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DEVELOPMENT AND EVALUATION OF GLUTEN FREE INSTANT PORRIDGE BASED ON AMARANTH

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SUMMARY

Amaranth (*Amaranthus* spp.) is a pseudo-cereal which has been used as a grain, forage or silage crop for many animals, including cattle, chickens, pigs and rabbits. Grains of amaranth are seeking attention of consumers due to high nutritional quality and gluten free composition. Instant porridge was prepared from amaranth grains and analyzed for functional and sensory properties. For standardization of process for preparation of instant porridge two cooking methods (open pan and pressure cooker) and germination of grains were followed. The pressure cooker produced the product with better sensory and nutritional quality. Also germination of amaranth grains produced instant porridge with higher protein and lower fat content as well as improved sensory score. Non enzymatic browning in instant porridge increased during storage. Sensory quality slightly changed during storage but remained acceptable after three months of storage.

Key words: Amaranth, porridge, germination, nutritional value

Amaranth (*Amaranthus* spp.) comes under the category of pseudo- cereal which is known for its appreciable nutrient content, a good agronomic potential and multiples uses for human as well as animals. Amaranth has a high potential as forage for ruminants which have always eaten wild amaranth, and attention towards amaranth as a feedstuff has recently ascended owing to its good protein profile as well as fatty acid content. High nutritional profile of amaranth grains is making it more attractive for its utilization as a food by humans. Today's consumer is focusing on foods naturally rich in nutrients, having functional ingredients and easy to cook or ready to serve. This demand of modern population has set a new direction to food industry towards the production of convenient food products with longer shelf life. Porridge is a traditional food item in basic diet in India as well as other countries. It is most preferred food product for Infants, old aged people and patients due to its easy digestibility and good nutrient quality (Rhim *et al.,* 2011). Depending on the consistency porridge are of two types – thick and thin. Porridges having solid like texture are thick type and eaten with spoon or hand while thin porridges are slurry or fluid like in consistency (Moussa *et al.,* 2011). Generally, porridges are prepared from the major cereals like wheat, rice and maize etc. Pseudocereals including amaranth, buckwheat and quinoa are known for their nutritional value and usually consumed in the form of flour (Rao *et al.,* 2022; Sindhu *et al.,* 2019; Sindhu and Khatkar, 2018). Amaranth have the potential to be used for preparation of gluten-free products like porridge, cookies and other similar foods for celiac patients (Malik *et al.,* 2023; Sindhu and Khatkar, 2016, 2019). Processing of grains is generally done for the preparation of various food products. However sometime grain processing- like soaking, roasting, germinating is done as additional step during food preparation to improve the nutritional quality of final product. The soaking of legumes for 12–18 h has efficiently reduced the phytic acid and proteolytic enzyme inhibitors (Embaby, 2010). Germination enhanced the nutritional value and sensory qualities of legumes (Collado *et al.,* 2019; Saleh *et al.,* 2019). The present work was aimed at the formulation of porridge from germinated amaranth grains and evaluation of its sensory and storage quality.

MATERIALS AND METHODS

Procurement of raw materials and product formulation

Amaranth (*Amaranthus hypochondriacus*) grains were procured from local market, Hisar. All the grains were washed under the running tap water and rinsed with distilled water properly to remove dirt and foreign materials. The washed amaranth grains were

divided into two batches. One batch was cooked in open pan and another batch was cooked using pressure cooker. For open pan cooking, washed amaranth grains and boiling water (1:3) were taken in a stainless steel pan and cooked with continuous stirring on medium flame for 8-10 minutes. For steam cooking, washed amaranth grains of second batch were cooked in pressure cooker for 2-3 minutes (after pressure built in cooker) and then kept in steam for 6-7 minutes till the release of steam normally from pressure cooker. For germination, grains were washed with NaOCl (0.01%), rinsed and soaked in distilled water for 3 hrs, and allowed to germinate for 36-38 hours at room temperature. Distilled water was sprayed over the germinating grains after every 5-6 hrs interval for keeping them moist. The germinated amaranth grains were cooked using open pan and pressure cooker similarly as non-germinated grains. All cooked grains were spread on trays and dried in cabinet drier at 55±5°C in for 12-14 hrs. The dried amaranth porridges were scraped from trays and grinded in kitchen grinder for 15-20 sec. All the amaranth dried porridge samples were packed in air tight glass containers with proper labelling till further use. For the reconstitution of dried preparation of porridge, 10 gm of dried porridge samples was added in 80-90ml boiling water and cooked for 1min with continue stirring. During cooking salt (4 to 4.5% of dried amaranth porridge) or sugar (40 to 45% of dried amaranth porridge) was added for preparation of salty or sweet version of porridge, respectively, for sensory analysis purpose.

Product analysis

The dried porridge prepared from germinated and control samples of amaranth grains were analyzed for proximate composition, bulk density, water uptake ratio, rehydration capacity and cooking time. The moisture content, fat content, protein content and total carbohydrate contents were determined by following the standard methods of analysis (AOAC, 2010). Bulk density was determined by simply measuring the volume of dried porridge sample of known weight using measuring cylinder. Rehydration capacity of instant porridge was determined by the method followed by Mahgoub *et al.,* 2020. Water uptake ratio was calculated by taking the ratio of weights of cooked sample to that of before cooking. Non-enzymatic browning was determined using method described by Ranganna, 1986. Reconstituted gluten free porridge samples prepared form germinated and non-germinated amaranth were served hot to the panelists for the evaluation of sensory attributes to assess the acceptability at nine-point hedonic test ranging from 'like extremely' to 'dislike extremely'. On the basis of sensory scores, the instant porridge prepared form germinated amaranth grains cooked with high pressure processing were selected for storage. The stored version of amaranth porridge was further evaluated for functional and sensory properties after storage period of three months. The present work has been carried out during 2019-2021 in the Centre of Food Science and Technology, CCSHAU, Hisar (India).

RESULTS AND DISCUSSION

Functional properties

Functional properties of porridge are the indicator of quality and behavior of product during processing of cooking. A considerable difference was noticed in functional parameters of porridge due to grain processing as well as cooking method (Table 1). Bulk density parameter used to determine the packaging and storage size of grain like products while water uptake ratios is useful for determination of water required for cooking of cereals based products. Bulk density and water uptake ratio values were higher in case of open pan cooked samples prepared from both control as well as germinated grains over pressure cooked porridge version of theses samples. The rehydration capacity is the indicator of the ability of dried materials to absorb water and to hold soluble solids inside the dried material. Instant porridge prepared from germinated amaranth grains in open pan and pressure cooker had higher rehydration capacity (8.12 and 7.77 g/g) than control (7.35 and 6.64 g/g). This increase in rehydration capacity of amaranth porridge could be attributed to the increase in protein content with that provide more hydrophilic part during germination. Porridge samples cooked in pressure cooker (control and germinated amaranth grains) exhibited higher overall acceptability score than cooked in open pan that granted the base for the preference of pressure cooker over open pan for selection of cooking method for further study.

Proximate composition

Composition of instant porridge prepared from amaranth grains has been presented in table 2. The amaranth porridge showed the composition

TABLE 1
Functional properties of gluten free instant porridge of amaranth cooked in open pan and pressure cooker

Parameters	Control		Germinated		CD at 5%
	Open Pan	Pressure Cooker	Open Pan	Pressure Cooker	
Bulk density (g/ml)	0.75±0.02	0.69±0.02	0.72±0.01	0.65±0.01	0.01
Rehydration capacity (g/g)	7.35±0.06	6.64±0.10	8.12±0.12	7.77±0.14	0.97
Water uptake ratio	8.98±0.08	8.61±0.04	8.53±0.05	8.21±0.04	0.10
Overall acceptability*	8.29±0.01	8.45±0.02	8.34±0.01	8.56±0.03	0.07

All values are mean ± standard deviation (n=3). *9-point Hedonic scale.

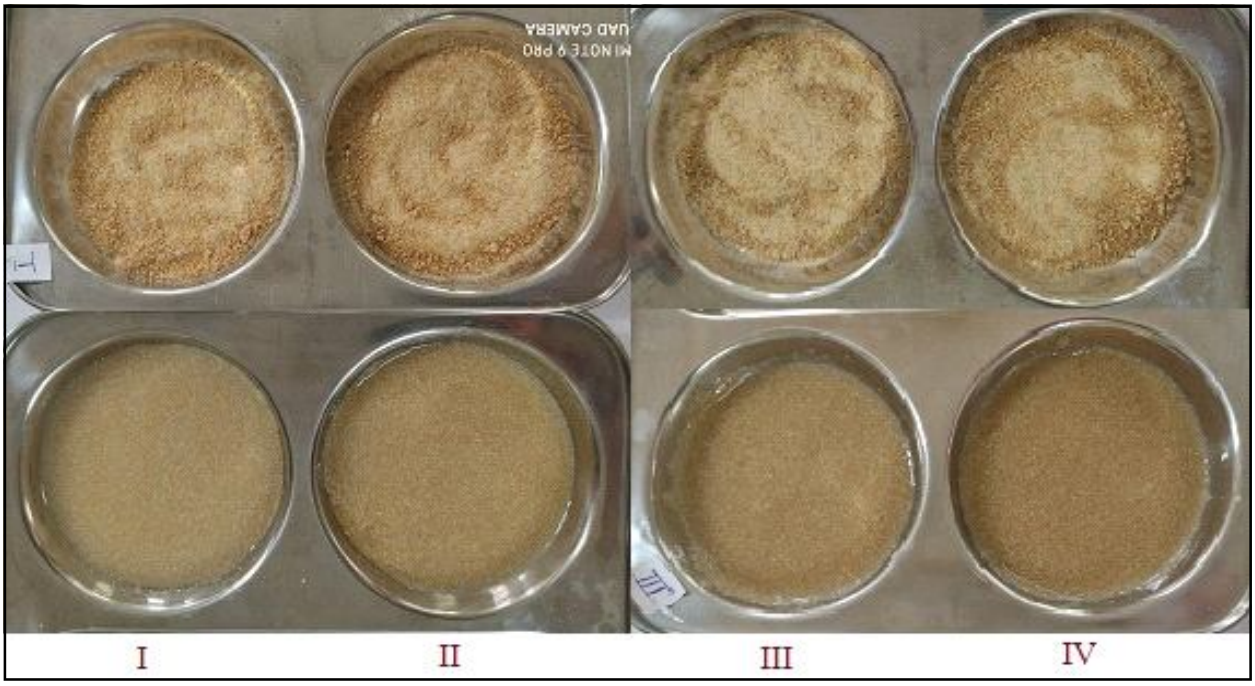

Fig. 1. Gluten-free instant porridge from amaranth grains. 1: Control open cooked; 2: Control pressure cooked; 3: Germinated open cooked and 4: Germinated pressure cooked.

comparable to that of amaranth grains of different species compiled by Malik *et al.* 2023. The porridge made from germinated amaranth grains had higher protein and total carbohydrates while lower ash content, crude fibre and energy content as compared with the porridge prepared using amaranth grains without germination. The increment in protein content during the germination could be attributed to the enzymatic activity responsible for release of amino acids and peptides resulted in new protein formation. A similar trend of increasing protein content and decreasing fat and ash content following germination of pseudocereals has been reported in earlier studies by Beniwal *et al.* 2019. Increased lipolytic enzymes activity that hydrolyzed the fat and so used it as energy source during germination could be the reason for lower fat content of porridge made from germinated amaranth grains. The decrement in ash content in case of porridge prepared from germinated grains might be attributed to the diffusion of some of the minerals into water during soaking and germination process.

TABLE 2
Proximate composition of gluten free instant porridge prepared from amaranth

Parameters	Control	Germinated
Moisture (%)	7.33±0.15	7.05±0.13
Protein (%)	15.33±0.12	15.81±0.11
Fat (%)	6.61±0.07	3.44±0.06
Ash (%)	2.41±0.21	1.93±0.07
Crude fibre (%)	5.79±0.09	4.53±0.15
Total carbohydrates (%)	69.85±0.22	74.29±0.26
Energy(Kcal)	400±2.04	391±1.41

All values are mean ± standard deviation (n=3).

TABLE 3
Effect of storage period on functional properties of gluten free instant porridge prepared from germinated amaranth grains

Parameters	Storage period (months)			
	0	1	2	3
Moisture content (%)	6.05±0.05[a]	6.09±0.00[a]	6.18±0.02[b]	6.29± 0.02[c]
Rehydration capacity (g/g)	8.79±0.29[a]	8.58± 0.06[a,b]	8.41± 0.00[b,c]	8.24±0.05[c]
Water absorption ratio	7.39±0.30[a]	7.90±0.06[b]	7.94±0.04[b]	8.08±0.07[b]
Bulk density (g/ml)	0.71±0.00[a]	0.72±0.27[a]	0.77±0.02[b]	0.79±0.00[b]
NEB (OD at 440 nm)	0.13±0.02[a]	0.15±0.02[a]	0.21±0.02[b]	0.32±0.03[c]

All values are mean ± standard deviation (n=3). Values with different superscript in the same row are significantly different ($p< 0.05$).

STORAGE STUDY

(a) Functional properties

It was observed from the storage study that moisture content of instant amaranth porridge increased from 6.05 to 6.29% during storage (Table 3). Rehydration capacity (g/g) of instant porridge decreased from 8.79 to 8.24, whereas water absorption ratio increased from 7.39 to 8.08 during three months' storage. Non-enzymatic browning and bulk density of gluten free instant amaranth porridge increased significantly during storage.

Sensory scores indicated slight changes in sensory quality of instant porridge made from germinated amaranth grains during three months' storage (Fig. 2). Colour & appearance, taste, texture and flavor scores decreased during storage. Gluten free instant amaranth porridge was acceptable even at three months' storage. Slight alteration in organoleptic properties of porridge could be due to non-enzymatic browning reactions and some oxidative changes occurring during general storage conditions.

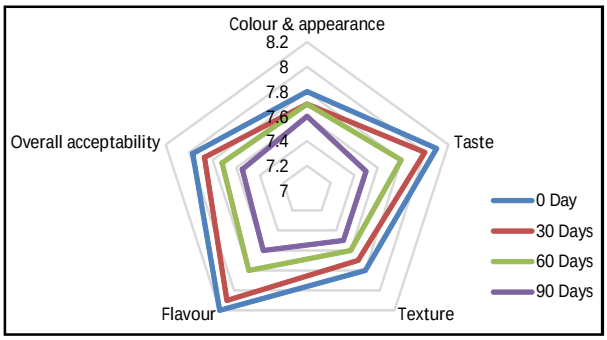

Fig. 2. Effect of storage period on sensory score (9-point Hedonic scale) of gluten free instant porridge prepared from germinated amaranth grains.

CONCLUSION

Present work showed that amaranth grains have the potential to produce an instant gluten free product with appreciable content of protein and other nutrients. The instant porridge prepared from amaranth grains had good organoleptic properties that can be relished by celiac patients. Pressure cooker was found to be the better and fast process of cooking for the preparation of instant porridge. Germination came out to be important processing step that improved the nutritional, functional and sensory properties of the final product. It can be concluded from the present work that instant porridge prepared from amaranth grains can be easily stored for up to three months.

REFERENCES

AOAC, 2010: Official Methods of Analysis of the Association of Official Analytical Chemists. 18th Edition, Association of Official Analytical Chemists, Washington.

Beniwal, S.K., A. Devi, and R. Sindhu, 2019 : Effect of grain processing on nutritional and physic-chemical, functional and pasting properties of amaranth and quinoa flours. *Indian Journal of Traditional Knowledge*, **18**(3): 500-507.

Collado, E., T. V. Klug, G. B. Marti´nez-Herna´ndez, F. Arte´s-Herna´ndez, A. Marti´nez-Sa´nchez, E. Aguayo, P. A. Go´mez, 2019: Nutritional and quality changes of minimally processed faba (*Vicia faba* L.) beans during storage: Effects of domestic microwaving. *Posthar vest Biol Technol*, **151**: 10-18.

Embaby, H.E.S., 2010: Effect of soaking, dehulling, and cooking methods on certain antinutrients and in vitro protein digestibility of bitter and sweet lupin seeds. *Food Sci Biotechnol*, **19**(4): 1055-1062.

Mahgoub, S., A. Mohammed, and E. Mobarak, 2020: Physiochemical, Nutritional and Technological Properties of Instant Porridge Supplemented with Mung Bean. *Food and Nutrition Sciences*, **11**: 1078-1095. *doi: 10.4236/fns.2020.1112076.*

Malik, M., R. Sindhu, R., S. B. Dhull, C. Bou-Mitri, Y. Singh, S. Panwar and B. S. Khatkar, 2023: Nutritional Composition, Functionality, and Processing Technologies for Amaranth. *Journal of Food Processing and Preservation. https://doi.org/10.1155/2023/1753029*.

Moussa, M., X. Qin, L. Chen, O. H. Campanella and B. R. Hamaker, 2011: High quality instant sorghum porridge flours for the West Africa market using continuous processor cooking. *International Journal of Food Science and Technology*, **46**: 2344-2350.

Ranganna, S., 1986: Handbook of Analysis & Quality Control for Fruit & Vegetable Products. 2nd Edition. New Delhi: Tata McGraw Hill publishing Co. Ltd.

Rao, H., R. Sindhu and S. Panwar, 2022: Morphology and functionality of dry heat-treated and oxidized quinoa starches. Journal of Food Processing and Preservation. *https://doi.org/10.1111/jfpp.16672*.

Rhim, J. W., S. Koh and J. M. Kim, 2011: Effect of freezing temperature on rehydration and water vapor adsorption characteristics of freeze-dried rice porridge. *Journal of Food Engineering*, **104**(4): 484-491.

Saleh, H.M., A. A. Hassan, E. H. Mansour, H. A. Fahmy and A. E. F. A. El-Bedawey, 2019: Melatonin, phenolics content and antioxidant activity of germinated selected legumes and their fractions. *J. Saudi Soc. Agric. Sci.*, **18**(3): 294-301.

Sindhu, R. and B. S. Khatkar, 2016: Physical properties of grains of some pseudocereals. *Annals of Agri-Bio Research.*, **21**(2): 174-178.

Sindhu, R. and B. S. Khatkar, 2018: Thermal, structural and textural properties of amaranth and buckwheat starches. *Journal of Food Science and Technology*, **55**(12): 5153-5160.

Sindhu, R. and B. S. Khatkar, 2019: Pseudocereals: Nutritional composition, functional properties and food application. *Food Bioactives: Functionality and Applications in Human Health*. ISBN: 9781771887991.

Sindhu, R., A. Devi and B. S. Khatkar, 2019: Physico-chemical, thermal and structural properties of heat moisture treated common buckwheat starches. *Journal of Food Science and Technology*, **56**(5): 2480-2489.