिलेट को आप कही पर भी उगा सकते है। इसे सूखे क्षेत्र,वर्षा आधारित क्षेत्रो, तटीय क्षेत्रो, या पहाड़ी क्षेत्रो में आसानी से उगाया जा सकता है मिलेट्स को बीजो के आकार और उगने के तरीके के आधार पर हम दो भागो में बाँट सकते है।

- मोटे दाने वाला अनाज – major millets
- छोटे दाने वाला अनाज – minor millets

major millets इन धान्यों के बीज मोटे होते है। मोटे दाने वाले अनाज को Naked grain के नाम से भी जाना जाता है जैसे – बाजरा, मूंग, रागी, ज्वार, चना आदि। यह मोटे अनाजो में सूखा सहन करने की क्षमता होती है। इन फसलो को उगाने में कम लागत भी आती है। इन फसलो में कीटो से लड़ने की रोगप्रतिरोधक क्षमता होती है। जिस कारण कम उर्वरको और खाद्य की भी आवश्यकता पड़ती है।

minor millets इन धान्यो के बीज छोटे होते है। छोटे दाने वाले अनाज को Husked grain के नाम से भी जाना जाता है। जैसे – कुटकी, कंगनी, कोदो, चावल आदि। मोटे धान्यों की तुलना में लघु धान्यो में अधिक पौष्टिक तत्व पाए जाते है। जैसे – जैसे लोगो को यह बाते पता चल रही है वो वापिस इन अनाजो की ओर रुख करने लगे है।

बाजार में उपलब्ध मिलेट्स की मुख्य किस्मे कंगनी, कुटकी, कोदो, रागी, झंगोरा, बैरी ज्वार, बाजरा।

मिलेट्स में पाए जाने वाले पोषक तत्व विटामिन बी-3, विटामिन बी-6, कैरोटिन, फास्फोरस, मैग्नीशियम, पोटेशियम, कैल्शियम, लेसिथीन, लोहा, जस्ता, फाइबर, आदि प्रचुर मात्रा में पाए जाते है।

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