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Formulation and nutritional evaluation of multi grain porridge incorporated with Amaranthus seeds

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Abstract

In college of food science and technology, Rudrur, Nizamabad, research was conducted to formulate and develop the product instant multigrain porridge by selecting the different grains like sorghum, barley, finger millet, foxtail millet, barnyard millet, corn, Amaranthus and black gram which are of increasing their demand in recent years due to their, nutritional content and also these control the lifestyle diseases like diabetes, reduce the risk of obesity because the millets have the high fiber content. Amaranthus is used as it is rich in protein, calcium and iron which are required by human body. Using these grains in different proportions we made treatments like T₁, T₂, T₃ compared with control sample which does not have amaranthus grains and black gram.

In this laboratory investigation, amaranth grains and black gram along with other millets and cereals are taken and soaked and then pressure cooked and then dried and milled to a coarse powder. Three different samples are prepared with varying amaranth grain and black gram percentage i.e., different proportions like 8%, 10%, 14% and 8%, 10%, 20%. These formulations were analyzed to study proximate composition, sensory evaluation, Water absorption capacity, cooking time.

From proximate analysis it was concluded that Amaranthus seeds and black gram incorporated instant multigrain porridge was rich in protein and iron. From sensory analysis it was concluded that instant multigrain porridge prepared with 14% Amaranthus seeds and 20% black gram was best in terms of taste, flavour and overall acceptability.

Keywords: Nutritional quality, organoleptic evaluation, multigrain, porridge, amaranth grains, millets

Introduction

In India, there are wide range of traditional foods are generally consumed as breakfast. To attract consumers, traditional products are reformulated to meet demands for instant products with less preparation time, convenience and health significance. Wheat porridge is a major breakfast cereal in north India and it is made from cracked wheat by cooking in milk or water and is eaten with salt or sugar added. This product offers unique advantage to incorporate multigrain concept in ready-to-eat, wholesome breakfast food. The cooking of grains with steam under pressure is the initial process for porridge making. This process is important as it develops the grain properties necessary for the development of product characteristics such as flavour, colour and texture primarily by gelatinization of starchy grain fractions, Caldwell (2000) [2].

In recent years, a wide range of processed foods in ready-to-eat form have been marketed with increased interests in health foods. In addition to whole grain benefits, multigrain concept can provide breakfast foods with number of benefits associated with all types of grains having different nutritional benefits. Multigrain blend helps to mix different whole grains to maximize their nutritional, functional and sensory properties. Along with the health significance, convenience is also a recent trend in international as well as Indian food market. Convenience products are instant, quick and easy to prepare, thus, saves cooking time and requires few cooking skills.

As reviewed by Ojijo (2004) [9], whole grains have high concentrations of dietary fibre, resistant starch and oligosaccharides, also rich in antioxidants including trace minerals and phenolic compounds.

Whole grain feeding studies in human subjects also report improvements in biomarkers such as weight loss, blood-lipid improvement and antioxidant protection.

Legumes and cereals contain a wide range of phenolics and also acts as good source of natural antioxidants, Krings (2000) [6]. Mitsuru (1999) [7], Chethan (2007) [3] reported the presence of antioxidative phenolics in millets. Flavonoids like tannin and anthocyanins also have antioxidative potential, Guohua (1997) [4]. All these indicate the bioactive potential of whole grains.

The present study was carried out to investigate technological challenges associated with preparation of instant multigrain porridge, having greater nutritional value and to assess physical characteristics and cooking, sensory quality of the multigrain porridge.

Cereals like corn, sorghum, Barley and Pulses like Black gram and millets like Finger millet, Foxtail millet, Barnyard millet are used to in this study to prepare multigrain porridge and Amaranth grains are used in this study to increase the nutritional value of the porridge and to increase the mineral content of the porridge.

Objectives

- Formulation of multigrain porridge using cereals, millets and pulses incorporated with Amaranthus seeds
- To analyze physical and functional properties in porridge
- To analyze the nutritional value in porridge
- Sensory evaluation of porridge

Material and Methods

Raw materials

Finger millet, Black gram, corn, barnyard millet, foxtail millet, sorghum, Amaranthus, Barley were purchased from local market. The grains were thoroughly cleaned and stored in plastic packets.

Equipment and instruments

The Equipment used grinder, weighing balance, Sieve shaker, Tray dryer, Hot air oven, Soxhlet apparatus, Muffle furnace and UV spectrophotometer.

Table 1: Formulation of instant multigrain porridge

Ingredients	Control(g)	T ₁ (g)	T ₂ (g)	T ₃ (g)
Sorghum	16	16	16	10
Barley	16	13	10	10
Finger millet	20	15	14	10
Foxtail millet	20	16	16	10
Barnyard millet	20	16	16	16
Corn	8	8	8	10
Amaranthus	0	8	10	14
Black gram	0	8	10	20

Sorghum, barley, finger millet, foxtail millet proportions were reduced from control to treatment 3 because the grains are rich in carbohydrates which gives high calories on consumption. As black gram and amaranthus are less in carbohydrates compared to other grains and rich in proteins and iron respectively.

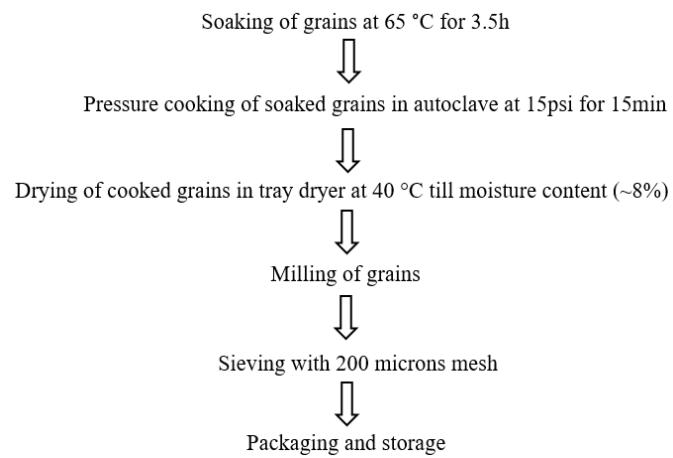


Fig 1: Flowchart of preparation of instant multigrain porridge

Physical and functional properties

Bulk density: Bulk density was determined according to the method of Shukla *et al.*, (1986) [10]. Samples are to be poured into a graduated cylinder, gently tapped ten times and filled to 500 ml.

1000 kernel weight: One thousand undamaged raw grains were weighed on a weighing balance. Weight of 1000 sorted grains measured on electronic balance and was expressed in grams.

Water absorption capacity: An accurately weighed quantity of the sample (0.25 g) (m_1) was immersed in 100 ml of distilled water at room temperature and allowed to reach the maximal swelling. For the determination of sorption kinetics, tests were run where at intervals of 30 min the swollen sample was separated by filtration through a filter paper. It was then weighed (m_2). The water absorption capacity is calculated as g H₂O/g dry powder using,

$$\text{WAC(g/g)} = \frac{m_2 - m_1}{m_1}$$

Nutritional evaluation of instant multigrain porridge

Estimation of moisture: Moisture was estimated by oven drying method (AOAC, 2000) [11].

$$\% \text{ Moisture} = \frac{w_2 - w_3}{w_2 - w_1} \times 100$$

Fat estimation: Fat estimation was done using Soxhlet apparatus.

$$\text{Fat content (gm /100 sample)} = \frac{\text{Weight of ether extract}}{\text{Weight of the sample (equivalent to fresh sample taken)}} \times 100$$

Protein estimation: Protein content was estimated by using Kjeldahl apparatus.

$$\text{Ng/Kg} = \frac{(\text{ml of HCl} - \text{ml blank}) \times \text{Normality} \times 14.01}{\text{Weight}}$$

Ash content: Ash content was estimated by using muffle furnace (AOAC, 2000) [1].

$$\text{Ash content (\%)} = \frac{W_3 - W_2}{W_1} \times 100$$

W_1 = weight of sample

W_2 = weight of crucible

W_3 = weight of crucible after combustion

Estimation of carbohydrates

$$\text{Carbohydrate (\%)} = 100 - (\% \text{ Moisture} + \% \text{ Ash} + \% \text{ Fat} + \% \text{ Protein})$$

Estimation of crude fibre: Crude fibre content was estimated according to (A.O.A.C. 2000) [1].

Sensory analysis: Judgment were made through rating products on a 9 points Hedonic Scale with corresponding descriptive terms ranging from 9 'like extremely' to 1 'dislike extremely'. The format for sensory evaluation card, Meilgaard *et al.*, (2007) [8].

Results and Discussion

The results show that the multigrain blend of jowar, finger millet, corn, barley, foxtail millet, barnyard millet, black gram, Amaranthus can be instantized into an acceptable, nutritious traditional breakfast food known as porridge. Various physical, functional, proximate and organoleptic analysis were carried out in order to determine the most acceptable porridge formulation. Porridge with 14% of Amaranthus is confirmed to be the best.

Instant Multigrain Porridge Formulations

Control sample is prepared with 0% Amaranthus, treatment 1, 2, 3, with 8%, 10%, 14% Amaranthus respectively.

Table 2: Physical Properties of Grains

Grains	1000 kernel weight(g)	Bulk density(g/ml)
Jowar	34.15	1.16
Finger millet	2.5	1.54
Corn	254.1	1.2
Barley	34.72	1.5
Foxtail millet	2.6	1.18
Barnyard millet	2.92	1.07
Black gram	52.3	0.82
Amaranthus	2.45	1.76

In the various types of grains that are used for the preparation of multigrain porridge corn has the highest 1000 kernel weight because of its bigger size whereas Amaranthus has the least 1000 kernel weight due to its smaller size. Bulk density is highest for Amaranthus because of its smaller size and least for black gram.

Table 3: Functional properties of Instant Multigrain Porridge

Formulation	Bulk density(g/ml)	Water absorption capacity (g of H ₂ O/g of dry powder) at 100 °C
Control sample	1.23	5.689
Treatment 1(T ₁)	1.25	5.999
Treatment 2(T ₂)	1.27	6.648
Treatment 3(T ₃)	1.24	6.81

Functional properties of multigrain porridge include bulk

density and water absorption capacity. Bulk density is noticed highest for the treatment 2 (T₂) which has 10% Amaranthus and least for the control sample with 0% Amaranthus. Water absorption capacity is noticed highest for the treatment 3 (T₃) with 14% Amaranthus and least for the control sample due to more corn and barnyard millet which absorbs more water to become soft in T₃.

Table 4: Cooking Time of Instant Multigrain Porridge

Temperature	Control sample(min)	T ₁ (min)	T ₂ (min)	T ₃ (min)
90 °C	7.5	6.20	6.29	6.25
100 °C	6.26	4.33	4.53	5.31
120 °C	4.40	3.53	4.23	4.33

Cooking of the formulations was done at 90 °C, 100 °C, 120 °C where different cooking times were noticed. At 90°C highest cooking time was noticed for control sample and the least for T₁ sample. At 100 °C highest cooking time is noticed for control sample and the least for T₁ sample. At 120°C control sample noticed the highest cooking time and T₁ sample noticed the least cooking time. The most accepted T₃ sample noticed the highest cooking time at 90°C and the least at 120 °C.

Table 5: Proximate Composition of Instant Multigrain Porridge

S.no	Parameter	Control	T ₁	T ₂	T ₃
1	Moisture (%)	5.594±0.00	3.75±0.00	3.47±0.00	4.768±0.00
2	Protein (%)	10.156±0.05	11.65±0.09	11.71±0.06	13.736±0.2 10036
3	Carbohydrates (%)	79.834±0.30 05	78.098±0.26 6	78.414±0.64 1	74.907±0.8 1
4	Fat (%)	3.0±0.26	4.716±0.46	4.543±0.542	4.793±0.53 8
5	Ash (%)	1.42±0.42	1.786±0.30	1.863±0.35	1.796±0.30
6	Crude fiber (%)	1.4±0.10	1.9±0.16	2.07±0.18	2.27±0.14

Moisture content of control is higher compared to other treatments and moisture in treatment 3 is high compared to treatment 1 and treatment 2 because of maximum use of black gram and amaranthus grains. Protein content in T₃ is high as black gram is present which is rich in proteins. Proximate composition include moisture, protein, carbohydrate, fat, ash, crude fiber contents of the sample. Based on the above values the most accepted T₃ sample is highest in protein, fat and crude fiber contents.

Table 6: Organoleptic Evaluation of Instant Multigrain Porridge

S.no	Parameters	Values		
		Control	T ₁	T ₂
1	Color	7	7	8
2	Taste	7	6	6
3	Texture	6	7	6
4	Overall acceptability	7	6	7

Organoleptic evaluation was performed for all the samples using the 9-point hedonic scale. Based on this scale the most accepted sample is the T₃ as it has scored more for its color, taste, texture and overall acceptability. It is because of the roasted black gram aroma, highest content of Amaranthus and the fine blend of millets and other cereals used in the preparation of instant multigrain porridge.

Conclusion

1. Multigrain blend mix maximizes the properties like nutritional, functional and organoleptic. Whole grains have high concentrations of dietary fibre, resistant starch and oligosaccharides. They are also rich in antioxidants including trace minerals and phenolic compounds and these compounds have been linked to disease prevention.
2. Grain Amaranthus stands unique because of its superior nutritional characteristics. These grains serve as a good source of protein, micronutrients and phytochemicals
3. As the market for processed foods like ready to eat foods is increasing, it is recommended to consume products like multigrain composite mixes like instant multi grain porridge.
4. Due to addition of black gram and amaranthus grains raise the protein much on maximum usage of these compared to other grains and I conclude that treatment 3 has the good amount of proteins and reduced amount of carbohydrate which make benefit to human health

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