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Comparative Study of Nutrient Composition of Selected Cereal Grains Available in Jaffna, Sri Lanka

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ABSTRACT

Grains are the seeds of grass-like plants called cereals. Grains contain important nutrient necessary for human health. Consumption of grains and grain foods is encouraged in dietary guidelines around the world because of the significant contribution of the nutrient content of grains. The present work aims to compare the general nutrient composition of selected seventeen grains available in Jaffna, Sri Lanka to consider them as excellent candidates for consumption. Proximate macronutrient content of the seeds of selected grains were estimated by nutrient content analysis according to the standard protocols recommended by the Association of Analytical Chemists (AOAC), the USA at the Department of Botany, University of Jaffna and compared the general nutrient composition among cereal grains. Grain varieties have moisture contents varied from 3.70% to 14.42%, ash contents varied from 0.66% to 5.52%, fat contents ranged from 2.80% to 52.93%, protein contents varied from 7.44% to 48.47%, and carbohydrate contents varied from 12.39% to 68.58%. Black gram has the highest moisture content (14.42%), soya has the highest ash (5.52%) and protein content of 48.47% while sesame has the highest fat content (52.93%). Among the entire samples, soya possesses some desirable nutritional attributes than other grains with respect lower fat and carbohydrate and greater protein (48.47%) and ash content (5.52%).

Keywords: Grains, Nutrient content, Fat, Carbohydrate, Protein, Ash and moisture.

INTRODUCTION

The world population has topped 7.7 billion people and is predicted to double in the next fifty years (World Population Prospects-Population Division-United Nations, 2018). Ensuring an adequate nutritional food supply for this booming population is going to be a major challenge in the years to come. Malnutrition is common in third world countries where impoverished people rely on single crop rice for the main staple food of their diet [1]. The growing third world population requires more protein and good nutrition for a healthy lifestyle. Nutrition plays a vital role in the prevention of diseases. The richest source of protein and nutrients are those that can be derived from cereal grains present abundantly in the developing countries [2].

Cereals are the edible seeds or grains and classified under the grass family, Gramineae. A large number of cereals are grown all over the countries in the world, including wheat, barley, maize, sesame, gram sorghum, etc. among them rice and wheat are mostly cultivated and accounting for 50% of the total world's cereal production [3].

The seed is the beginning and the end of the life cycle of many higher plants. Seeds are a vital component of world diets. Cereal grains contribute to half of the global per capita energy intake [4]. All of the cereal has some structural similarities and consist of an embryo that is the fusion product of male and female gametes, endosperm (reserved food materials which supply nutrients for the growing embryo) and seed coat which helps to protect the embryo from mechanical injury and from drying out.

Foods are mainly made up of five main nutrients; carbohydrate, protein, fat, vitamins, and minerals. Cereals contain above nutrient in a good proportion in their natural form [3]. When cereals are refined by the removal of the outer covering; the remaining endosperm is mostly carbohydrate and lacks the majority of the other nutrients due to this refining [5].

Proximate Analysis stands for a method which determines the values of the nutrients in food samples and partitioned the compound in food in to five main categories based on chemical properties of food and feeding stuffs for moisture, nitrogen (for protein), ether extract (for fat), ash (minerals) and carbohydrate content is calculated difference.

There is a lot of cereal grains are available and consumed by the people in Jaffna but their nutritive values may vary to a considerable extent. Therefore, there is a need for a systematic study to assess the nutritive values of cereal grains available in Jaffna.

Therefore, the objective of this study was to investigate the proximate general nutritional composition of selected cereal grains available in Jaffna, Sri Lanka to consider them for consumption.

MATERIALS AND METHODS

Sample collection

Seventeen different types of cereals commonly consumed by the people in the study area (Jaffna, Sri Lanka): black gram, maize, horse gram, finger millet, beans, barley, green gram, chickpea, soya, little millet, groundnut, foxtail millet, red cowpea, Kodo millet, sesame, wheat and green pea were obtained from local markets and grocery stores, collected in polythene bags and transferred to the laboratory for analysis.

Sample preparation

Grains were washed with distilled water and dried in direct sunlight and milled into a fine powder with laboratory mill and pass through a sieve then stored in airtight bottles and maintained at room temperature until use. Five replicates from each sample were used in this study.

Proximate composition

Standard methods recommended by the Association of Analytical Chemist (AOAC) were used in the analysis [6]. This method consists of the analytical determinations of water (moisture), ash, crude fat (ether extract), crude protein and carbohydrate.

Moisture content

An empty dish and the lid were dried in an oven at 105°C for 3 hrs and transferred to desiccators until cool and weight was recorded. Subsequently, the seed sample was placed in the dish and oven dried at 105°C until a constant weight is reached. After drying, the dish with partially covered lid was transferred to a desiccator for cooling and the weight of the dish was recorded.

Ash content

Crucible and the lid were placed in the furnace at 550°C for overnight to ensure that impurities on the surface of the crucible are burned off. Crucible was cooled in the desiccator for 30 min and weight was recorded. Weight of sample and crucible was then measured (before ignition) again. Crucible with the sample was heated over low Bunsen flame with half covered lid and placed in a furnace until fumes are no longer produced. Crucible was then heated at 550°C for overnight, cooled in a desiccator and the weight was recorded.

Crude fat content

A flask and the lid were placed in an incubator at 105°C overnight to ensure the weight of the flask is stable. The weighed sample was filled into extraction thimble and transferred into a Soxhlet apparatus. Petroleum ether (250 ml) was filled into the flask and heated for about 14 hrs (heart rate was 150 drops/min). The solvent was evaporated by using a vacuum condenser. Flask was incubated at 80-90°C until the solvent is completely evaporated and the flask was completely dried. Then the flasks were transferred to the desiccator for cooling and the residue weight was recorded.

Protein content

The weighed sample was placed in a digestion flask. Then Kjedahl catalyst (5 g) and of concentrated H_2SO_4 (200 ml) was added. A separate flask was prepared as the blank by adding above chemicals except for the sample. Flask was placed in an inclined position and heated gently until frothing ceases and boiled briskly until the solution was clear. The the flask was allowed to cool and 60 ml of distilled water was added. Flask was connected to digestion bulb with the tip of condenser immersed in standard acid (H_2SO_4) and 5-7 drops of mix indicator in the receiver. The condenser was rotated to mix the content thoroughly and heated until all NH_3 was distilled. Then the receiver was removed and titrated with standard NaOH solution.

Carbohydrate content

The total percentage of carbohydrate content in the grain sample was determined by the difference method as reported by Onyeike et al. [7].

RESULTS AND DISCUSSION

The results of the present investigations on the proximate composition of the cereal samples were presented in Table 1.

Table 1. Comparison of general nutritional composition of selected grains

Grains	Moisture content (%)	Ash content (%)	Fat content (%)	Protein content (%)	Carbohydrate content (%)
Black gram	14.42	3.33	6.99	24.94	50.32
Beans	11.07	4.21	2.8	20.13	61.81
Horse gram	10.53	3.69	4.97	21.88	58.94
Green gram	10.83	3.58	7.78	22.75	55.06
Soya	9.81	5.52	9.23	48.47	26.97
Ground nut	5.17	2.57	50.76	25.07	16.43
Red cowpea	10.65	3.59	8.44	22.31	55.06
Wheat	12.7	1.06	5.41	15.23	65.61
Maize	12.05	2.06	6.47	10.85	68.58
Finger millet	14.07	1.61	8.45	9.19	66.69
Barley	12.93	0.66	10.99	7.88	67.55
Chick pea	12.9	2.52	11.53	17.94	55.12
Little millet	10.8	3.54	7.09	11.03	67.55
Foxtail millet	9.89	2.57	9.26	13.17	65.12
Sesame	3.7	3.59	52.93	27.39	12.39
Green pea	11.15	2.62	9.77	22.31	54.14
Kodo millet	10.24	2.37	12.56	7.44	67.4

Moisture content was highest in black gram (14.42%) and lowest in sesame (3.70%). The food with adequate moisture content facilitate the growth of microorganisms and spoil the food while low moisture content in food samples increased the storage periods of the food products [8-10]. Therefore the lower moisture content value of the sesame indicates that it would have a good keeping quality than the other cereals under consideration.

Protein is the most important macronutrient necessary for growth and bodybuilding was found to be the highest in soya (48.47%) and lowest in kodo millet (7.44%). According to Pearson [11], plant food which contains more than 12% of protein is considered a good source of protein-rich food. Therefore in this study, black gram, beans, horse

gram, green gram, soya, groundnut, red cowpea, wheat, chickpea, sesame, and green pea have more than 12% of protein and those cereals can be considered as a good source of protein-rich food.

Highest crude fat content was found in sesame (52.93%) followed by groundnut (50.76%) and the lowest level of crude fat was observed in beans (2.80%). This low percentage of crude fat facilitates the prolonged storage of the grains as it reduces the food spoilage by rancidity (peroxidation of polyunsaturated fatty acid). If the grains spoil due to rancidity that would produce an unpleasant odor and change the nutrient content of food thus it reduces the consumption of food intake. Therefore cereal grains with higher fat content (sesame and groundnut) have less keeping or storage quality among the cereal grains tested.

The ash content, which is an index of mineral contents, was found in the range of 0.66% to 5.52%. Soya having the highest value (5.52%). Most of the grains contain carbohydrate as the major food component. It was found in the range of 12.39% for sesame to 68.58% for maize followed by barley and little millet (67.55%). The starch is the main part of the carbohydrate of all cereals [12]. FAO (Food and Agriculture Organization) reported that grains such as millet, maize, rice, and sorghum are high in starch and food materials with high starch absorb a lot of water during cooking. In this present study also most of the cereal grains contain greater carbohydrate content except soya, sesame and groundnut.

CONCLUSION

This study investigated the proximate composition of seventeen different types of cereal grains available in Jaffna, Sri Lanka. From the results obtained, Soya was ranked best among all cereal grains as it possesses desirable nutritional attributes than other grains samples analyzed with respect to highest protein (48.47%) and ash content (5.52%) and lower carbohydrate content (26.97%).

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