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Development and quality evaluation of optimized traditional food porridge formulation based on processed amaranth grain

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Abstract
Amaranth is a fast growing crop which can grow under varied soil and agro climatic conditions and is also resistant to heat and drought with no major disease problems. It is a rare plant whose leaves are eaten as vegetable while seeds are eaten as cereal. Because of its similarity with other cereals, it has been considered a pseudo- cereal which can be an alternative rich source of protein and nutrient for poor people in developing countries. This paper reports the sensory characteristics and nutrient composition of two types of porridge prepared from popped amaranth grain i.e sweet and salty porridge. Two levels of popped amaranth grain i.e. 25% (Type-I porridge) and 50% (Type-II) were used. Wheat grain porridge served as control. Sensory evaluation showed that amaranth could be incorporated up to 50% in both sweet and salty porridge. Results indicated that the mean scores of wheat grain (control) porridge were rated as 'liked very much' for all the organoleptic characteristics. The scores of appearance and texture were similar i.e. 7.2 in Type- I porridge whereas the scores for colour, aroma, taste and overall acceptability were 7.30, 7.10 and 7.24, respectively. In Type-II porridge mean scores for colour, appearance, aroma, texture, taste and overall acceptability were 7.10, 6.50, 6.60, 6.70, 6.40 and 6.58, respectively, and fell in the category of 'liked moderately'. It was observed that all types of porridge were acceptable in terms of all sensory characteristics and the scores fell in category of 'liked moderately'. Proximate composition of both types porridge indicated a significant increase in the crude protein content of amaranth incorporated Type I (13.35%) and Type II (14.54%) salty porridge. Similarly, crude fibre content also increased significantly with the increase in level of amaranth grain to wheat grain. A non- significant difference in ash content between control and Type I and significant differences between control and Type I and Type II porridge were observed.

Keywords: Amaranth, grain, protein, proximate, ash, sensory

1. Introduction
Amaranth is a plant with high nutritional value, whose nutrients are concentrated in the leaves and the grains. Amaranth seeds have attracted attention as a human nutritional source because, they contain higher amount of protein with a well balanced amino acid composition as well as minerals, vitamins, and phytochemicals compared to those of major cereals such as wheat and rice (Alvarez *et al.,* 2010) [5]. Amaranth grains contain 48 to 68% starch, 5.6 to10.9% fat, 3.1 to 5.0% dietary fibre and 2.5 to 4.4% ash (Mlakar *et al.,* 2010) [7]. The grains also have high content of calcium, magnesium, iron, potassium and zinc. It is also characterized by higher dietary fibre and lipid content than most cereals and contains between 50 and 60 g of starch per 100 g of grains (Jubete *et al.,* 2010) [5]. In addition to nutritive value, amaranth has various health benefits and medicinal properties including gastric problems, blood purification, regular consumption reduces blood pressure and cholesterol levels and improving antioxidant status. The amaranth grains can be toasted, popped, extruded or milled into flour and can therefore be consumed as such or included in other cereal products such as bread, cakes, muffins, pancakes, cookies, dumplings, noodles and crackers. The optimal nutritive composition of this seed has made its use attractive as a blending food source to improve the nutritional value of some cereal by-products. In Mexico, the popped amaranth confection, 'alegria' is a popular favorite among locals and tourists. The flour or flaked forms are combined with wheat or other flours to make bread, cookies and other baked goods. Amaranth is used to make up only 10-20% of the flour blend, but it can be blended at 50-75% levels and still maintain functional properties and flavour. Coarsely ground amaranth is used to make a tasty and nutritious porridge cooked by itself or mixed with other grains and pseudo cereals such as oats, wheat, milled flax seed.

At present, consumption of alternative crops has attracted much interest as potential recipes for healthy food production and for special dietary uses. The opportunity to supplement or completely replace common cereal grains (corn, rice or wheat) with a higher nutritional value cereal (such as quinoa or amaranth) is becoming increasingly popular among people interested in improving and maintaining their health status by changing dietary habits.

2. Experimental procedure

Amaranth grains were procured in a single lot from the Medicinal Aromatic and Underutilized Plants Section, Department of Genetics and Plant Breeding, College of Agriculture, Chaudhary Charan Singh Haryana Agricultural University, Hisar. For the preparation of porridge other required ingredients were purchased from the local market in a single lot.

Amaranth grains were cleaned and washed under tap water to remove dirt, dust and foreign materials. The washed grains were spread over filter paper sheet and dried completely. After drying, the grains were ground in an electric grinder to fine powder and stored in air tight plastic containers at room temperature for further analysis.

3. Product formulation

Two types of porridge i.e sweet and salty porridge was prepared by varying proportion of popped amaranth grain and split wheat grain as per traditional method. Standardization of levels of amaranth was done in basic recipe of both types of porridge. Two different trails were done at 50 and 75 per cent level and sweet and salty porridge were prepared. Sensory evaluations were carried out by 60 untrained consumers consisting of students and staff of the HAU Campus. They evaluated samples for colour, texture, juiciness, chicken flavour, cornsilk flavour and overall acceptance on a 9 point scale. (Amerine *et al.*, 1965) [1].

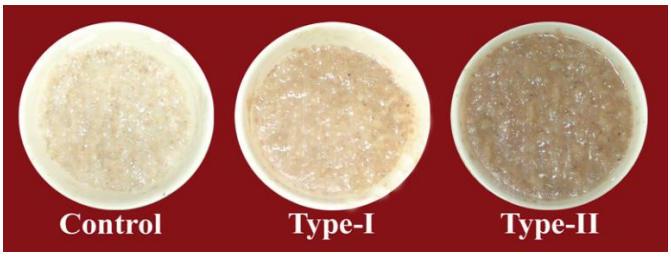

Fig 1: Sweet Porridge

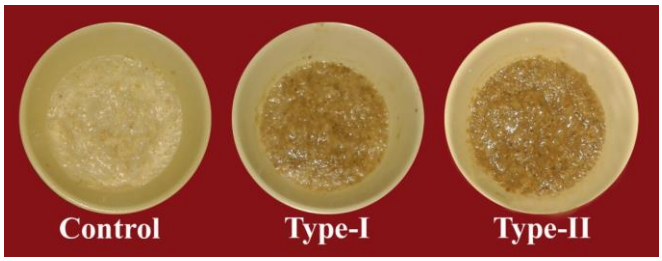

Fig 2: Salty porridge

4. Statistical analysis

The statistical analysis of various data was done by using ANOVA technique to find out the significant differences between control and different level of incorporated amaranth grain.

5. Results and discussion

5.1 Sensory evaluation of products

In Type I salty porridge with the incorporation of 25% of amaranth no difference was observed in the scores of colour, appearance, aroma, texture, taste and overall acceptability. In salty porridge with the incorporation of 50% amaranth, mean scores for colour, appearance, aroma, texture, taste and overall acceptability were 7.00, 7.60, 7.30, 7.30, 7.20 and 7.28, respectively, and were 'liked moderately' by the panelists.

Table 1: Mean scores of sensory characteristics of salty porridge

Product	Sensory characteristics					
	Colour	Appearance	Aroma	Texture	Taste	Overall acceptability
Salty porridge	Scores					
Control (WP:100%)	7.60±0.16	7.65±0.15	7.75±0.20	7.55±0.21	7.65±0.15	7.72±0.14
Type I (WP:AG:75:25)	7.60±0.16	7.70 ±0.15	7.60±0.16	7.60±0.16	7.70±0.21	7.64±0.12
Type II (WP:AG:50:50)	7.00±0.29	7.60±0.26	7.30±0.30	7.30±0.26	7.20±0.35	7.28±0.20

Values are mean ± SE of ten observations.
WP: Wheat Porridge AG= Amaranth Grains

The results showed that the control sweet porridge was 'liked very much' in terms of colour (7.90), appearance (7.90), aroma (8.10), taste (7.60) texture (7.80) and overall acceptability (7.86). The mean scores of organoleptic characteristics of Type-I porridge were in the category of 'liked very much'. The mean scores for colour, appearance, aroma, texture, taste and overall acceptability of Type I porridge were 8.20, 8.40, 8.10, 7.90, 7.90, and 8.12, respectively. In Type II porridge mean scores of colour, appearance, aroma, texture, taste and overall acceptability were 7.50, 8.00, 7.90, 7.80, 7.90 and 7.82. It was found that the sweet porridge prepared with 50% amaranth was as good as that of control in terms of all the sensory characteristics and fell in the category of 'liked very much'

Table 2: Mean scores of sensory characteristics of sweet porridge

Sensory characteristics						
Product	Colour	Appearance	Aroma	Texture	Taste	Overall acceptability
Sweet porridge	Scores					
Control (WP:100%)	7.90±0.18	7.90 ± 0.18	8.10±0.18	7.80±0.35	7.60±0.37	7.86 ±0.20
Type I (WP:AG::75:25)	8.20±0.24	8.40±0.22	8.10±0.23	7.90±0.34	7.90±0.34	8.12±0.22
Type II (WP:AG::50:50)	7.50±0.37	8.00 ±0.14	7.90±0.18	7.80±0.29	7.90±0.27	7.82 ± 0.22

Values are mean ± SE of ten observations
WP: Wheat Porridge AG= Amaranth Grains

5.2 Proximate composition

The protein content of Type I and Type II was significantly higher than that of control porridge. The fat content of wheat porridge was 16.13% and that of Type I and Type II was 17.66 and 18.13%, respectively. Control porridge had significantly lower fat content as compared to Type I and Type II porridge. The wheat porridge contained 1.06% crude fibre and Type I and Type II porridge had 2.40 and 4.16% crude fibre, respectively. Both Type I and Type II porridge differed significantly between themselves as well as from wheat porridge (control) for their fibre content. Both Type I and Type II porridge had significantly higher ash content as compared to control wheat porridge.

Table 3: Proximate composition of salty porridge (% dry weight basis)

Types of salty porridge	Moisture	Crude protein	Fat	Crude fibre	Ash
Control (WP: 100%)	85.08±0.06	11.85±0.01	16.33±0.06	1.06±0.08	4.29±0.01
Type I (WP:AG: 75:25)	84.51±1.02	13.35±0.01	17.66±0.13	2.40±0.05	5.10±0.01
Type II (WP:AG: 50: 50)	85.09±0.03	14.54±0.01	18.13±0.06	4.16±0.06	6.07±0.01
CD (P=0.05)	N.S.	0.05	0.33	0.25	0.06

Values are mean ± SE of three independent determinations
WP: Wheat Porridge AG=Amaranth Grains

5.3 Dietary fibre

With the increase of incorporation level of amaranth in porridge, the amount of insoluble and soluble dietary fibre increased significantly. Data on dietary fibre content of porridge are depicted in Table 4

Table 4: Dietary fibre content of salty porridge (% dry weight basis)

Product	Dietary fibre		
Salty porridge	**Total dietary fibre**	**Insoluble dietary fibre**	**Soluble dietary fibre**
Control (WP: 100%)	4.40±0.05	3.50±0.05	0.90±0.02
Type I (WP: AG: 75:25)	8.78±0.15	6.18±0.09	2.60±0.11
Type II (WP:AG: 50:50)	15.78±0.16	11.15± 0.07	4.63±0.08
Sweet porridge	**Total dietary fibre**	**Insoluble dietary fibre**	**Soluble dietary fibre**
Control (WP: 100%)	6.54±0.09	5.46±0.08	1.07±0.01
Type I(WP: AG: 75:25)	13.30±0.26	9.63±0.14	3.66± 0.12
Type II (WP: AG: 50:50)	21.69±0.23	15.22±0.06	6.46±0.17

5.4 Minerals

The amount of all minerals i.e. calcium, zinc, iron and potassium increased significantly with the incorporation of amaranth grains to wheat porridge

6. Conclusion

The present study provides information pertaining to utilization of amaranth in development of value added porridge. Amaranth grains were procured from the Medicinal Aromatic and Underutilized Plant Section, Department of Genetics and Plant Breeding, College of Agriculture, CCS Haryana Agricultural University, Hisar. The developed porridge were evaluated for sensory and nutritional parameters Incorporation of amaranth resulted in increased protein, cooking yield, moisture and fat retention but decreased fat content of porridge. The amount of all the proximate principles i.e. crude protein, fat, crude fiber, and ash were found to be increased in Type I and Type II salty porridge as compared to wheat porridge (control). The total, insoluble and soluble dietary fibre also increased significantly over the values of control porridge after addition of 25% (8.78%, 6.18% and 2.60%) and 50% (15.78%, 11.15% and 4.63%) amaranth to wheat porridge. The contents of total calcium, iron, zinc and potassium also increased in Type I (102.92, 3.13, 5.63 and 367.25 mg/100g, respectively.) and Type II porridge (198.67, 4.30, 7.60 and 481.50 mg/100g, respectively) containing 25% and 50% amaranth. Available calcium (21.46 and 49.77 mg/100g) and iron (0.62 and 0.93 mg/100g) also increased in the amaranth incorporated porridge Type 1 and Type II, respectively, over the wheat porridge (14.17 mg Ca/100g and 0.41 mg Fe/100g). Similar trend was observed in nutrient composition of sweet porridge. The results of the study indicated that amaranth can replace the staple cereal wheat up to 50% in porridge to increase its nutritive value. Overall it is inferred that amaranth can be utilized in preparation of various traditional and snack products to enhance their nutritive value. The study demonstrated that grain amaranth has potential to contribute to the alleviation of dietary nutritional deficiencies.

7. References

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