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N Prathyusha
M.Sc. II Year, C.C.Sc., PJTSAU, Hyderabad, Telangana, India

V Vijaya Lakshmi
Professor, C.C.Sc., PJTSAU, Hyderabad, Telangana, India

T Manasa
M.Sc. II Year, C.C.Sc., PJTSAU, Hyderabad, Telangana, India

Corresponding Author:
N Prathyusha
M.Sc. II Year, C.C.Sc., PJTSAU, Hyderabad, Telangana, India

Review on consumer awareness and health benefits about millets

N Prathyusha, V Vijaya Lakshmi and T Manasa

Abstract
Millet plays a major key role in the traditional diets of numerous regions all over the country. Millet contains superior nutritive values and they could be easily cultivated in areas where water is inadequate. Millets have high amounts of photochemicals, however, the types and amount present vary greatly between and within different species. Few, evidences presenting that many health- promoting factors like anti-obesity, cardiovascular disease and anti-diabetic properties improves through millet foods and beverages. However, direct evidence of health- enhancing effects are lacking as most studies have been carried out on the grains and their extracts and not particularly on food and beverage products, and the present research work has been conducted on nutritional composition of millets. The current review is to collect the available information from existing literature either offline or online related to the consumer awareness and health benefiting properties of millet and trying to present the collected data in an easily-documented pattern. Due to the high nutritional profile of millets, the Nutritionist/ Dieticians must make an effort to encourage the millet consumption among public.

Keywords: Millets, consumer awareness, satisfaction and health benefits

Introduction
Millet is the French word derived from "mille" i.e. handful of millet contains thousands of grains (Taylor and Emmambux, 2018) [30]. Millet is fibrous in content, has magnesium, Niacin (Vitamin-B3), gluten-free and has high protein content. PJTSAU included few millet products like semiyah and biscuits in the diet chart of 400 social welfare schools in Telangana; and is supplying to them in order to address malnutrition issues (The Hindu, 2017) [5]. Government of India proposed budget to these millets as nutria - cereals and encouraging millet production. Millet food entrepreneurs are also trying to promote and commercialize different millet - based products, thereby increasing the consumption of millets and ensuring nutritional security of the consumers (Sulthana, 2014) [28]. India, Niger, and China are the largest producers of millet in the world, accounting for more than 55% of global production. Among the states, during 2017-18, the maximum area under millets was in Rajasthan, followed by Maharashtra and Karnataka.

Millets
Adekunle (2012) [1] reported that, millets are the major food sources for millions of people, especially those who survive in hot and dry areas of the world. Mostly grown in the insignificant areas under agricultural conditions where major cereals fail to give significant yields. According to Michaelraj and Shanmugam (2013) [18] millets are the first cereal grain to be used for domestic purposes and are very old foods known to humans. Various food entrepreneurs are also trying to promote and commercialize different millet-based products, thereby increasing the consumption of millets and ensuring nutritional security (Sulthana, 2014) [28].

Objectives
1. To study the awareness of consumers about Millets.
2. To assess the health benefits regarding Millets.

Methodology
The review papers and web articles published from 2002 to 2019 were reviewed. To search the articles, a number of databases and search engines, including Research gate, Shodhganga, Krishikosh, Google scholar, Sci hub were used. The references given in the published review

papers were also reviewed to recognize papers that are more relevant. Searches were conducted with the key terms like millets, millet products, consumer awareness, satisfaction and health benefits.

Discussion

Millets are broadly categorized into major and minor millets. Major millets are naked grains i.e. without husk eg: finger, pearl, sorghum etc. Minor millets are husked grains where in husk needs to be removed before consumption eg: kodo, browntop, barnyard, foxtail, proso etc.

Types of Millets: There are nearly 10 types of millets available in the market.

Sorghum millet (Jowar)

It is also called as Great millet, when compared to the major cereals like rice and wheat, jowar contains high proportion of calcium and filled with fiber, iron and protein. Many research studies, expressed that a typical sorghum wax is rich in Policosanols that helps in reducing the cholesterol levels.

Finger millet **(Ragi)**

It is a good source of calcium and iron which helps for bone strengthening and reducing anemia. Finger millet is highly nutritious and is the excellent food for pregnant women, infants and elderly people. Its high calcium content helps in producing sufficient breast milk for lactating women.

Pearl millet **(Bajra)**

It consists of fiber content which helps in reducing the gall stone occurrence. Pearl millet contains high amounts of magnesium that plays a major role in reducing the respiratory problems and also helps to reduce the effect of migraine.

Kodo millet (Arikelu)

It is one of the traditional foods that resembles the rice. It is easily digestible, rich in photochemical and helps to loose weight. To prevent different lifestyle related diseases, the antioxidant content in kodo millet is essential. Kodo millet has a key role in reducing the joint pain and also helps in regularizing the menstruation in woman.

Proso millet (Variga)

Pellagra is a skin disease which causes the skin to become dry, scaly and is caused due to the lack of niacin. Proso millet is rich in vitamin B3 (niacin) and protein content.

Foxtail millet **(Korra)**

On consuming the foxtail millet, the occurrence of diabetes is reduced. It helps in balanced release of glucose without affecting the body metabolism of human and due to good source of magnesium it is known as healthy heart food.

Barnyard millet **(Sanwa)**

This nutrient dense millet has high fiber content, which can effectively help in losing weight. It is a rich source of calcium and phosphorous, which helps in bone building and its daily consumption helps infighting bone diseases.

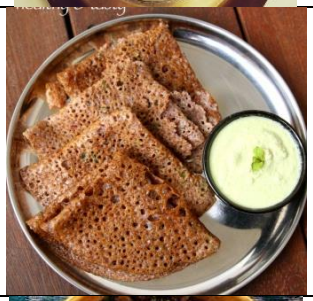
Little Millet **(Sama)**
It might be called as little but it is not less in its nutritional content. It is highly nutritious and has high amount of B – vitamin, minerals like calcium, iron, zinc, potassium among others. It contains essential fats and fiber content that help in weight loss.

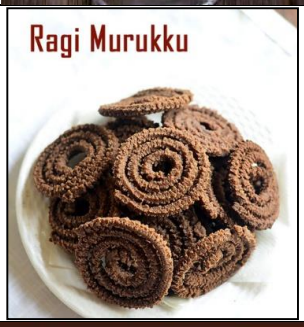
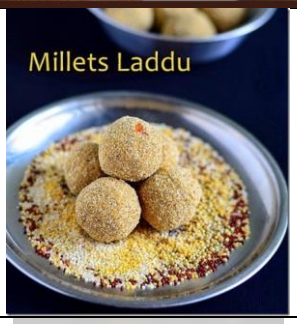
Browntop millet (**Andu korralu)**
They are Rich in protein, fiber, minerals and vitamins. Reported to be useful in thyroid, arthritis, obesity and high Blood pressure.

Buckwheat **(kuttu)**
It is naturally gluten free and should therefore be safe to eat for those with celiac disease and gluten sensitivities. It is rich in protein and fiber. It is rich in many trace minerals, including manganese, magnesium and copper and is a good source of the B vitamins.

Millet Recipes
By using either whole millets or processed millets in the form of flour/ extruded products, various recipes are being prepared. Since millets are healthy, nutritious and tasty, the millet recipes are chosen for breakfast, snacks, dinner and only few preferred for lunch. Tasty, nutritious and most frequently consuming millet recipes are mentioned below…

Pattern Of Consumption	Name Of the Recipe	Picture
Breakfast /dinner	***Baked ragi chakli***	
	Millet idly	

	Millet Pongal	
	Millet curd rice	
	Jowar roti	
	Jowar medley	
	Foxtail millet porridge	
	Ragi wheat dosa	
	Millet upma	

Lunch	***Ragi sankati***	
	Pudina millet pongal	
Snacks	***Bajra tartlets with fruit custard***	
	Ragi muruku	
	Ragi cakes	
	Multi-millet laddu	
	Millet energy bars	

	Ragi soup	
	Kodo millet burgur	
	Ragi cookies	
	Mixed millet bhel puri	

Online market survey on frequently consuming millet products: Online market survey was done to identify the various millet products prepared under various brand names. Mainly flour, noodles and flakes are available along with ready to eat foods like cookies, energy bars and laddus. But several local vendors are preparing unbranded products like murukku, chudwa, namak para, sakkar para etc. Among the branded products Lippia is in the top position.

Millet products	Brands	Quantity	Price	Rating
Cookies	Grandmaa millets	200g	248/-	4.8
	Tots and moms	450g (pack of 3)	499/-	4.5
	Flat Tummies	600g (pack of 10)	450/-	4.3
Laddu	Suruchi millet laddu	250g	350/-	4
	Lippia mixed millet laddu	0.15kg	180/-	5
	B&B organics	1kg	300/-	4.4
	Value life	490g	170/-	5
Flakes	Soulful	180g (pack of 3)	100/-	4.6
	Trunaturals	1.35kg	500/-	4
Energy bars	Yoga bar	380g (pack of 10)	400/-	4.4
	Mindful snack bar	Pack of 12 bars	408/-	4.2
Noodles	Nalabagam barley Hakka noodles	180g x 3	300/-	4.6
	B&B organics barnyard millet noodles	180g	182/-	4.5
	Somemore multi millet instant noodles	195g	99/-	4.2
Flour	Aashirvaad multi mix flour	500gm	75/-	5
	Eat Millet	1000gm	70/-	5
	Manna Millets	2500gm (pack of 5)	380/-	4.6

Millet products -Top Rating Brands

Brands	Rating
Lippia	5
Trunaturals	4.8
Nature's trunk	4.6
Saaral	4.5
B&B organics	4.4
Value life	4.3
MilTop	4.2

Research studies related to consumer awareness & its health benefits regarding millets were presented under the following headings.

Consumer Awareness

Consumer awareness is more due to social media and peer group. Millet contains essential amino acids, fatty acids and dietary fiber thus its Health benefits were the most influencing factors for buying millet based products. The production of biscuits, beverages, weaning foods, beer and confectionery uses mostly millets as an industrial raw material. Due to high protein and fiber content kodo millet is highly consumed. The barnyard millet cookies were highly acceptable with pleasant aroma, excellent taste and crisp

texture. Millets available at a lower cost but giving higher nutritional benefits thus called as miracle grains. They are simply digestible, least allergic and is the most excellent food for gluten sensitive patients.

Millet provides many health benefits, reduces the risk of heart diseases, help from diabetes, fighting against cancer, several degenerative diseases like metabolic syndrome. It plays a major role in the hunger satisfaction and also helps in satiety thereby reducing the risk of development of obesity. It improves the muscular, neurological, digestive and respiratory system. Millet contains high amount of nutrients such as starch resistant, lipids, oligosaccharides, antioxidants such as phenolic acids, flavonoids which are responsible for number of health benefits. Sorghum has unique physical characteristics as rich in dietary fiber that helps in adding bulk to the diet, water holding and absorption capacity, which determines the subsequent physiological behavior.

Basavaraj *et al* (2010) [8] conducted a study on the availability and utilization of pearl millet production. Findings revealed that the value of pearl millet usage and production was improved especially in alternative uses in agricultural and allied industries.

Varnashree *et al* (2008) [32] conducted a study by preparing idlis using ragi flour. Black gram dhal flour and parboiled rice are also used along with ragi flour in different ratios. In the preparation of idli, rice can be replaced with ragi without effecting on the quality parameters thereby improves the nutritional quality.

Alekhya and Shravanthi (2019) [3] explored on consumer buying behaviour towards food products made from millets. Findings of the study revealed that income and consumption of millet was not correlated. Consumers were aware through magazines and television (2%), newspapers (7%), peer group (35%), and social media (55%). Most influencing factors for buying millet based foods were health benefits (57%), taste (26%), to lose weight (13%) and 4% - preferred by habituation.

Kalaiselvi *et al.* (2016) [15] explored on the awareness and consumption of millets by woman in Coimbatore city. Rank was given for consumption and awareness as 1 - Nutritional value, 2 - Consumption pattern, 3 - Best food for diabetics, 4 - Price, 5 - Convenience factor, 6 – Taste, 7 - Weight reduction. It concludes that the awareness of millets is associated with age and education of the respondents.

Millet is a minor cereal possessing high nutritional value, highly palatable and the grains were used for traditional and for novel foods but its consumption level is limited mainly due to lack of cooking knowledge regarding millet products. Processing of millet increases its nutritional quality and economic value (Devi and Sangeetha, 2013) [11].

Barnyard millet cookies with light and crisp texture, pleasant aroma and excellent taste were highly acceptable (Ballolli *et al*., 2001). Millets are non-glutinous and non-acid forming with more nutritious benefits and also easy to digest (Nazni and Bhuvaneswari, 2015) [20].

Advancement in science and technology has paved the way in upsurge of food industry. Foods which are partially cooked that can be utilized in a very easy and convenient form within a short duration are known as Ready-To-Cook (RTC) foods (Takhellambam *et al.*, 2015) [29].

Awareness remains one of the most important factors in this revival. The queries tend to increase in regions where millets are not part of the staple diet or their consumption has been minimized over the years. In Southern Karnataka, 100% of the rural population and 94% of the urban population consumes finger millet as a traditional food called mudde or thick porridge as mentioned by Sehgal and Kawatra (2002) [25].

Rajput *et al.* (2019) [22] conducted a study on consumer acceptance regarding millet based products. To achieve nutritional consumption of food and also to fight against health complications of this generation, different attributes influencing consumer buying behavior towards millet products were identified and for school children novel foods were developed from millets. The results revealed that, more acceptancy by students were malted drink of kodo millet and teachers preferred mostly sweet balls of puffed millets.

Barratry and Rajapushpam (2018) [7] carried out a research in Salem district regarding perception level of millet products which revealed that finger millet foods was highly consumed by the households.

Consumer satisfaction

Mathew *et al*. (2017) studied about the products made out of refined proso millet flour. By using refined proso millet flour (0%, 25%, 75%, and 100%) in varying amounts, biscuits and extruded snacks were developed. For 8 products i.e. 4 types of biscuits and extruded snacks types, sensory analysis was done in 2 separate tests (for biscuits and snacks). The results indicated that as the incorporation of millet flour amount in extruded snacks and biscuits was increased the liking of flavor, texture and overall acceptability had decreased.

Using optimized flours of red, white sorghum and pearl millet, breakfast items were developed as instant cereals. Findings of the study revealed that they are highly accepted by the consumers as it contains more nutritional attributes in comparison to other similar products available in the market (Akoth *et al* 2012) [2].

Kalidas and Mahendran (2017) [16] had done a research on consumer buying behavior towards instant millet – based products. Results shown that 81.33% were Satisfied, 9% - Highly satisfied, 2.67% - Dissatisfied, 6.67% - Neutral and 58.67% have suggested to reduce the price.

Shirisha (2018) [26] studied on pattern of consumption regarding millets and millet based products. Research was conducted in Guntur city. Results of the study showed that 70% were consuming millets, 30% were not consuming and 92% were aware of millets

Health Benefits

Millets are easy to digest as they contain a high amount of lecithin, which provides excellent support for nervous system health by helping to restore nerve cell function, regenerate myelin fiber, and intensify brain cell metabolism. Millets contains high amounts of micronutrients such as folic acid B-complex vitamins, niacin and Vitamin B6 (Pathak, 2013; Habiyaremye *et al*., 2017) [14].

Mostly millets offer many nutritional health benefits in daily diet and also helps in the management of disorders like obesity, hyperlipidemia, diabetes mellitus, etc. (Veena, 2003) [33]. The findings of the research indicate that sorghum was used as food ingredients or dietary supplements. Sorghum was significantly used to manage cholesterol levels in humans (Carr *et al*., 2005) [9].

In comparison to major cereals such as wheat and rice, millets are the key source of energy, protein, and contain high nutritive value (Habiyaremye *et al*., 2017; Amadou *et al*., 2013) [14, 4]. Due to the presence of high calcium, iron,

potassium, magnesium, phosphorous, zinc, dietary fiber, polyphones, and protein content millets are most unique among the cereals (Habiyaremye *et al*., 2017; Gupta *et al*., 2014) [14, 13]. Millets are gluten-free, ideal for gluten-intolerant people, though millet flour cannot be used for raised bread (Amadou *et al*., 2013; Santra, 2015) [4, 24].

Saleh *et al.* (2013) [23] worked on millet grains – processing, nutritional quality and its potential health benefits. Processed food enhances bioavailability of micronutrients. Findings of the study revealed that they contain many health promoting components and are highly nutritious.

Usually postmenopausal women suffer from signs of cardiovascular disease, like high cholesterol levels, high blood pressure. Hence, consumption of kodo millet in their daily diet is extremely beneficial to maintain good health (Shahidi and Chandrasekara, 2013).

Gitanjali *et al.* (2004) [12] revealed that malted ragi flour, wheat, cooked rice, dhal, sprouted green gram, and jowar roti to be good sources of phenolics which along with fiber would reduce chronic disease. It was shown that the consumption of these whole grain products mostly increase the average daily antioxidant intake.

Shukla and Srivastava (2011) [27] prepared noodles using finger millet as a main ingredient mainly for diabetic patients. The glycemic Index was significantly lower (45.13) than control noodles (62.59) regarding 30% finger millet incorporated noodles. The results of the study concluded that finger millet flour incorporated noodles to be highly nutritious and have hypoglycemic effect.

Fatma *et al*. (2016) aimed to study about the healthy gluten free biscuits and cake from germinated millet flour (GMF) and rice flour (RF). 100% rice flour was the control sample and was substituted by 25, 50, 75 and 100% germinated millet flour. The results elucidated that the substitution of germinated millet flour (GMF) increased fat, protein, Zn, Fe, Ca phenolic and flavonoid contents in the produced biscuits and cake and decreased their antinutritional factors. Processing millet to prepare ready-to- use and ready-to-eat products would enhance its food and economic value (Ushakumari *et al.*, 2004) [31]

Dayakar Rao *et al*, (2013) states that millet contains gluten free properties thus regular consumption is beneficial for patients suffering with celiac disease. Tryptophan an amino acid present in ragi helps in lowering of appetite and helps in losing weight. Digestion of ragi occurs at a slower rate that helps in keeping away the consumption of excessive calories. Due to more fiber content it slows down the food movement from stomach to the intestine. Pearl millet aids in weight loss. Hence, consumption of millets makes longer duration of food intervals and thus millets have great role in helping to fight against obesity.

5. Conclusion

Now a day's consumers are easily attracted to bakery and fast foods thus facing several complications in health. Thus to recognize the significance of healthy food and to introduce the millets in their regular diet as a healthy - nutritious food, present study has been taken up. Encouraging the consumption of millets is very essential to lessen the problems of consumers i.e. malnutrition. Due to the presence of high amount of nutrients like fiber, protein, calcium and iron, millet foods are providing significant health benefits. Fiber content in millet helps to avoid various metabolic disorders like diabetes, cardiovascular diseases, obesity etc. The superior protein content in millet makes child growth and development in a better way. Calcium content helps in the bone development and reduces risk of bone fractures and millets also contain high-quality iron that helps to get rid of anemia and gluten free nature of millet helps the celiac disease patients and thus, helps in gluten insensitivity.

In fact millets have multiple nutritional benefits, it is necessary to include these prehistoric cherished grains in our regular diet but the majority of the educated people have not even heard about millets and the nutritional benefits of millet. The entire world is facing numerous health challenges because of fiber-less foods. Based on the earlier research studies it is very clear that all the lifestyle diseases can be made to fade away just by inculcating the habit of consuming millets in their regular diet and thus neglecting the refined foods like rice, wheat, processed meats, refined flours, refined oils, and ready to consume foods. Most of the educated people have not even heard about millets and much less understand about the nutritional benefits of millet. To ensure food and nutrition security for our country, it is important to increase the production of these crops and simultaneously revert the control of production, distribution and consumption back to the people. Nutritional benefits of using millets in regular diet helps to overcome the problem of malnutrition among children which could be telecasted through TV, newspapers can broadcast and interpret the significance of this miracle grains. Though several branded products are available, consumers are less aware of them and more over price is little high which is not afforded by lower income group. Thus it can be concluded that people must be aware of millets and its health benefits through attending different exhibitions, awareness programs and media campaigns as use of millet based food products helps to lead a healthy and happy life. When demand is increased, perhaps production also would be increased which in turn leads to drop in prices.

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