Development of breakfast recipes from amaranth grains for pre-schoolars, celiac and osteoporotic subjects

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ABSTRACT: The present investigation was designed to develop amaranth products for per-scholars, celiac and osteoporotic subjects. Puffed amaranth grains were used for sweet product development i.e. *laddoo* and *kheer* and raw amaranth grains were used for salty product development i.e., *upma* and *khichri*. In organoleptic evaluation it was observed that sweet products were liked significantly more than the salty products. However, no significant difference was observed in between amaranth *laddoo* and amaranth *kheer*. Overall acceptability was maximum for amaranth *kheer* followed by amaranth *laddoo*, amaranth *upma* and amaranth *khichri*. Organoletically all the products were found acceptable. Serving size and cooked weight of the developed amaranth product was also recorded. Weight per serving size of *laddoo*, *kheer*, *upma* and *khichri* was 100 g (4 pieces), 255 g (1 bowl), 300 g (1bowl) and 250 g (1 bowl) respectively. Nutrient content of the developed products was also done on the basis of calculation method and it was noted that per serving amaranth *upma* had highest energy content followed by *laddoo*, *kheer* and *khichri*.

Key words: *Amaranthus,* breakfast recipe, children, celiac disease, osteoporosis, sensory evaluation

Amaranth (*Amaranthus cruentus*) grain is a pseudo-cereal which has better nutritional profile than the traditional cereals and is also gluten-free. In India, amaranth is known as *Chaulai* and *Rajgira*. Amaranth was considered major crop by the Pre-Colombian cultures in Latin-America for centuries, as important as maize and beans. (Berghofer and Schoenlechner, 2002; Mota *et al.*, 2016). Amaranth grains share characteristics of both a cereal and a leguminous seed from botanical and nutrient composition point of view as the protein content and the amino acid composition of these grains are somewhere between those of a cereal and a legume. Therefore, it could be considered as a natural mixture of rice and beans nutritionally (Caselato-Sousa and Amaya-Farfán, 2012). Cereals are considered "unbalanced" in terms of amino acid composition because they possess very low amounts of lysine for optimum health. Amaranth protein has nearly twice the lysine content of wheat protein and thrice the content of maize protein. It contains lysine almost as much as found in milk which is considered the standard of nutritional excellence (A.C.T.I., 1984). Amaranth also has high vitamin and mineral contents, such as riboflavin, niacin, ascorbic acid, calcium and magnesium and a low level of anti-nutritional factors (Zapotoczny *et al.*, 2006).

Breakfast is an important meal of the day for providing energy and nutrients. It is recommended that everyone should consume around 15–25% of daily energy intake at breakfast (Spencer, 2017; Betts *et al.*, 2014). The large scale surveys suggest that somewhere 18–25% of adults, and 36% of adolescents in North America skip breakfast meal (Spence, 2017; Kant and Graubard, 2006; Seiga-Riz *et al.*, 1998). Study conducted by Murugalatha and Ramya (2018) on 1000 children (500 – study group and 500 control group) of age 5 -9 years concluded that breakfast with adequate nutrient had positive impact on the nutritional status regardless of age.

Amaranth doesn't have gluten protein hence is best suited for celiac subjects. In addition amaranth is high in fibre, with three times fibre that of wheat. It has more than 20% of the recommended daily amount of calcium, iron, magnesium and folate per 100g. Thus, as a food source amaranth seeds can be best as breakfast cereal and can contribute significantly to a nutritious diet. The present investigation was undertaken with the objective to formulate the food products (snacks and meals) using amaranth seeds as main ingredients to be served at breakfast for one and all with specific reference to pre-school children, celiac patient and osteoporotic subjects. The four recipes prepared from amaranth seeds were namely *laddoo*, *upma*, *kheer* and *khichri*.

MATERIALS AND METHODS

Procurement of raw material: The puffed amaranth seeds and grains of amaranth were procured from local market for product development along with other ingredients.

Standardization of the recipes: Selection of product for development was done on the basis of commonly prepared recipes with soft texture. Among these products, two were sweet i.e. *laddoo* and *kheer* and two products were salty i.e., *upma* and *khichri*.

Recipes formulation: The selected sweet products were formulated by following method:

Amaranth *laddoo:* In 450 ml boiled water 67 g jaggery added and cooked till thread consistency. Puffed amaranth (35 g) was added to jaggery mixture and *laddoo* was prepared.

Amaranth *kheer*: Milk (125 ml) was boiled and puffed amaranth (25 g) was added. It was cooked for some time till mixture became thick and sugar 25 g was added.

Amaranth *upma:* Amaranth seed (80 g) was boiled in water (450 ml) till it tenderized. In hot oil all the chopped vegetables i.e. onion (50 g), potato (100 g), green chilly (1.5 g), was added and cooked it till it became tender. Then, turmeric powder (0.4 g), and salt was added to the above mixture. Garnished with coriander leaves (10g).

Amaranth *khichri*: In fried potato (100g), washed amaranth seeds (50 g), green gram dal (25 g), turmeric powder (0.5 g), salt (1.25 g) and water (375 ml) were added and pressure cooked.

Serving size: Developed products were placed in serving bowls and panellists were asked how much quantity they may like to eat in one serving. Amount taken out by the panellist was averaged to finalize the serving size.

Organoleptic evaluation: Formulated products were evaluated for organoleptic qualities to find out the acceptability of the developed product. Panel of 20 judges was made from semi trained young adults. Sensory evaluation of the developed products was analysed at score card rating scale (Swaminathan, 1987). The parameter studied were colour, taste, flavour, texture and over all acceptability.

Nutrient composition: All the developed amaranth products were assessed for the proximate principle- i.e. moisture, protein, fat, ash, crude fibre, carbohydrate and energy; minerals i.e. calcium and iron on the basis of calculation per serving (IFCT, 2017).

Statistics: Acceptability of products was assessed by using one way ANOVA (score card method)

RESULTS AND DISCUSSION

Serving size: Serving size of the product effects the amount of nutrient content per serving. In present study serving size and cooked weight of the developed amaranth product was also recorded. Weight per serving size of *laddoo*, *kheer*, *upma* and *khichri* was 100g (4 pieces), 255g (1 bowl), 300 g (1bowl) and 250 g (1 bowl) respectively.

Organoleptic evaluation of the developed products:

Organoleptic evaluation of the amaranth products is presented in Table 1. The results depicted that over all acceptability of amaranth *kheer* was significantly higher. However in terms of colour, appearance and taste amaranth *laddoo* was liked significantly more than amaranth *kheer*. This was also noted that the overall acceptability of sweet products i.e. *kheer* and *laddoo* was liked very much and vary significantly than the salty products i.e. *upma* and *khichri*.

The present study deals with 100 per cent amaranth seeds preparation and all the developed products were liked by the panellist. This indicates that these would be highly accepted for celiac patients. Zebdewos *et al*. (2015) formulated porridges with different proportions of amaranth flour and chickpea were acceptable to mothers and their children. Virginia (2014), developed biscuits, *mathri* and *laddoo* by incorporating amaranth and watermelon seeds in different ratio i.e. 1:1, 2:1, and 3:1. The most acceptable combination was 2:1 treatment. Amaranth grains are eaten boiled, roasted, crushed, or ground. It is also used for porridge production, confectionery and pasta production (Bruna *et al.,* 2011). It doesn't give strong taste and flavour hence amaranth is especially suited for mixing with other plant-derived flours (Svirskis, 2003). Amaranth meal, or flour, is especially suitable where it can be used as a sole, or predominant, cereal ingredient (Emire and Arega, 2012).

Table 1: Mean sensory scores of developed products

Products		Characteristics					
		Colour	Appearance	Taste	Texture	After taste	Overall acceptability
Sweet	Amaranth *laddoo*	8.20	8.20	8.60	7.25	8.05	8.25
	Amaranth *Kheer*	8.05	8.05	8.30	8.95	8.20	8.35
Salty	Amaranth *Upma*	7.80	7.95	7.75	7.45	7.65	7.65
	Amaranth *Khichri*	7.60	7.50	7.15	7.4	7.45	7.30
	SEM	0.136	0.181	0.207	0.182	0.191	0.1486
	CD at 5%	0.383	0.511	0.583	0.513	0.538	0.526

Table 2: Nutrient composition of the developed amaranth products (per serving)

Product	Nutrients	Serving size (g)	Moisture (g)	Protein (g)	Fat (g)	CHO (g)	Ash (g)	Crude fibre (g)	Energy (Kcal)
Sweet	Amaranth *laddoo*	100	6.29	5.14	0.7	83.54	1.43	3.2	361.80
	Amaranth *Kheer*	255	103.85	9.08	8.60	46.27	1.8	2.4	325.50
Salty	Amaranth *Upma*	300	134.73	14.80	11.75	68.4	3.64	8.61	440.00
	Amaranth *Khichri*	250	105.03	15.11	1.38	68.35	5.42	3.02	345.68

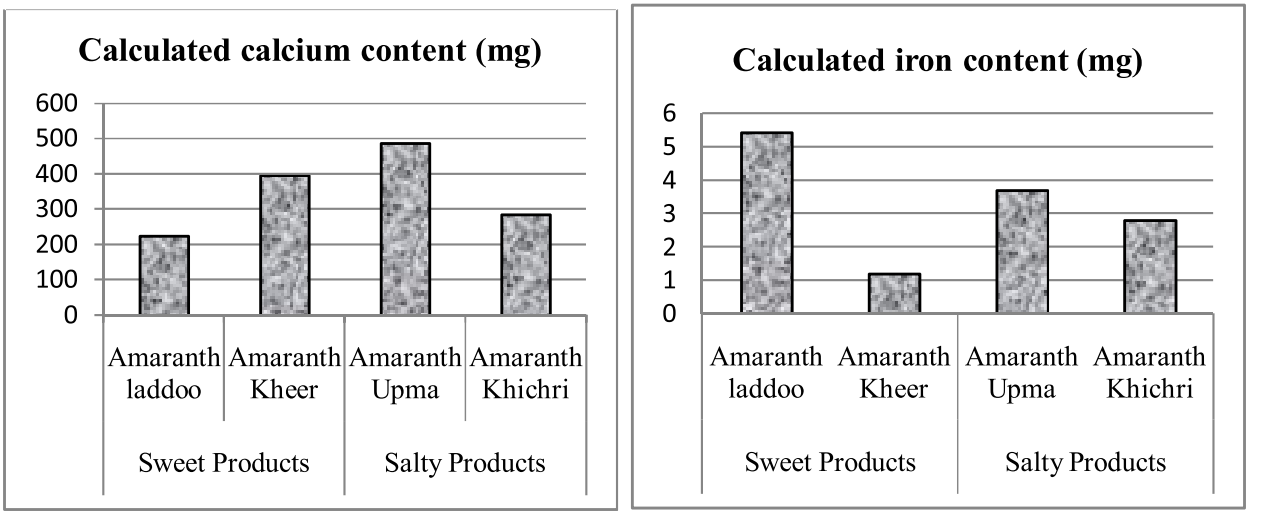

Fig 1: Calcium and iron content in developed products (per serving)

Amaranth is used as weaning ingredient by replacing wheat and rice. It has soft light colour therefore it can be used as weaning food. It was therefore concluded that amaranth seeds can be suitable for making various breakfast recipes and play an important role in making enhanced nutritional parameters and overall product quality.

Nutrient Composition: Proximate composition of developed product was done on the basis of calculation and presented under Table 2. Results revealed that protein content was highest in *khichri* (15.11 g) followed by *upma*, *kheer* and *laddoo*. The energy content was maximum for *upma* i.e. 440.00 Kcal/ serving and minimum in *kheer* i.e. 325.50 Kcal/ serving. Energy content is mostly affected by the amount of fat content in product development.

Mineral composition: Fig. 1 shows the calcium and iron content in the products developed using amaranth. Per serving amaranth *laddoo* contains maximum amount of iron content. However, calcium content was noted maximum in amaranth *upma* followed by amaranth *kheer*, *khichri* and *laddoo*. Zebdewos *et al.* (2015) found that adding amaranth improve the content of iron and decrease phytate levels. The lowest phytate to iron ratio and viscosity measure was observed in the 70: 30 ratio of amaranth and chickpea blend porridge.

Amaranth products are very much accepted for breakfast or snack item due to soft consistency. As it is easily chewable it can also be given to preschool children. Amaranth *kheer* and *khichri* can also be used as weaning food because of high protein and calcium content. In north India wheat is staple and used as breakfast item. In such situation it is difficult to provide satisfactory breakfast to celiac patient. Amaranth *upma* and *kheer* are better with a substitute for wheat as amaranth does not have gluten content. Amaranth *khichri* can also be taken as a major meal by the celiac patient. Osteoporosis is present in over 50 years of age population. One serving of amaranth *kheer* and *upma* can provide 2/3rd of calcium requirement per day of the adult (Nutritional Requirements and Recommended Dietary Allowances For Indians, 2010). Therefore these products are good for subjects suffering from calcium deficiency. Requirement of energy, protein and iron is increased during pregnancy and lactation (Nutritional Requirements and Recommended Dietary Allowances For Indians, 2010). High iron and protein content in amaranth *laddoo* makes it a good snack item for pregnant and lactating women with good acceptability. Therefore the present study concludes that amaranth products are better accepted by the population as breakfast food for various health situations.

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