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Proximate and Antioxidant Analysis of RTE Breakfast Cereal Made from Popped Pearl Millet, Amaranth Grains and Groundnut Powder

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Abstract: ***The present study was performed to analyze the RTE breakfast cereal prepared from popped pearl millet, amaranth grains and groundnut powder. Nowadays people, especially working professionals are in need for a nutritious and quick breakfast to match with their busy schedule. This cereal is prepared without addition of preservatives and artificial sugars. The ingredients are gluten free, maintains blood sugar, prevents anemia and boosts immunity and are rich in antioxidants. The moisture content, protein, fat and crude fiber of breakfast cereal were 24.5 ±0.05, 25.8±0.00, 19.15±0.00 and 9.4g per 100 g, respectively. The analysis also revealed that RTE-BC contain good amount of total dietary fiber (6.13±0.14). Using under-utilized grains that are rich in nutrients is a huge step towards better nutrition and for the framers.***

Keyword: Proximate analysis, DPPH determination, antioxidant activity, RTE breakfast cereal

1. Introduction

Maintaining good health is getting difficult for people nowadays with their busy lifestyle. Breakfast is the most important meal of the day and people are neglecting it because of their busy work schedules but it is really important to eat nutrient rich food in the morning to function properly throughout the day. The working individuals find it difficult to have a healthy breakfast quickly and here we can introduce breakfast cereals that are full of essential nutrients and are mostly ready to eat, hassle-free and makes you feel full for long. The concept of ready to eat foods was introduced in India in the 1980s, so the idea of ready to eat breakfast cereal is not so new and is highly influenced by the western countries and cereal products manufactured by them are being sold and consumed in India at a large scale but most of them are full of artificial flavors, colors and sugars that does not have any health benefits whatsoever. In this study, RTE breakfast cereal is prepared from popped pearl millet, popped amaranth grains and groundnut powder, these grains are full of nutrients but are underutilized. Their health benefits are not able to reach the people though being highly accessible.

Pearl millets are a very good source of carbohydrate, protein, fat, dietary fiber, iron and zinc. Pearl millet is higher in insoluble dietary fiber which helps in slow release of sugar hence, good for people suffering or prone to diabetes. Studies have shown that regular consumption of pearl millets help in preventing gallstones in women and also provide protection against breast cancer in pre – menopausal women. It contains magnesium which helps in lowering blood pressure of people with hypertension also normalizes cholesterol levels in blood. Pearl millets contain high amounts of iron and zinc which may increase the production of hemoglobin in the blood thus preventing anemia. Pearl millet is a good weaning food for infants from 6 months of age it is also good for lactating mothers as it acts a potent galactagogue which is known to increase lactation in nursing mothers.

Amaranth grains are a super food, they are high in fiber and can be used in combination with wheat, corn or brown rice to get the goodness of a complete meal full of proteins fibers, calcium, potassium, phosphorous, magnesium and vitamin C. It has protein levels as high as found in fish, red meat or poultry & has more than three times the amount of Calcium. It's an easy grain to digest & considered as prime source of energy during fasts.With just a cup of amaranth providing over 100 percent the daily recommended dose of manganese, it can be eaten as part of a diabetic diet that helps reduce high blood sugar levels. The folate in amaranth grain helps the body make new cells, specifically by playing a role in copying and synthesizing DNA. For pregnant women, a folate deficiency can lead to neural tube defects, such as spina bifida. A deficiency can also cause defects such as heart and limb malformations. Grain amaranth protein is of superior amino acid profile compared to proteins found in most other plant foods. Amaranth grains contain twice the level of calcium in milk, five times the level of iron in wheat, higher sodium, potassium, and vitamins A, E, C, and folic acid than cereal grains (Becker et al. 1981).Grain amaranth has been shown to exhibit antioxidant activity and this has been attributed to its content of polyphenols, anthocyanins, flavonoids, and tocopherols (Klimczak et al. 2002; Escudero et al. 2011). Phenolic content of grain amaranth varies between species and may be affected by environmental conditions (Escudero et al. 2011). The antioxidant activity of phenolics is associated with inhibition of lipid peroxidation (Charanjit et al. 2009).Both amaranth grains and pearl millets are gluten free so good for celiac patients, are good for gut health and blood sugar. Groundnuts are full of healthy fatty acids, protein and vitamin E that play a crucial role in improving the cognitive function of the brain.

Antioxidants are substances that protect cells from damage caused by unstable molecules known as free radicals. Cellular damage or oxidation injury caused by these free radicals or reactive oxygen species which are generated through normal metabolism of drugs, environmental

chemicals and other xenobiotics as well as endogenous chemicals appears the fundamental mechanism underlying a number of human diseases such as neuro-degenerative disorders, diabetes mellitus, nephritis, rheumatism, Alzheimer disease, cataracts, cardiovascular diseases, acute liver toxicity, inflammation, viral infections, digestive system disorders and DNA damage that can lead to carcinogenesis. The bran layer of millets are good sources of B-complex vitamins. However, millet also feature high fiber contents and poor digestibility of nutrients, which severely limits their value in nutrition and influence their consumer acceptability. The action of one antioxidant may therefore depend on the proper function of other members of the antioxidant systems. The amount of protection provided by any one antioxidant will also depend on its concentration, its reactivity towards the particular reactive oxygen species being considered, and the status of the antioxidants with which it interacts.

2. Materials and Methods

2.1 Materials

Pearl millet (Pennisetum glaucum), amaranth grains (Amaranthus) and groundnuts (Apios americana) were brought from the local market in Lucknow city.

2.2 Sample Preparation

Pearl millet and amaranth grains are popped in hot sand and groundnuts are dry roasted. All the ingredients are then grinder together in equal quantities and made into a powder and the sample is ready.

2.3 Proximate Analysis

2.3.1 Determination Of Moisture Content

Apparatus and Requirements:

- Moisture dish
- Hot air oven
- Desiccators
- Electronic weigh machine
- Sample

Procedure

1) Weigh accurately about 5 gm approx. of the prepared sample in the moisture dish.
2) Previously dried in the oven at 105°C and weighed.
3) Place the dish in the oven maintained at 105°C± 2°C, for 4 hours.
4) Cool in the desiccators and weigh.

Calculation:

$$\text{Moisture percentage by weight} = 100 \times \frac{(W1 - W2)}{W1 - W}$$

W1 – Mass in gm, of the dish with the material before drying
W2 – Mass in gm, of the dish with the material after drying
W – Mass in gm, of the empty dish

2.3.2 Determination Of Fat Content

Apparatus and Requirements:

- Soxhlet Extraction apparatus
- Desiccators
- Thimble
- Electronic Weigh Balance
- Solvent (Petroleum ether 40 - 60°C boiling point)
- Sample
- Glassware (flower flask 250ml)

Procedure

1) Weigh accurately about 5 to 10 g of the dried material sufficient to give about 1.0 g of fat in the suitable thimble and dry for 2 hours at 100 ± 5°C.
2) Place the thimble in the Soxhlet extraction apparatus and extract with the solvent for about 16 hours.
3) Dry the extract contained in the Soxhlet flask, the empty mass of which has been previously by taring at 95°C to 100°C for an hour.
4) Cool in desiccators and weigh.
5) Record the weigh.

Calculation:

$$\text{Fat content by mass} = 100 \times \frac{(W1 - W2)}{W}$$

W1 – Mass in gm of the flower flask with the extracted fat
W2 – Mass in gm of the flower flask clean and dry
W – Mass in gm of the material taken for the test

2.3.3 Determination Of Ash Content

Apparatus and Requirements:

- Silica crucibles
- Muffle furnace
- Desiccators
- Electronic weigh balance
- Sample

Procedure:

1) Weigh accurately about 5 gm of the prepared sample in a Tared, clean and dry silica dish difference.
2) Ignite the material in the dish with the flame of a suitable burner for about one hour.
3) Complete the ignition by keeping in a muffle furnace at 550°C
4) Cool in desiccators and weigh.
5) Record the observation.

Calculation:

$$\text{Total ash content (on dry basis), percentage by mass} = \frac{(W2 - W1)}{W1 - W} \times 100$$

W2 = Mass in gm of the crucible with the ash
W = Mass in gm of the empty crucible
W1 = Mass in gm of the dish with the material taken for the test

2.3.4 Determination Of Protein Content

Reagents:

1) Potassium sulphate (anhydrous)
2) Cupric sulphate (anhydrous)

3) 40 % NaOH Solution
4) 4% Boric acid solution
5) Mixed indicator (Bromocresol Crystal green + Methyl red)
6) Standard Hydrochloric acid (0.1 N)

Apparatus:

- Automated Biokigel (Protein estimation machine)
- Digestion unit (Multi program / profile PID Controller)
- Biodistilation FESTS (distillation unit)
- Bio scrub ES Control Panel (fume neutralizer / Controller)
- Kjeldahl's flask
- Conical flask
- Burette
- Burette stand

Procedure:
Weigh 0.5 to 1.000gm test portion into, digestion tube. Add 30gm potassium sulphate 0.5gm anhydrous cupric sulphate. Add 10ml concentrated H2SO4

Digestion: Place the tube with-rack in digestion unit and lock the tube with bio scrub fume neutralizer. Select the programme 01 and click to start.

Adjust the temperature: 250℃ - 10 min
300℃ - 10 min
350℃ - 10 min
420℃ - 75 min

After completion of digestion, cool the tube at room temperature.

Automatic Distillation: Place the tube into automatic digestion unit add 40% NaOH 40ml in tube and 4% Boric acid 25ml in receiver by machine. Select the programme 01 and distillation will complete in 9 min.

Titration (Manually): Remove the receiver flask add the mix indicator 2-3 drop and titrate with 0.1 N HCl / N H2SO4 end point shows pink color.

1) It is proceeded by Kjeldahl's method.
2) Take 2gm of sample in a Kjeldahl's flask.
3) Add 1-2gm of catalyst mixture.
4) Now keep the flask in protein digester. In this digester chamber add 5.8ml hydrogen peroxide and 12ml concentrated sulphuric acid.
5) Heat till mixture boils briskly at moderate rate at temperature of 420℃ and color changes to pale blue.
6) Transfer the content to 100ml flask and place it automatic protein distillation unit. It has mixture of 35% NaOH, 25ml H2O and 4% boric acid.
7) When flask is placed under the condenser of the distillation unit, nitrogen is obtained as small droplets another conical flask which is collected.
8) Titrate it with 0.2N HCl till faint pink color is appeared, using methyl red as indicator. Note down the value.

$$\text{Calculation: Protein content} = \frac{(\text{titration value} \times \text{normality of HCl} \times 6.25 \times 2.809 \times 100)}{(\text{Sample weight} \times 0.2 \times 1000)}$$

2.3.5 Determination of Carbohydrate Content and Calorific Value (Total Energy Value)

Theory:

1) Dietary carbohydrates should be classified according to their chemical form, as recommended at the 1997 FAO/ WHO Expert Consultation.
2) The physiological and health effects of carbohydrates are dependent not only on their primary chemical form but also on their physical properties, which include water solubility, gel formation, crystallization state, association with other molecules and aggregation into the complex structures of the plant cell wall.
3) Total carbohydrate in food should be determined by direct measurement rather than 'by difference'.
4) Many terms exist to describe sugars in the diet. The most useful are total sugars and their division into mono- and disaccharides. The use of other terms creates difficulties for the analyst, confusion for the consumer and suggests properties of foods that are not related to sugars themselves, but to the food matrix.
5) Because neither chemical nor physical description of carbohydrates directly reflects their physiological properties and health benefits, a number of terms to describe carbohydrates, based on their physiology, have been created. Of these prebiotic, glycaemic, RS and dietary fibre are useful.
6) Dietary fibre should be defined to reflect the health benefits of a diet rich in fruits, vegetables and whole grains and not the variable physiological properties or health effects of the various carbohydrate types. The definition proposed by the group was 'intrinsic plant cell wall polysaccharides'.
7) The effects of foods containing different types of fibre on glycaemic control and lipid levels should be investigated further to determine the exact properties needed for their effects. The distinction between soluble and insoluble forms of fibre is inappropriate since the separation is pH dependent and does not reflect the physiological properties of whole foods in the gut.
8) The term whole grains should be defined more clearly and the role of intact versus milled grains established. The whole-grain concept, along with fresh fruits and vegetables is central to a healthy diet message
   Calculation: Carbohydrate percentage = 100 – (% Moisture content + %Fat content +%Ash +% Protein content)

2.4 Antioxidant Activity

0.2 gm of powdered food sample was taken in a conical flask then added 5 ml of 99% methanol to the sample and sealed with aluminium foil. Put the sample in shaking water bath at (100 rpm temperature 2.5 hr). 2 mg DPPH was added in 50 ml of methanol then covered the solution with aluminium foil and kept it in a cool condition. After 2.5 hrs of shaking the sample was taken in centrifuge tube and centrifuged them for 15 mins at (6000-8000 rpm). After that a flask and funnel was taken and put a filter paper in funnel

and filter the solution part. 1 ml of extracted solution was taken with pipet and putted in flask in ratio 1 ml, 2 ml, 3 ml, 4 ml and 5 ml and added 99% of methanol to make up 10 ml. after that sample was transferred in a beaker and 1 ml of sample taken and poured in conical flask. 3 ml DPPH solution was added in each ratio and make up with 99% methanol to 10 ml then keep the solution in dark place for 30 mins. After that take the assay of the spectrophotometricand take the reading of the samples (Tailor Chandrashekhar*1 and Goyal Anju2 (2014).

Formula: DPPH= $\frac{\text{Abs of control} - \text{Abs of sample}}{\text{Abs of control}}$ X 100

3. Result and Discussion

3.1 Proximate analysis

The RTE breakfast sample prepared was analyzed for proximate composition and shown in (Table 1). The moisture content of the RTE breakfast cereal is 24.8%, fat content is 19.15%, protein content is 25.8%, carbohydrate content is 23.37%.

Table 1: Proximate composition of RTE breakfast cereal

Composition	Concentration
Crude fiber (g/100g)	9.4±0.00
Protein (g/100g)	25.8±0.00
Moisture (g/100g)	24.8±0.00
Fat (g/100g)	19.15±0.00
Energy (kcal/100g)	380±0.00
Carbohydrate (g/100g)	23.37±0.00
Ash (g/100g)	7.05±0.00

3.2 Antioxidant activity

The DPPH· radical scavenging activity has been widely utilized for determining the antioxidant properties of products like fruits and vegetable juices or their concentrates. At the point when free radical DPPH associates with an odd electron, the best absorbance happens at 517 nm (purple tone). A free-radical scavenger antioxidant responds to DPPH to form DPPHH, which has a lower absorbance than DPPH due to the lower measure of hydrogen. In comparison to the DPPH-H state, this radical version causes de-colorization(a yellow tint) as the quantity of electrons gathered increments.

Calculation of antioxidant activity % =
$\frac{\text{absorbance of sample} - \text{absorbance of sample}}{\text{Absorbance of control}}$ X 100

Amaranth grains and pearl millet are rich in antioxidants.

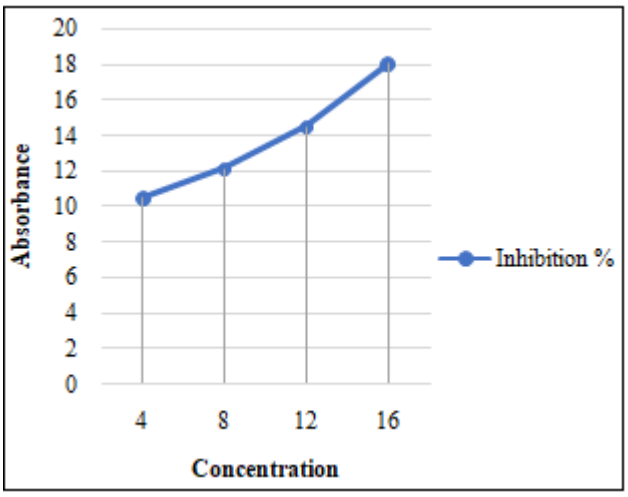

Figure 1: Reducing activity of RTE breakfast cereal

4 Conclusion

The product prepared is rich in nutrients and are a good choice to be incorporated in breakfast as a ready to eat breakfast cereal. We have found out from this study that this cereal is very nutritious as the ingredients used are rich in protein, carbohydrate, fats and are gluten free. They are best to be consumed as breakfast and are really healthy for elderly and toddlers. They are rich in antioxidant so they help in reducing the risk of chronic disease development because they negate those free radicals from causing havoc to our cells. They are good for diabetic patients as they regulate blood sugar and also prevent anemia.

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