



Wholistic Framework for Consumption of Millets: Summarizing the Research Evidence

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Abstract

The year 2023 has been declared the “Year of Millets” by Indian PM Narendra Modi. Millets usually grow in semi-arid regions with scanty rainfall and poor soil quality. Despite that, millets are a powerful source of nutrients and health-benefiting compounds, including high protein and carbohydrates. Throughout the years, millet consumption had declined due to overdependence on cereals like wheat and rice post-green revolution. However, these dietary habits of people combined with a sedentary lifestyle have led to an increase in obesity, lifestyle diseases like cholesterol, diabetes, heart ailments, cancer, gastrointestinal disorders, etc. Due to the high nutritional value of millet and the conditions in which it can be grown, it is garnering much interest from food scientists, nutritionists, and agriculturists worldwide. Through this paper, the researchers are trying to study available literature on the behavior of millet consumption among India's urban population. The papers carefully investigate all the research evidence in detail that discusses the health benefits, environmental benefits, and factors affecting millet consumption; based on this evidence, the paper summarises the determinants of millet consumption and provides recommendations for the enhancement of the consumption of millet.

Keywords: Millet, Consumption Behaviour, India, Nutrition, Food, Environment, Policy Framework

Introduction

Millets:

Millets are found worldwide, with their primary production in Africa, China, India, Asia, and other developing nations. They are a powerhouse of proteins, carbohydrates, calcium, antioxidants, phenolic acids, and many more. Millets are drought-resistant crops usually grown in semi-arid areas with soils containing less nutrition. Despite this fact, millets provide a great source of nutrition for people and have the potential to provide food security to those residing in such areas. They are a varied group of small-seeded grass. Based on the grain size, millet is classified as significant or small grain millet. Sorghum and pearl millets belong to the considerable millets category, while foxtail millets, finger millets, kodo millets, proso millets, and barnyard millets belong to the small grain millets category. (Gowri et al., 2020)

Apart from being important from a nutrition point of view due to the ranging health benefits provided by millet, they are also of extreme importance from an agriculture point of view. Climate change in recent years has led to a decrease in the production of cereals and other food crops. Millets, on the other hand, are drought-resistant and can be grown quickly in scanty rainfalls. They are C4 plants, meaning they have superior photosynthetic efficiency, higher dry matter production capacity, require a short duration to grow, and have a high degree of tolerance to heat and drought. (Paschapur et al, 2021).

Nutritional benefits of Millets

Millets are known for their high nutritional value and various health benefits provided by them. Such properties of millets are attributable to high fiber content, high levels of polyphenols, and non-glutinous and non-starchy carbohydrates. (Saleh et al., 2013). For these reasons, millet is considered superior to wheat and other wholegrain cereals. The different health benefits provided by millets include high levels of antioxidants, they are anti-diabetes, protection from tumors cardiovascular disease, and gastrointestinal diseases, immunity boosting in nature, and increased energy levels, among other health benefits provided by millets (Paschapur et al., 2021).

Consumption Pattern of Millets

Millets are one of the oldest crops cultivated worldwide, with records dating back to 8700-10,300 years ago (Paschapur et al., 2021).

There is also a history of millet cultivation in ancient civilizations of India. According to historical records, the foxtail millet spread from China, and its cultivation began in the Harappan period (2500-2200 BC). There is also mention of foxtail, porso, and barnyard millets in the Sanskrit verses of Yajurveda. Also, there is mention of various millets in ancient Indian texts such as Charak Samhita, Sushruta Samhita, Vishnu Purana, Abhijnana Shakuntalam and Ramadhanya Charithre. (Paschapur et al, 2021).

Various epidemiological studies have been conducted to study the health benefits provided by each of the millets, which prove that millets protect us from various diseases (Tripathi et al., 2021) and are dense in nutrients, carbohydrates, lipids, protein, amino acids, antioxidants, calcium among other things. (Hassan et al, 2021).

Factors Affecting Behaviour for Consumption of Millets

Various studies have been conducted to study the factors that affect the behavior of people who consume millet. Some studies suggest that demographical factors like age, gender, geographical location, educational qualification, monthly income, and marital status of people affect the consumption of millet (George et al., 2021).

Some of the other factors determined by researchers include the consumer's health consciousness, environmental concern, health and safety consciousness, price consciousness, and social status of the people. (Shirahatti et al, 2021)

Another study has attributed economic factors like income and cross-price effect to millet consumption. Moreover, the researchers think that low-income groups consume millet as a staple diet regardless of income. However, high-income groups have started consuming millet due to health awareness and concerns. (Umanath et al, 2018).

Millets and Health benefits

Paschapur, in 2021, proposed that millets are C4 plants with superior photosynthetic properties and can be cultivated easily in semi-arid regions with scanty rainfall and lower soil quality. The researchers have also mentioned the history of cultivation and consumption of millets in Harappan civilization around 10,000 years ago and its mention in Sanskrit verses of Yajurveda, Charak Samhita, Sushruta Samhita, Vishnu Purana, Abhijnana Shakuntalam and Ramadhanya Charithre. Apart from this, the researchers have highlighted millet's various health and medicinal properties, including its use against coronary disease, diabetes, gastrointestinal diseases, and cancer and its high antioxidant content.

The researchers have attempted to study the nutritional quality and health benefits of millets and have focused on recent research work done to examine the health benefits of millets. The researchers conclude that novel processing techniques are required to enhance the bioavailability of micronutrients in millets. (Saleh et al., 2013)

One of the research studies focuses on the growth and area of cultivation of different types of millet in other parts of India and where each type of millet is consumed. The researchers also talked about the health and medicinal benefits of various kinds of millet, with a particular focus on sorghum, pearl millet, finger millet, Foxtail millet, and little millet. The researchers have mentioned the procedure for processing different types of millets in the paper. (Rao et al, 2017)

In their paper, "The nutritional use of millet grain for food and feed: a review," the researchers have tried to do a comparative study of the nutritional profile of Pearl Millet and Finger millet. The different nutrition considered while doing the research include Carbohydrates, Protein, Dietary fiber, Macronutrients, Lipids, Polyphenols, and Antioxidant properties of millets. The researchers have concluded that millets are used more in human than livestock diets. Considering the health benefits and nutritional value of millets, the researchers recommend more usage of millets as livestock feed. (Hassan et al, 2021)

Cultivation of Millets around the world

The researchers, through the paper "Earliest domestication of common millet (*Panicum miliaceum*) in East Asia extended to 10,000 years ago," have attempted to study the origin and domestication of Common millets and Foxtail Millets in Neolithic China. Through the study, the researchers have concluded that cultivation and domestication of common millet in Neolithic China, dating back to around 10,000 years, can be found. However, the results show that Foxtail millets may not be indigenous to China. (Zhang et al, 2009)

The researchers have attempted to study the origin and cultivation of Foxtail millet and Broomcorn millet in Northern China in the paper "Early millet use in Northern China." After an extensive study of the archaeobotanical records available, the researchers concluded that millet cultivation dates back to 11 Cal BP. In the documents, the presence of starch grains on processing tools is mentioned, which indicates that millets were ground into flour and consumed as early as 10 Cal BP. The researchers conclude that foxtail millet might have been cultivated, domesticated, and consumed in Northern China as early as 11 Cal BP. (Yang et al, 2012)

The researchers have attempted to study the declining cultivation trend in India in the paper "Millet Scenario in India." The trend shows a decline in millet consumption due to increased production of major cereals like rice and wheat following the Green Revolution. The study also showed that the cost of cultivation of millets is less than the cost of cultivation of other crops. On the other hand, gross income realized from millet crops is higher than that of other crops. MSP of millets like maize and ragi were higher than the market price till 2018. However, the market price of millets increased post-2018. The researchers have suggested ways to increase millet consumption, like introducing unique meal plans and increasing the quantity of millet in the Public Distribution System. The decrease in millet consumption may be attributed to high prices and complicated cooking procedures. (Gowri et al., 2020)

Factors Affecting Behavior for Consumption of Millets

The researchers attempt to study the consumption probability of millets and demand for millets at the household level in India through the paper "Millets' Consumption Probability and Demand in India: An Application of Heckman Sample Selection Model." Data was collected from the National Sample Survey Organization (NSSO) for 2004-05 and 2011-12. The researchers used the Heckman sample selection model to study the relationship between household and millet consumption. The study revealed that price was the primary factor considered during nonconsumption/ consumption of millet. Income was not a factor that significantly impacted the demand for millet. As per the survey, millet is considered inferior goods. The study also found that the age of the household head has a positive correlation with millet consumption. In contrast, education level and household size negatively correlated with millet consumption. (Umanath et al, 2018)

The paper "Authenticity in Traditional Food Marketing Using Millets: Consumers' Opinion Analysis" aims to study the impact of the 7Ps marketing strategy on the consumption of organic foods like millets. The sample size selected was 50 using the convenience sampling method. Percentage analysis, weighted average analysis, frequency analysis, regression analysis, and H test were conducted on the data. The findings were: (i) Product analysis - better packaging is required and is the most influencing factor. (ii) Price analysis - the consumers found the product to be expensive in comparison to regular cereals (iii) Place analysis - customers are satisfied with the place (iv) Promotional analysis - promotion strategy used is good but could be better to tap the potential market (v) People - consumers feel that better grooming is required for handling the customers (vi) Process analysis - customers expect more transparency in the process. As per the study, the most influential factor is product, and product innovation may increase millet consumption. (Nithaya A, 2020)

The study "Impact of demographic factors on consumption pattern of millets in Kerala" is conducted by researchers in 14 districts of Kerala to study the impact of demographical factors on the consumption of millets. The data was collected through a convenience sampling method using an online questionnaire. Out of 641 respondents, 278 consumed millets. The researchers used the Chi-square method to test the hypothesis. The research tests the impact of demographical factors vis a vis age, gender, income, education, marital status, and district on type of millet, frequency of millet, quantity of millet, type of millet-based product, and quality of millet consumed. The study found that consumers of millets are less in Kerala, and demographical factors have less impact on consumption of millets. The researchers have further suggested ways to market and promote the cultivation and consumption of millets in Kerala. (George et al., 2021)

The researchers conducted a study in nine villages of Murhu and Torpa blocks in the Khunti district of Jharkhand to study the different kinds of Indigenous foods (IF) consumed by them, levels of IFs in routine diets, nutritional attributes of the IF and factors influencing IF consumption for the research paper "Traditional Food Environment and Factors Affecting Indigenous Food Consumption in Munda Tribal Community of Jharkhand, India." Factors that affected the consumption of millets and IFs were a desirable taste, nutritional content, satiety, adaptability to climate, cultural and traditional practices, and the importance of food. The potential barriers to the consumption of millets and IFs were the impact of

climate on agroforestry, access to food brought from the stores or distributed by the government, and the promotion of hybrid seeds by agriculturists. (Ghosh et al, 2021)

The researchers attempted to study the awareness and practices of consuming millets in urban areas through the paper "Assessing Millets and Sorghum Consumption Behaviour in Urban India: A Large-Scale Survey." A study with respondents ranging from 15,522 individuals from urban areas of seven major cities of India was conducted for the research. The number of respondents considered post-cleaning of data was 15,139. The results were: (i) early adopters of millet were people with health problems- 28%, followed by people wanting to shed weight, 15%, and those who found it tasty -14%. A significant gap was found between people who wanted to lead a healthy lifestyle and were health conscious -91% and people who thought millets were healthy -40%. Ahmedabad and Delhi had the highest number of people who preferred millet for its nutritional value and health benefits. In contrast, people from Chennai and Hyderabad preferred taste over health. Family eating habits and customs were the primary reason for the non-consumption of millets in all the cities (40%), except for Kolkata and Chennai, where the reason was primarily the high price of millets. The researchers further recommend awareness among the urban population through social media, promotion of the benefits of millets, understanding of different ways of cooking millets, and creating other food products from millets to satisfy the population's tastes. (Potaka et al., 2021)

Conclusion

Through the preliminary review of the literature, the researchers conclude the following:

- Millets are a powerhouse of nutrition and health benefits
- Millets are C4 plants with superior photosynthesis, which makes them suitable for cultivation in semi-arid regions with scanty rainfall and low-quality soil
- Millets have a long history of being cultivated, domesticated, and consumed in semi-arid regions of China, Africa, Asia, and India
- Market variables such as availability of millet products in the market, knowledge of associated health benefits, price, and product-associated variables such as texture, taste, flavor, and appearance play a significant role in consumption behavior for millets. (Alekhya and Shravanthi, 2019)
- Various factors affect the behavior of people who consume millet, including demographic factors, health consciousness, environmental concerns, food safety, and quality.
- Millet consumption is also significantly affected by health consciousness, household size, diet consciousness, income level, and staple cereal. Factors like doctor recommendations, promotional activities, and availability across e-commerce also affect millet consumption. (Reddy and Patel, 2023)

Enhancing Consumption of Millet

Recommendations	
Educational Campaigns	Educating People through Promotional and educational campaigns through government-private setups for: - For Nutritional Value - Health Benefits - Environmental Benefits
Incorporating Millet into Modern Recipes	- Consumers, especially urban consumers, can be influenced to consume millet through - Recipes and Cooking Classes - Fusion Foods

Demographics	• Making cost-effective, low-price packaging product variants and deviants from millets to facilitate lower-income groups. • Including millet as a part of the regular course curriculum at the school level. • Spreading awareness about the use of millet for combating diseases through medical practitioners and dieticians
Market-Related Factors	• An appropriate combination of Product, Proce, Place, and Promotion to enhance the reach and access of customers for millet-based products • Product development of Ready to Eat recipes • Creative and attractive branding • Enhancing availability through retail partnerships and café and restaurants
Socio-cultural dimensions	• Promoting and reviving traditional cuisines that include millet-based recipes for local and regional festivals
Psychographics	• Promoting millet recipes through e-commerce and social platforms and associating a sense of belongingness and pride with the usage of local millet • Campaigns by Social Media influencers showing the benefits and versatility of millets
Government and Policy Support	• Subsidies and incentives for millet production • Public health campaigns by public health departments

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