Milk Based Finger Millet (Ragi) Porridge: A Functional Food

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ABSTRACT

Traditional weaning foods for infant-feeding practised in countries like India, are usually cereal based. Cereals including finger millet (Eleusine Coracana) in combination with milk solids are generally used for the preparation of porridge. This review attempts to explore the utilization of finger millet for the preparation of different cereal foods mainly porridges using different processing methods and simultaneously it focuses on the nutritional features and plausible health benefits of ragi. With the changes in scenario of utilization pattern of processed products and awareness of the consumers about the health benefits, finger millet has gained importance because of its functional components. Hence to enjoy the benefits of the functional constituents of ragi and milk, it is imperative to identify the judicial combination of both of these components through appropriate research.

Key words: Finger millet, processing, milk, porridge.

INTRODUCTION

Milk is the sole source of nutrients for most young mammals for lengths of time and it serves the broad functions for both young and old for growth, reproduction, energy supply, maintenance and repair of body tissues and appetite satisfaction. To fulfill these functions, it contains various nutrients namely lipids, proteins, carbohydrates, minerals, vitamins and water. Several investigations have shown that lactose in milk promotes the utilization of calcium, magnesium and phosphorus.

In modern era consumers are very much aware about their health. So the demand of functional foods is increasing day by day at a global level. Milk has always been a choice of innovation for food researchers to meet the ever changing consumer’s preferences for newness in the products. Moreover, milk is consumed by people of all ages. It can act as potent carrier for the value added products which add functional attributes and favors the consumers well being, but it is a poor source of iron and zinc (Jensen, 1995) and their deficiency lead to severe consequences, with great impact on health.

Ragi (Finger Millet) (Eleusine coracana) is one of the important cereals occupies highest area under cultivation among the small millets and it is a good source of iron (Tatala et al., 2007), magnesium (Guigliano, 2011) and dietary fiber (Devi et al., 2014). Ragi has also gained importance because of its functional components, such as slowly digestible starch and resistant starch (Wadikar et al., 2007). It is a humble grain with low glycemic index which makes it more suitable for diabetic patients (Pradhan et al., 2010). Processing ragi using traditional as well as modern techniques for the development of value added and convenient food products would be the possible solution for its promotion and enhancement of consumption, nutritional status and thereby increasing profitability and better livelihood to the tribal community. There are various benefits of malting of ragi such as vitamin-C is elaborated, phosphorus availability is increased and lysine and tryptophan are synthesized (Desai et al., 2010). Their exploitation for preparation of ready-to-use or ready-to-cook products would help in increasing the consumption of millets. Traditionally ragi is processed either by malting or fermentation. The malted and fermented ragi flour are extensively used in preparation of weaning food, instant mixes, beverages and pharmaceutical products (Rao and Muralikrishna, 2001).

Ragi porridge serves as an ideal low calorie diet for all age groups especially growing infants and pregnant women. Ragi has some of the inherent qualities, which makes it superior compare to other cereals and also qualify for malting and preparation of malted foods. It is resistant to fungal infection; elaboration of alpha and beta amylase takes place during germination and during roasting/kilning, a desirable aroma is developed, which makes it an ideal grain for malt foods. Keeping in view the above mentioned facts, this review has been presented here to attract the attention of future workers for development of novel technology to prepare ready to serve milk based ragi porridge for commercial exploitation to the entrepreneurs and industry.

DEVELOPMENT OF DIFFERENT PORRIDGES

Different processing techniques have been developed for preparation of milk based cereal porridges by various workers. Han et al. (2011) developed milk porridge (Tarakjuk) sterilized with radiation technology and reported that 5 kGy gamma irradiation could be beneficial for preparing food with higher nutrient density and lower viscosity, especially for gastric tube-fed patients. Yadav et al. (2014) optimized pearl millet grits size for the preparation of acceptable porridge with skimmed milk powder (SMP) and they suggested that 0.841 mm size of grits of pearl millet with 15 % SMP was found optimum for preparation of acceptable porridge.

In ancient India, finger millet cooked in milk was served with honey to poets (Achaya, 1992). The pinkish flour from red finger millet was eaten as a ball or gruel, either sweetened or salted. Finger millet was also popular as weaning foods (Achaya, 2009)
Finger millets (Ragi grains) were used by Subastri et al. (2015) to evaluate the nutrients profile of a traditional porridge (Koozh). They studied the effects of germination and fermentation on macro and micro nutritional quality of Koozh and concluded that koozh prepared from germinated and non-fermented contains higher level of carbohydrate, protein and glycogen; however germinated and fermented Koozh has increased amino acids, phytochemicals and free radical scavenging activity.

Mbithi-Mwikya et al. (2002) developed a Ragi based complementary food incorporating Kidney beans (Phaseolus vulgaris), Peanuts (Arachis hypogoea) and Mango (Mangifera indica) for children of weaning age. The germination, autoclaving and lactic acid fermentation of Ragi and Kidney beans gave better results. They recommended a 33% (w/v) pap (soft diet) made from this mix having an energy density of 5.4 kJ/g of pap, which is sufficient to meet the energy requirements of well-nourished children of 6-24 months of age at three servings a day with average breast-feeding frequency. Malleshi and Desikachar (1982) formulated a weaning food with low hot paste viscosity based on malted Ragi and green gram (Phaseolus radiatus). Various workers (Malleshi, 2007; Shobana et al., 2013; Verma and Patel, 2013) further improved the nutritional and technological features of Ragi porridges for value addition.

NUTRITIONAL FEATURES OF RAGI

Mahadevappa and Raina (1978) worked on lipid profile and fatty acid composition of 7 varieties of Ragi and reported that Ragi normally contained 1.85-2.10% total lipids out of which constituted 70-72% neutral lipids, 10-12% glycolipids and 5-6% phospholipids. Wankhede et al. (1979) reported about 0.46% to 0.69% free sugars and 56 to 61% starch based on the whole millet grains. Some workers (Ravindran, 1991; Sripriya et al., 1997) reported that Ragi has a carbohydrate content of 81.5%, protein 9.8%, crude fiber 4.3% and mineral 2.7%. They concluded that its crude fiber (4.3%) and mineral (2.7%) contents were significantly higher than those of wheat (1.2% fiber and 1.5% minerals) and rice (0.2% fiber, 0.6% minerals). The proteins in Ragi are relatively better balanced as it contains more lysine, threonine, and valine than other millets.

Various workers (Malleshi, 2007; Shobana et al., 2013; Verma and Patel, 2013) reported that among all the cereals and millets, Ragi has the highest amount of calcium (344 mg %) and potassium (408 mg %). It has higher dietary fiber, minerals, and sulfur containing amino acids compared to white rice. Ragi is comparable to rice with regard to protein (6-8%) and fat (1-2%) and is superior to rice and wheat with respect to mineral and micronutrient contents.

HEALTH BENEFITS OF RAGI

Antioxidant:

Sripriya et al. (1996) reported that DPPH radical quenching with 50 μl of the extracts brown Ragi quenched 94% whereas the white Ragi quenched only 4%. Hegde et al. (2005) reported that significant increase in protein and collagen and decrease in lipid peroxides occurred when aqueous paste of finger millet flour was applied topically on the excision wound (rat model) once daily for 16 days. Rajasekaran et al. (2004) reported that Ragi feeding improved the antioxidant status on skin which hastened the dermal wound healing process.

Antibacterial:

Varsha et al. (2009) evaluated the antioxidant and antimicrobial properties of Ragi polyphenols and their results indicated that potential exists to utilize Ragi seed coat as an alternative natural antioxidant and food preservative.

Ilango and Antony (2014) assessed the microbiological quality of koozh, a fermented millet beverage. Koozh is a fermented beverage made with millet flour and rice. Six street vended samples were assessed for the total bacterial count (TBC), lactic acid bacteria (LAB) count, yeast-mould count (YMC), coliforms at 35°C and pathogens. Although no Staphylococcus sp. and Listeria sp. were found, high colony counts of Clostridia sp., Salmonella sp. and Shigella sp. were present in some samples. The LAB was dominant as compared to TBC, YMC and coliforms.

Anti-diabetic:

The phenolic content of brown Ragi was 96% higher than the white variety. Consumption of Ragi based diets resulted in significantly lower plasma glucose levels, mean peak rise, and area under curve which might have been due to the higher fiber content of Ragi compared to rice and wheat. Millets helps to lower blood glucose levels and improves insulin response (Lakshmi and Sumathi, 2002). Pradhan et al. (2010) reported that ragi is a humble grain with low glycemic index which makes it more suitable for diabetic patients. They worked upon the dietary management of Ragi on controlling diabetes. The effect of replacing regular wheat chapatti with multigrain chapatti (Ragi and wheat in 30:70) on the blood glucose level of 13 diabetics living in different rural and urban locations in India was investigated. All subjects who consumed the multigrain chapatti had a considerable decrease of blood glucose level.

Shobana et al. (2010) reported the blood glucose lowering, cholesterol lowering, nephro-protective properties of Ragi. Chethan (2008) worked upon the extraction of seed polyphenols from Ragi and their nutraceutical potential and reported that the millet polyphenols inhibit the millet malt amylases and aldose reductase from cataract human eye lenses.

Rajasekaran et al. (2004) concluded that in hyperglycemic rats fed with Ragi diet, the healing process was hastened with an increased rate of wound contraction. However, Finger millet feeding to the diabetic animals controlled the glucose levels which hastened the dermal wound healing process. Whole grains like millet may have health promoting effects equal to or even in higher amount than fruits and vegetables and have a protective effect against insulin resistance, heart diseases, diabetes, ischemic stroke, obesity, breast cancer, childhood asthma and premature death (Cade et al., 2007).

Source of Minerals:
Srivastava and Sharma (2012) said that Ragi is not only a rich source of calcium but contains also other micronutrients essential for good health. Shashi et al. (2007) reported that phosphorus from millets is an important mineral for energy production and is an essential component of Adenosine Triphosphate (ATP) – the energy store of the body. Incorporation of Ragi beverage at 75% level in children food for six months resulted significantly increase in haemoglobin concentration than in the non-fortified group (Tatala et al., 2007).

Guigliano (2011) reported that magnesium from millets not only help to reduce the severity of asthma and migraine attacks, but also helps to reduce high blood pressure, diabetic heart disease, atherosclerosis and heart attack. Nicacin is been used since ages to reduce high cholesterol levels in the body. It also forms an essential part of nervous system and cell membranes. A cooked cup of millet provides 26.4% daily value for magnesium and 24% daily value for phosphorus. Magnesium from millets also helps to relax blood vessels, enhances nutrient delivery by improving the blood flow and maintains the blood pressure and thus further protects the cardiovascular system. They also reported that lignin present in millets is converted to mammalian lignans by the healthy gut micro flora in our body which is thought to protect against breast cancer as well as heart diseases. The insoluble fiber from millets helps in gallstones prevention. A study proved that including insoluble fiber in diet lowers the risk of getting gallstones by 17% compared to women whose diet lack in fiber. This gallstones protection from fiber is dose related, with every 5g increase in insoluble fiber the risk drops by 10%.

Truswell (2002) and Gupta et al. (2012) also reported that in addition to their nutritive value, several potential health benefits such as preventing cancer and cardiovascular diseases, reducing tumor incidence, lowering blood pressure, risk of heart disease, cholesterol and rate of fat absorption, delaying gastric emptying, and supplying gastrointestinal bulk have been reported for millets.

Devi et al. (2014) concluded that the dietary fiber and polyphenols in Ragi are known to offer several health benefits such as antiglycemic, antioxidant, hypcholesterolaemic, antimicrobial effects and protection from diet related chronic diseases. The millet polyphenols is a complex mixture of benzoic acid and cinnamic acid derivatives and exhibit enzyme inhibitory and anti-cataractogenic activities also. The non starch polysaccharides of the millet form bulk of its dietary fiber constituents and offer several health benefits including delayed nutrient absorption, increased faecal bulk and lowering of blood lipids. Regular consumption of Ragi as a food helps in managing diabetes and prevention of dyslipidaemia.

CONCLUSION

Processing ragi using traditional as well as contemporary methods for preparation of convenience products like porridges would certainly diversify their food uses. The modern trend for development of new food products aspires for complementary foods in order to fulfill the widening gap of food availability and nutritional security. Innovation in the production of value added dairy products offers a valuable growth opportunity for the food and beverage industries. The synergy between milk and ragi to develop porridge can prove vital not only for taste and delight of eating but also for high nutritional quality and health benefits for children and old age people.

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