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SCOPE OF MILLET GRAINS AS AN EXTENDER IN MEAT PRODUCTS

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ABSTRACT

India stood first for millet production in the world and plays a significant role in meat production and consumption too. To meet up the demand of health conscious consumers for healthy and nutritious meat food item, the incorporation of millet grains and its byproducts to the meat products by the processors can serve the purpose. The multidimensional positive nutritional and functional characteristics millet grain not only improve the acceptability of the meat products but also increase its own demand as a main coarse food grain in competition to the wheat and rice over the world.

Key words: millet grain, meat products, extender, products characters

INTRODUCTION

Millets are the most drought-tolerant grain crops and require little input for its production and are often considered to be "poor man's cereal". It has a tiny, pale, yellow seed with a nutty flavor which lends itself well to being cooked and eaten whole.With gradually increasing human population, millets are acquiring a status in the diet of health conscious consumers. This is the vital food crop for millions of people in parts of Africa and Asia. They are an underutilized food resource in most developed countries, and it has considerable potential to be used as human food and beverage source. In India, minor millets are still the staple to large section of people in the semi-arid region.

In developing countries, the commercial processing of these locally grown grains into value added food and beverage products is an important driver for economic development. Particularly in the developed countries, there is a growing demand for gluten-free foods and beverages for people with coeliac disease and other intolerances to wheat, who cannot eat products from wheat, barley or rye, to those millet has been established as the substitute. Millet grains can contain substantial levels of a wide range of phenolic compounds and contribute to an antioxidant supplements. The health promoting properties of millets, in particular their antioxidant activity is used as nutraceutical and its utilization in functional foods is well established (Dykes and Rooney, 2006).

Meat is the most accepted nonvegetarian food item for its nutritional character. Due to the changing socio-economic condition of the country, consumers prefer the nutritious, cheap, healthy and convenient meat food items. To meet up this requirement, meat is being added preferably with healthy, functional vegetative ingredients by meat processors. These types of

extended meat products are very popular among consumers. The popularity of extended meat products also attributed the economic reasons, as the cost of production can be reduced to a good extent. The nutritional and functional quality of the traditional meat products can be improved easily through the development of various meat based products as per the consumer demand. Planning for the extended products by utilizing locally available agricultural produce and their valuable byproducts in the formulation of value added meat based cuisines is the present trend. The extended meat products provide a mixture of plant and animal based proteins and other essential food components to the consumers, which are desirable from nutrition point of view, and it also satisfies the consumer's desire for meat particularly when they cannot afford the costly meat as such. It can prove to be an effective way to utilize agriculture produce.

Various food items viz., cakes, cookies, pasta and snack foods have been successfully produced by adding millets. The incorporation of millets to food items has increased the possibilities of millets to be used as an extender in meat products too. Since the production of millet grains in India is measured to be very high and it is not considered as privileged food grains as wheat or rice, it can be one of the preferred grains to be effectively utilized in meat products development. The functional character tagged with low cost grain also promotes its effective exploitation. The compatibility of millets flour as a meat extender is yet to be fully explored (Modi and Prakash, 2008).

Gluten free food grain

Traditionally the meat processors use some vegetative extenders like refined wheat flour, barley etc. which are high in gluten protein. Approximately 1 to 2% of adults and nearly 5% of infants and young children are afflicted with food allergies (Kagan, 2003). One of the most

important allergen source is wheat containing the “gluten” world over. A gluten-free diet entails the exclusion of grains such as wheat, barley and rye. The only available treatment for coeliac disease is the strict, lifelong avoidance of gluten. When gluten is removed from the diet, the small intestine will start to heal and overall health should improve. The most important traditional substitutes for gluten-containing grains have been millet, flax seed etc. (Kupper, 2005). Therefore, the utilization of millets grain instead of wheat and other gluten containing grains should be promoted, as they are suitable for coeliacs. The production cost of this grain is also very less along with very good nutritional and functional characters which add extra worth to the food products containing this grain. Therefore, the use of such ingredients like millet as extender cum binder which has no allergic properties can really be boon for the processed meat industry.

Functional benefit of Millets

Excellent source of natural antioxidants

Meat contains high amount of polyunsaturated fatty acids which accelerates oxidative process in meat products. The use of natural antioxidants in meat products can prevent lipid oxidation and therefore quality of products can be retained longer period. In various studies, it has been found that millets contain a good proportion of phenolics and act as natural antioxidants by different mechanisms, including free radical scavenging, acting as reducing agents and as chelators of transition metal ions. The antioxidant activity of millet phenolics has been demonstrated in foods and biological systems.

During the refrigerated storage of meat products, lipid oxidation causes quality degradation of meat flavor, color, texture and nutritional values. The incorporation of

antioxidants enriched millets grains in products can increase the shelf life of the products many fold by scavenging the oxidizing free radicals molecule (Chandrasekara and Shahidi, 2011).

A significant source of dietary fiber

The meat is devoid of dietary fiber which is essential for normal physiological function of our body. Dietary fiber intake through meat substituted with fruits, vegetables and certain grains is associated with reductions in plasma LDL-cholesterol, reduce the risk of major diet related problems such as obesity, coronary diseases, diabetes, gastrointestinal disorders including constipation, inflammatory bowel diseases etc. Besides health benefit effects, dietary fiber supplementation increases the bulk and prevent cooking loss in meat products with no or fewer changes in textural parameters by enhancing water binding capabilities and offers great economical advantages for both the consumers and processors (Grigelmo-Miguel et al., 1999).

Millet is one of the excellent sources of the dietary fibers (DFs) and its bran contributes the maximum. The dietary fiber content of millet bran is about 73.18g/100g total dietary fiber, 65.55g/100g insoluble and 7.63g/100g soluble dietary fiber, respectively. The dietary fiber exhibit an excellent binding ability to the cholesterol at pH 7. Therefore, the use of millet grain or its byproducts such as bran in processed meat products can fulfill the requirement of dietary fiber in human body (Liu et al., 2011).

Millets provide resistant starch

Resistant starch refers to any starch that escapes digestion in small intestine and reported to exhibit a wide range of health benefits such as lowering caloric density, low glycemic response and acts as a fecal bulking agent (Ranhotra *et al.,* 1991). Minor millets with their low carbohydrate content, low digestibility and water soluble gum content (Beta-glucan) have been

attributed to improve glucose metabolism. These grains release sugar slowly in the blood and also diminish the glucose absorption. The dietary fiber and resistant starch of minor millets have been attributed to exhibit hypoglycemic and hypolipidemic effects (Pathak and Srivastava, 1998). It has also been found that the dietary resistant starch opposes the mutagenic effects of dietary processed red meat (Winter et al, 2011), therefore the incorporation of resistant starch in form of millet in the meat products can reduce the chance of carcinogenesis, calorific value of the products and its efficacy as fecal bulking agent helps in easy purgation.

Nutritional benefits of millets

The protein content in millet is very close to that of wheat; both provide about 11% protein by weight. As none of the millets are closely related to wheat, they are appropriate foods for those with coeliac disease or other forms of allergies/intolerance of wheat.

The main components of millet include starch, protein, lipid, B vitamins (especially niacin, B_6 and folic acid) and minerals (Usha et al., 1996). It was further reported that minerals like, magnesium, manganese and phosphorus were significantly higher amount than the others (Gopalan et al., 1987). Millet in general contains significant quantity of essential amino acids particularly the sulphur containing amino acids like methionine and cysteine. It contains 12.3% crude protein and 3.3% minerals specially high amount of calcium, iron, zinc, copper and manganese (Vithal and Machewad, 2006). Dried grains contain approximately 12.4% water, 11.6% protein, 5% fat, 67.1% carbohydrate, 1.2% fiber and 2.7% ash.

As different millets differ from one another in their appearance, taste, grain quality and morphological behaviour, their biochemical composition is also different in a broad sense. For example, the major storage protein of Foxtail millet is alcohol soluble prolamins, whereas in

Kodo millet and Barnyard millet the alkali soluble glutelin forms the major storage protein as reported by Monterio *et al*. (1988). These variable characters of different millets add variation when added in meat products. Higher level of antioxidants and phytochemicals make it easily and slowly digestible. Hence, it helps to control blood glucose levels in diabetic patients very efficiently. The bulkiness of the fibers and the slower digestion rate makes consumers feel fuller on fewer calories and may help to prevent them from eating excess calories. Millet is considered to be ideal food for diabetic individuals due to its low sugar content and slow release of glucose/sugar in the body (Kang *et al.,* 2008). In the germination process, both starch and protein are partially degraded which is important for better digestibility and some of the flatus factors are also degraded. Fermentation has been found to increase pepsin digestibility of millet protein, decrease the concentration of phytic acid and polyphenols (Mahajan and Chauhan, 1987) with improvement in the availability of minerals.

The varieties of millet are used in most traditional homes in Africa, Europe and Asia, but no comprehensive study has been done to show their similarities, differences and their exact character in food system. Therefore, further studies are required to excavate the whole nutritional benefits and to analyze the amino acid composition, molecular weight distribution of the subunits and their thermal properties for its better and scientific utilization in processed meat products.

Improvement in sensory properties

The sensory attributes of the meat depends upon the ingredients used in it and its character. The unique grainy and gritty texture of the millets in most of the case can impart a different and acceptable texture to the products. The attributes of somewhat similar aroma, firmness increase and those related to characteristics of added millets products and byproducts in

the extended meat products could offer sensory advantage. An overall improvement in the flavor profile of the products added with millets has been reported by Nirmala *et al*. (2000). The juiciness of the millet flour added meat products increase considerably and it is contributed to the water holding capacity by millet flour starch. Pearl millet products have a unique blend of flavor and color, if added to the product formulation, it can impart characteristic flavor and color to the product. The millet flour added products generally possessed darker colour (Vijayakumar et al., 2010).

Storage of millet based food

Good storage quality of processed food is an essential attribute to extend their utilization. Various factors like quality of raw foods, pre-processing methods, composition of food, packaging material, and extent of heat application influence the storage quality. Gopaldas *et al.* (1992) used malted and roasted *ragi* in ready to eat mixes for young children were formulated and the roasted mixes packed and stored in sealed polythene bags were in good condition at room temperature for 28 days.

Various products like *dhokla, upma* and *laddu* mixes with foxtail millet in combination with fenugreek seeds and pulses were found to have an excellent storage quality in terms of organoleptic quality when packed in polythene pouches and stored at ambient conditions for one month (Pathak and Srivastava, 1998). *Foxtail* and *Little* millet based mix suitable for diabetics did not reveal any apparent effects of storage in sensory quality when stored for six months in two different packaging materials. Devaraju *et al.* (2003) developed pasta with *Finger* millet flour (50%), which was well acceptable for a period of 3 months with good sensory attributes. The literature reveals the storability of the products incorporated with millets or its byproducts as

determined by various factors like raw foods, pre-processing techniques, packaging material, storage conditions etc. and every time the suitability of millets to be used in food products has been proved. Thus, the meat processors can utilize millet effectively in meat products to improve the shelf life or storability of the meat products.

Drawbacks and its elimination

The utilization of millets is also limited due to the presence of various anti-nutrients, poor digestibility of proteins, carbohydrates and low palatability. However, various processing technologies are able to alter positively the physico-chemical composition of food grains in order to improve their nutritional value. Such primary processing technologies include malting and fermentation. Application of these easy and cost effective technologies can eliminate the negative aspect tagged with millet grain.

Conclusion

The product friendly functional properties of various millet grains promote its utilization in the processed meat products. The incorporation of millet in the meat products can stabilize the huge demand and supply of healthy, nutritious and economic meat food items. The easy availability and the positive nutritional spectrum of millet can make it the first preference to the food processors. The overall upgradation and promotion of the neglected grains will surely bring a revolutionary change in food processing industry and will satisfy the consumers.

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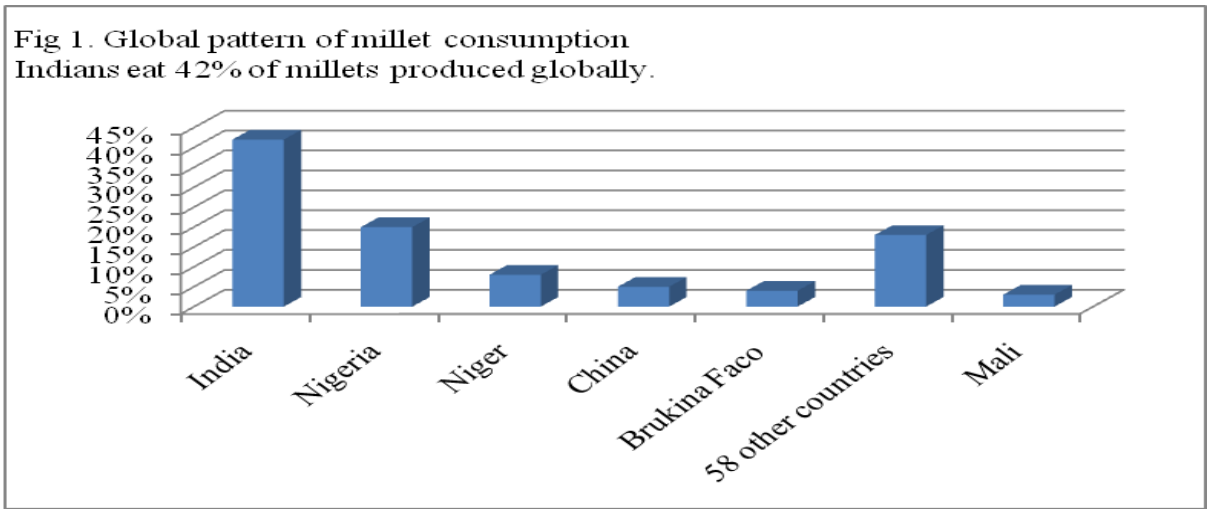
Table 1. Comparison of nutrients (100g-edible portions) of various millet grains and cereals (at 12% moisture)

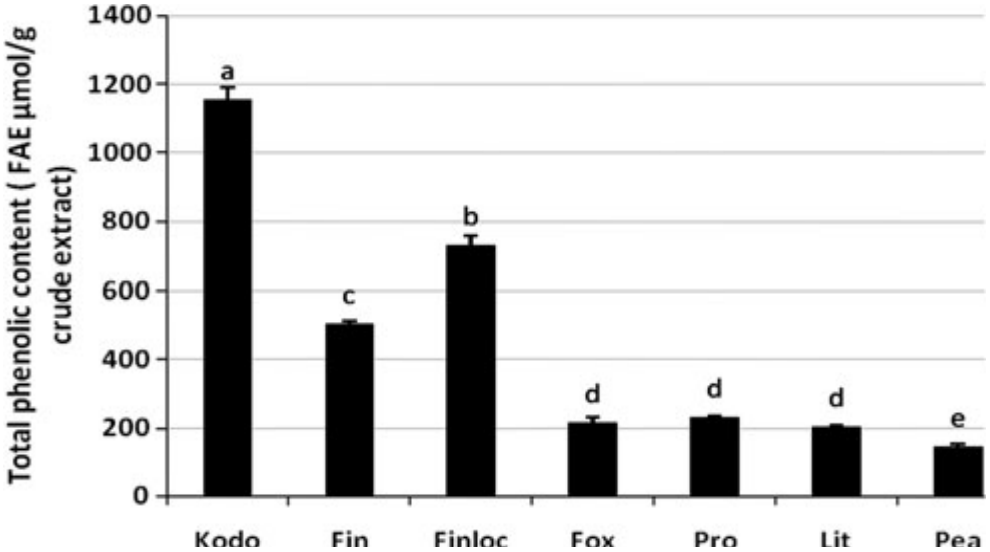
Cereal	Protein (g)	Fat (g)	CHO(g)	Crude Fiber (g)	Minerals/ash (g)	Energy (Kcal)
Pearl millet	11	5	69	2.2	1.9	363
Finger millet	6	1.5	75	3.6	2.6	336
Foxtail millet	9.9	2.5	72	10	3.5	351
Proso millet	10.6	4	70	3.2	1.9	364
Kodo millet	11.5	1.3	74	10.4	2.6	353
Barnyard millet	10.8	4.5	49	14.7	4	----
Wheat	11.6	2.00	71	2	1.6	348
Brown rice	7.9	2.7	76	1	1.3	362
Maize	9.2	4.6	73	2.8	1.2	358

(Source: By Iren Leder, Sorghum and millets, In Cultivated plants, primarily as food source, vol-1)



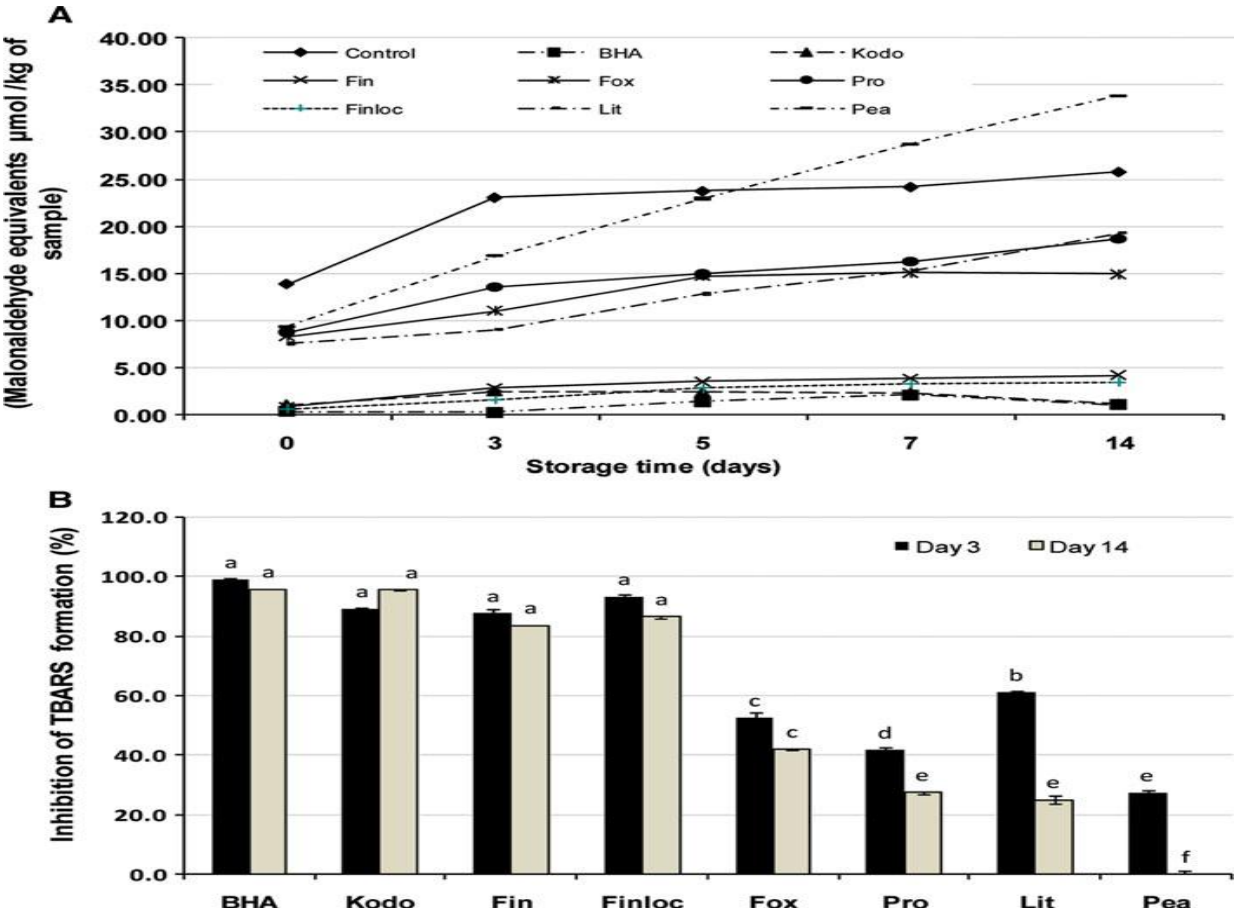
(Source: Millet Network of India - Deccan Development Society - FIAN, India)

Fig 2. Total phenolic content of soluble phenolic extracts of whole millets. *Kodo* kodo, *Fin* finger (Ravi), *Finloc* finger (local), *Fox* foxtail, *Pro* proso, *Lit* little, *Pea* pearl millets. Bars with different letters have significantly different (p\0.05) mean values. The letter 'a' represents the highest value.



(Source: Chandrasekara and Shahidi, 2011)

Fig 3. Effect of millet phenolic extracts on inhibition of linoleic acid oxidation (a) and percentage inhibition of linoleic acid peroxidation at the end of 48 h incubation. FA ferulic acid, BHA butylated hydroxyanisole, Kodo kodo, Fin finger (Ravi), Finloc finger (local), Fox foxtail, Pro proso, Lit little, Pea pearl millets. Bars with different letters have significantly different (p\0.05) mean values. The letter 'a' represents the highest value.



(Source: Chandrasekara and Shahidi, 2011)