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An analysis of multigrain testing for their nutritional availability

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Abstract
"An analysis of multigrain testing for their nutritional availability " with the objectives to determine the nutrient composition of different products by the incorporation of multigrain flour and Spirulina powder at different levels, to assess the organoleptic evaluation which were serve as treatment T_1 (refined flour + multigrain flour + spirulina powder 75:20:5), T_2 (refined flour + multigrain flour + spirulina powder 65:30:5) and T_3 (refined flour + multigrain flour + spirulina powder 55:40:5) respectively, and "Momos" was served as treatment T_1 (refined flour + multigrain flour + spirulina powder 75:20:5), T_2 (refined flour + multigrain flour + spirulina powder 65:30:5) and T_3 (refined flour + multigrain flour + spirulina powder 55:40:5) without incorporation of "Multigrain flour and Spirulina powder" (T_0) served as control. They were replicated five times for all three products and organoleptic evaluation was carried out using the nine point hedonic scale. Nutritional composition was calculated using the food composition table (Gopalan *et al.* 2011), data obtained during investigation were $_{11}$statiscally analysed by using analysis of variance (ANOVA) and critical difference (CD) techniques.

Keywords: multigrain testing, nutritional.

1. Introduction
The Institute of Medicine's Food and Nutrition Board (IOM/FNB, 1994) defined functional foods as "any food or food ingredient that may provide a health benefit beyond the traditional nutrients it contains." Functional foods are an important part of an overall healthful lifestyle that includes a balanced diet. Functional foods, provide benefits beyond basic nutrition and play a role in reducing or minimizing the risk of certain diseases and other health conditions. Examples of these foods include fruits and vegetable tables, whole grains, fortified foods and beverages and some dietary supplements. The potential of functional foods to mitigate disease, promote health, and reduce health care costs. Functional characteristics of many traditional foods are being discovered and studied, while new food products are being developed to include beneficial components. By knowing which foods can provide specific health benefits, we can make food and beverage choices that allows greater control of our health. (Hasler 1998) Multigrain composite mixes were prepared from different cereals, legumes, millets, nuts along with condiments by different processes. Multigrain composite mixes had 10 to 12percent moisture, 56 to 61percent carbohydrate, 15 to 20percent protein, 9 to 13percent crude lipid and 2 to 3percent ash. Energy value ranged from ~1600 to 1700 kJ/100 g. Among the vitamins studied, thiamine and riboflavin content varied from 0. 23 to 0.45 mg percent and from 8.7 to 21.6 microgram percent respectively. Dietary fibre was in the range of 12.4–16.5percent. Swelling power of these mixes was about 10; however solubility varied from 17 to 22percent. In-vitro Starch digestibility varied from 60 to 76percent. Pythic acid content in these multigrain composite mixes varied from 0.6 to 0.8percent. Poly-phenols ranged from 1.2 to 1.5 percent, DPPH free radical scavenging activity ranged from 75.2–86.2percent and metal chelating activity ranged from 1.9 to 3.9percent. Pasting profile by a bender Viscograph of these mixes indicated that they have cross linked starch type behaviour. These multigrain composite mixes can be used for the preparation of food formulations, savoury products. Pan cake, snacks preparation like muruku and chakli. (Singh et. al 20011)
A multigrain product contains more than one grain, such as a mix of wheat, oats, barley and cornmeal. In these products the grains might not necessary be whole grains. Because the product contains multiple grains, it may not use the entire components of the grain, costing the product significant nutritional value.

Method and Materials

The present study "Standardization of Traditional Snacks by Incorporation with Admixture of Multigrain flour and Spirulina for Value Addition." was conducted in the Nutrition Research Laboratory, Department of Foods & Nutrition, Ethelind School of Home Science, Sam Higginbottom Institute of Agriculture, Technology and Science (SHIATS), Allahabad.

The materials and methods adopted during this investigation are reported in this work. The sequence of operation designed to conduct the experiment is a mention below-

Experimental Site

The present investigation was carried out in the Research Laboratory of Department of Foods & Nutrition, Ethelind School Of Home Science, Sam Higginbottom Institute of Agriculture, Technology & Sciences (SHIATS), Allahabad.

Procurement of raw materials:

1. Spirulina was purchased online from Medizen labs, Bangalore-18.
2. Brown rice, Oats, Ragi, Chickpea, Maize, refined wheat flour were purchased from the Local market of Naini, Allahabad.
3. Spices and condiments, salt, oil, vegetableetable, onion, garlic, tomatoes, baking powder, cumin powder, ginger garlic paste, fresh coriander leaves were purchased from the local market of Allahabad.

Preparation of multi grain

Composite multi grains

↓

(Maize, Brown rice, Oats, Ragi, Bengal gram)

↓

Cleaning (Chaff, Dirt, etc.)

↓

Sun drying in thin layers till 10 percent moisture remain

↓

Grinding to fine smooth flour in Atta maker

↓

Storing in air tight container
(At room temperature in dry place)

Source: (K. M. Sahai, K.K. Singh, 1991)

Table 1: Ratio of Admixture Flours

Ingredient	To	T_1	T_2	T_3
Refined flours	100%	75%	65%	55%
Spirulina		5%	5%	5%
Multigrain flour		20%	30%	40%

Table 2: Ratio of multigrain flour

Oats	5%	8%	12%
Brown Rice	5%	4%	5%
Ragi	3%	4%	8%
Mazie	3%	2%	3%
Bengal gram	4%	12%	13%

Fig 3.1: Flow Diagram for preparation of Multigrain Flour

3.4. Details of Treatment:

Vegetable Momos were prepared using varying proportion of the main ingredients Multigrain flour and Spirulina powder.

(1) Momos -

- Control (T0): Momos prepared from refined flour.
  Treatment (T1): Momos prepared from mixture of refined flour and multigrain flour and spirulina in a ratio of 75:20:5 respectively.
- Treatment (T2): Momos prepared from mixture of refined flour and multigrain flour and spirulina in a raito of 65:30:5 respectively.
- Treatment (T3): Momos prepared from mixture of refined flour and multigrain flour and spirulina in a raito of 55:40:5 respectively.

3.5. Nutritional composition of Multigrain flour

Proximate Composition

Methods described by AOAC (2005) were used for determination of chemical composition of selected products. This included estimation of moisture, ash, fat, fibre, protein and carbohydrate was calculated by difference method.

Determination of Moisture

Principle

Sample is heated at specified temperature for specific period of time and the loss in weight was recorded as moisture content of the sample.

Requirements

Aluminium dishes, Tongs, Desiccators, and Analytical balance and Hot air oven.

Procedure

Accurately weighed 5 g of the sample in a tare porcelain dish. 3(W_1 g). Dish was shaken until the contents were evenly distributed. Dish was placed in a Hot air oven maintained at 105ºC ± 2ºC and dried for at least 2 h. Dish was cooled in desiccators and weighing was repeated until the difference between two successive weighing was not more than 0.0002 g. The lowest weight was noted (W_2 g).

Observation

Tare weight of dish = W g
Wt. of dish with sample = W_1 g
Wt. of dish + sample after keeping in oven = W_2 g

Calculation

$$\text{Moisture percentage} = \frac{\text{Loss of weight}}{\text{Initial weight of sample}} \times 100$$

$$= \frac{W1-W2}{W1-W} \times 100$$

Determination of protein (lowry's method)

The Lowry's reaction for protein estimation is an extension of the Biuret Method. The method developed by Lowry *et al.* (1951) is about 10 times more sensitive than the Biuret method. Hence, it is largely followed to determine the protein content of enzyme extracts.

Determination of crude fat

Principle

The sample of dried food stuff is placed in a continuous extractor (Soxhlet) and subjected to extraction with the ether. The ether soluble substance thus removed and collected in a flask, dried and weighed. The material extracted includes besides triglycerides, materials such as phospholipids, essential oils, pigments, waxes etc hence term 'crude fat'.

Requirements: 1.Soxhlet extractor. The extraction consists of a) condenser b) extractor c) receiver d) extraction thimble.

2. Petroleum ether
3. Heating elements.

Calculation

Percentage of ether extract was calculated by multiplying the increase in weight of the extraction flask by 100.

Percentage fat in sample = $\frac{W2 - W1}{W} \times 100$

Determination of crude fiber

Principle

The dry fat free material was boiled successively with dilute acid and alkali for a specified time period and filtered. The residue was dried and ignited. The loss in weight an ashing gave the crude fiber. This consisted chiefly of cellulose and lignocelluloses.

Apparatus

- Reflux water condenser
- Conical flask(1 litre capacity)
- Gooch crucible prepared with thin but compact layer of ignited asbestos.

Reagents

- Dilute sulphuric acid – 1.25 percent (0.25 N), accurately prepared
- Dilute sodium hydroxide solution - 1.25percent (0.313 N), accurately prepared
- Ethyl alcohol - 95percent

Observation

- Tare weighed of Gooch crucible (W gm)
- Weighed of Gooch crucible after washing with ethyl alcohol= (W_1 g)
- Weighed of Gooch crucible, and
- Weighed of heated Gooch crucible difference

Weighed of Gooch crucible + sample (ash) (W_2 gm)/ weight of residue (W_2×W) gm

Calculation

Subtract the weighed of the ash from the weighed of the residue dried at 105˚C to obtained the weighed of the crude fiber, calculated its percentage on moisture free basis.

Percentage of crude fiber = (W_1× W) + (W_2 × W)/ 2 × 100

Minerals- Iron and calcium were also be estimated by AOAC (2005) by standard procedures.

Determination of iron

Principle

Ferrous iron in acid solution reacts with the potassium thiocynate to form an intense red compound of ferric thiocynate. The compound is extracted with the organic potassium persulphate and measured colorimetrically at 560 nm.

$Fe^{+3} + 6CNS \longrightarrow [Fe(CNS)_6]$

Ferric thiocyanate (Red coloured)

Reagents

a) Stock iron (0.1 mg ferric iron/ml)
b) Working or standard iron (0.01 mg of iron/ ml).
c) Saturated Potassium persulphate solution.
d) 3N Potassium Thiocynate solution.

Observation

Colorimeter reading for blank solution = RB
Colorimeter reading for saturated (working) solution = RS
Colorimeter reading for ash solution = RA
Concentration of standard solution = Cs = 0.1 mg/ml
Weight of sample = W
Total volume of stock iron solution prepared = V
Volume of solution used for colour development = V1

Calculation

Concentration of iron in ash solution = $Cs \times \frac{RA - RB}{Rs - RB}$

Concentration of iron in sample (mg/ml) $Cs \times \frac{RA - RB}{Rs - RB} \times \frac{V}{V1} \times \frac{100}{W}$

Determination of calcium

Principle

Calcium in ash can be determined volumetrically. The acidic extract is treated with ammonium oxalate at pH 4.0 which precipitates calcium as calcium oxalate (CaC_2O_4).

Precipitation

$CaCl_2 + (NH_4)_2C_2O_4 \longrightarrow CaC_2O_4$ (white precipitate) $+ 2NH_4Cl$

The precipitate is purified and dissolved in hot sulphuric acid resulting an equivalent amount of oxalic acid.

Dissolving precipitate

$C_2O_4 + H_2SO_4$ (hot) $\longrightarrow H_2C_2O_4$ (Oxalic acid) + $CaSO_4$

The amount of oxalic acid is determined by titrating with standard solution of KMnO4

Titration

$5H_2C_2O_4 + 2KMnO_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O$

Reagents

- Ammonium oxalate solution – 4-5 percent
- Ammonium Hydroxide – 6N
- Dilute Hydrochloric acid – 5N
- Dilute Sulphuric acid – 5N
- Standard Potassium Permanganate Solution – 0.1 N
- Methyl Orange Indicator – 1percent

Observation

Volume of 0.1 N KMnO4 (V-ml)

Calculation

- Amount of Calcium= Volume of KMnO4 × 0.02= ….. g of Calcium
- 1 Equivalent of KMnO4 = 1 equivalent of calcium
- 1000 ml of N KMnO4 = 20 g Calcium

Amount of Calcium in Food = $\frac{\text{Amount of calcium} \times 10}{50 \times (w1 - w2)} \times 100$

Estimation of Carbohydrate

Total carbohydrate by difference method was calculated by subtracting the sum of percentage of protein, fat, ash and moisture. Carbohydrates are divided into two groups, crude fiber and nitrogen free extract. Total carbohydrate includes crude fiber also but nitrogen free extract (NFE) is calculated by subtracting the sum of percentage of ash, crude fibre, ether extract, protein and moisture from 100.

Results and Discussion

The data recorded of the present study "Standardization of Traditional Snacks by Incorporation with Admixture of Multigrain and Spirulina for Value Addition." on different aspects as per the methodology have been tabulated and analysed statistically. The results obtained from the analysis are presented and discussed in this chapter under the following sub headings.

A. Nutritional composition of multigrain flour

Table 4.1: The average nutrient composition of multigrain flour

Nutrients/100g	T0	T1	T2	T3
Moisture (g)	10.00	8.01	7.02	6.01
Ash (g)	0.5	0.8	0.6	0.7
Protein (g)	9.8	11.26	13.64	13.79
Fat (g)	0.8	2.47	1.96	1.48
Carbohydrates (g)	73.9	63.11	70.6	71.79
Fiber (g)	2.5	2.32	2.69	2.74
Calcium (mg)	57.7	59.61	60.18	73.5
Iron (mg)	3.3	4.6	4.5	7.18
Energy (kcal)	349	337.32	333.99	341.08

Value of refined flour is taken from readymade packet

Energy 349kcal, Fibre: 2.5g, Fat: 0.8g, CHO: 73.9g, Calcium: 57.7mg, Iron: 3.3mg

Calcium, iron and fiber content of multigrain flour were 2.74g, 73.5mg,7.18 mg/100g, In iron 4.5mg 4.6mgand In case of fiber 2.69g, 2.32g,2.74g respectively, which were 6-8 times greater than the refined flour i.e. 3.3mg/100g, in iron 2.74mg/100g and 2.5 g/100g respectively.

(Singh *et al.* 2011) was examined that the multigrain composite mixes had 10 to 12percent moisture, 56 to 61percent carbohydrate, 15 to 20percent protein, 9 to 13percent crude lipid and 2 to 3percent ash. Energy value ranged from ~1600 to 1700 kJ/100 g. Among the vitamins studied, thiamine and riboflavin content varied from 0. 23 to 0.45 mg percent and from 8.7 to 21.6 mg percent respectively. Dietary fibre was in the range of 12.4–16.5percent

Conclusion

On the basis of findings, it is concluded that selected multigrain flours and Spirulina were found to be good sources of nutrients i.e. Energy, protein, calcium fiber and iron. Admixture of flours can be successfully incorporated with multigrain flour and Spirulina powder to enhance the sensory and nutritional properties of the products made. The sensory scores of the prepared products with different flours were highly acceptable in terms of taste and flavour, body and texture, color and appearance and overall acceptability when compared with control. The food products prepared from multigrain flour and Spirulina were rich in fiber, calcium, iron and protein content which increased significant as the incorporation level increased. Cost of developed products per 100g increased as the incorporation level increased in all food products when prepared with different flour combinations.

Recommendations

Incorporation of developed products which are nutrient rich and low fat recipes intake daily diet can be recommended to at risk groups (vulnerable – preschool, adolescent and other age group) in order to improve their nutrient intake particularly of protein, fibre, carbohydrates, calcium content. They can also be helpful from the therapeutic point of view for the people suffering from various diseases such as Malnutrition, Osteoporosis, and Anaemia

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