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Proximate Analysis, Functional and Sensory Evaluation of Buckwheat and Water Chestnut Composite Flour

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Abstract: ***Buckwheat and Water Chestnut flour blends were prepared in different proportions like1:1, 1:2, 2:1 ratio. Functional and rheological properties of the composite flour were examined and compared with locally available wheat flour as control. After the assessment it was found that protein, fat and ash content was higher in 1:1 ratio composite, whereas carbohydrate content was higher in 1:2. Dietary fiber and moisture content were higher in 2:1 ratio and taste of 2:1 was more accepted by consumers. Present dietary scenario necessitates exploring the possibility of incorporating novel ingredients in commonly consumed foods rather than developing new food products. The study outcome orients towards employing flours made from combination of either two or three cereal flours in different ratios than using single one for the overall well-being of the population in context to different lifestyle disorders.***

Keywords: Buckwheat flour, Water Chestnut flour

1. Introduction

Fagopyrum esculentum (Buckwheat) is neither cereal grain nor related to the wheat. It is a seed but handled in a similar way like any other common cereal grains and hence named as pseudo cereal. The flour has rich, nutty flavor and a very high nutritional value, making it popular in many nations, in addition gluten free, leading people with gluten intolerance to seek it out as a wheat flour alternative. The pseudo cereal has many essential vitamins and macro minerals. The amino acids composition is well balanced and especially rich in lysine, which is generally the first limiting amino acid in other plant proteins [1]. Apart from this presence of resistant starch has given importance of this pseudocereal in various food preparations as alternative for controlling the blood sugar level. The contents of rutin, catechins, and polyphenols have even enhanced the role of this flour for their potential antioxidant activity in alleviating various free radical related diseases [2].

Trapa bispinosa Roxb (Water Chestnut) is an annual, floating-leaved aquatic plant found in fresh water wetlands, lakes, ponds, and sluggish reaches of rivers in India. In Indian Ayurvedic system of medicine this plant is used for treating the problems related to gastrointestinal, genitourinary system, liver, kidney, and spleen [3]. Water Chestnut flour is made from dried, ground water chestnut. The nuts are boiled, peeled and then ground into flour. Its primary use is as a thickening agent and to make batters for deep frying and bakery products in Indian and Asian cooking [4]. Buck wheat and Water chestnut flour is locally available at market but they are not popular in use by the common people. Both are easily digested than normal flour, more over they are gluten free, high in potassium and low in sodium content. Thus, they can be a supplement for the wheat flour usually consumed and might be very good for several diseased conditions.

Industrialization, urbanization and rapid rise in number of working women in recent years has led to a drastic change in the growth of the convenience foods in terms of quality and quantity, products available in the market, the packaging and the processing technologies involved. Convenience foods in the market vary from ready-to-eat dry products, frozen foods, various mixes, snacks [5]. Recently the research is oriented towards employing flours made from combination of either two or three cereal or pseudocereal flours than using single one. The study was aimed with interest to prepare supplementary food for various disease conditioned patients. Proximal and sensory characteristics evaluation was also the focus of the present study. Three different ratios 1:1, 1:2, 2:1 was used for the study to see the changes or any improvement in nutrient, biochemical, and sensory evaluation.

2. Method and Material

2.1 Preparation of sample

Sample were collected from local market and prepared by mixing both Buck wheat flour and Water chestnut flour in 3 ratio-

Sample no. 1-Buck wheat and Water chestnut flour were mixed in the ratio of 1:1

Sample no. 2-Buck wheat and Water chestnut flour were mixed in the ratio of 2:1

Sample no. 3--Buck wheat and Water chestnut flour were mixed in the ratio of 1:2

2.2 Estimation of nutritional composition

a) ***Determination of Moisture Content:*** The moisture content was determined by AACC protocol [6].
b) ***Determination of Ash:*** The Ash content was determined by AACC protocol.
c) ***Determination of Carbohydrate:*** The total sugar content was determined calorimetrically by the anthrone method as described in Laboratory Manual in Biochemistry [7].
d) ***Determination of Protein:*** Protein concentration was determined following the method of Kjeldahl [8].
e) ***Determination of Fat:*** Lipid content of the samples was determined as described by Soxhlet extraction method [9].

2.2.6 Determination of Crude Fiber: Crude fiber was determined by the following method [10].

2.3 Estimation of functional properties

a) *Determination of Water and Oil Absorption Capacity:* The water and oil absorption capacities were determined by the method of Köhn*et.al.*& Abu *et.al.*[11]-[12].
b) *Determination of Swelling Capacity:* The method of Hasan *et.al.*[13]with some modifications was used for determining the swelling capacity.
c) *Determination of Emulsion Activity:* The emulsion activity and stability were determined by the method of Abuluda*et.al.* [14].
d) *Determination of Foaming Capacity and Foaming Stability:* Foaming capacity and foaming stability were determined as described by Foegeding*et.al.*[15]with slight modifications.

2.4 Sensory evaluation

Evaluation was done on the basis of Five-point Hedonic scale rating (from 1=hate to 5=love) was used to determine the preference in Colour, flavour, taste, shape, smell, texture and overall acceptability. The consumers were instructed to first evaluate each sample by tasting. The intensity of perceived odour was rated as flavour.

3. Result and discussion

3.1 Nutritional content

3.1.1 Moisture Content:

Moisture content was found highest in S-3 than S-1 and S-2 whereas S-1 contained the lowest amount of moisture. Moisture content of S-3 was higher because of the WCF that contains more water molecules than BWF. So, they retain more moisture from atmosphere. Moreover, moisture content is increase due to protein content. The lower moisture content of S-1 justified the suitability for long term storage without deterioration.

3.1.2 Estimation of Ash Content:

Ash content was found highest in S-1 than S-2 and S-3 whereas S-3 contained the lowest amount of ash. The ash content of S-1 which contains both flour in equal amount, is higher due to high fat and dietary fibre content. Moreover, it also improves the nutritional value of the products made by this flour mixture.

3.1.3 Estimation of Carbohydrate Content*:*

Carbohydrate content in terms of glucose was found highest in S-2 than S-1 and S-3 whereas the lowest amount of carbohydrate was found in S-3. Resistance starch is present in both the flour along with soluble and insoluble carbohydrates. S-2 contain high amount of carbohydrate due to present of more soluble form of carbohydrate in BWF than WCF. So, S-2 which contains more BWF is high in carbohydrate and S-3 which contain more WCF, is low in carbohydrate.

3.1.4 Estimation of Protein Content:

Protein content was found highest in S-1 than S-2 and S-3, whereas S-2 contain lowest amount of protein. Both flour is gluten free and contain high quality protein with all nine essential amino acids including lysine. The protein content of these flours is almost equal so that the ratio sample also contain almost equal amount of protein.

3.1.5 Estimation of Fat Content:

The highest fat content was found in S-1 than S-2 and S-3; whereas the lowest fat content was observed in S-3. Fat content of BWF is higher than WCF but on the other hand they help to lowering body cholesterol level. S-1 contain high amount of fat due present of both sample in equal amount.

3.1.6 Estimation of Fiber Content:

Crude fibre content was found highest in S-3 than S-1 and S-2; whereas S-2 contained lowest. WCF is high in dietary fibre content than BWF due to present of more insoluble fibre which is not hydrolysed. Thus S-3 which is high in WCF, contain more amount of dietary fibre.

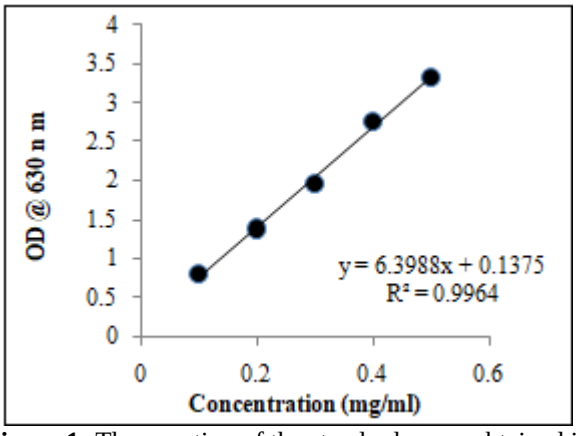

Figure 1: The equation of the standard curve obtained is y=6.396x, R^2 =0.996. From the equation the carbohydrate content of unknown sample/100g are given

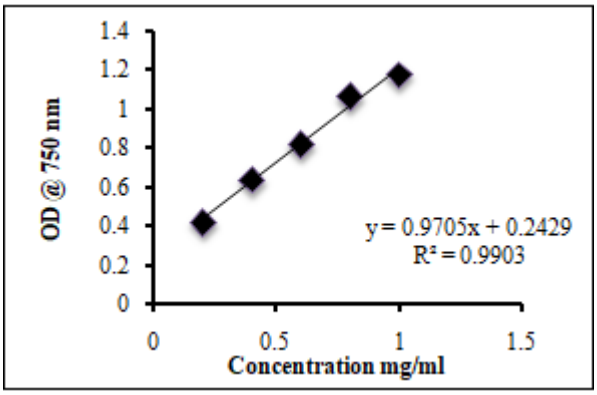

Figure 2: The equation of the standard curve obtained is y= 0.970x, R^2 =0.990. From the equation the protein content of unknown sample/100g are given in the table-4.

Table 1: Proximate Analysis of the Flour Combination

Nutrients	Samples		
	S-1	S-2	S-3
Carbohydrate(g)	69.24	72.87	61.9
Protein(g)	14.79	14.18	14.45
Fat (g)	2.2	1.6	0.8
Dietary fibre (g)	0.52	0.36	0.71
Moisture (%)	11.25	11.50	12.00
Ash (%)	15.55	10.55	5.05

3.2 Functional properties

Water Absorption Capacity (WAC): -It is evident from the table-2 that the WAC of WCF is lower than BWF so that the S-2 which is high with BWF is also having high WAC. The lower WAC of WCF and S-3 is attributed to the presence of lower number of hydrophilic constituents in WCF. On the other hand, BWF and S-2 shows more WAC due to presence of more hydrophilic constituents.

3.2.1 Oil Absorption Capacity (OAC):

The soybean oil absorption capacity of WCF was significantly higher than BWF. So that the S-3 which is high in WCF and soybean oil content also show high OAC. On the other hand, mustard oil is more absorb by BWF and S-2. OAC of S-3 is equally important as it improves the mouth feel and retains flavour. The higher OAC suggested that the presence of polar amino acids in the flour's mixture.

3.2.2 Emulsion Activity (EA):

The EA is higher in BWF so that the S-2 also shows higher EA due to presence of more BWF in this sample. The protein content of S-2 shows high EA than S-1 and S-3. High EA with high foaming capacity flour is used in several bakery products. They are also good for soup, confectionary, sweet and cakes.

3.2.3 Foaming Capacity (FC) and Foaming Stability (FS):

The foaming capacity of BWF and S-2was higher than that of WCF. Foaming capacity is assumed to be dependent on the configuration of protein molecules. Flexible proteins have good foaming capacity but highly ordered globular molecule gives low foam ability. The foam expansion and foam stability have been correlated with water-dispersible nitrogen. Foaming stability is only showed by S-2. Food ingredients with good foaming capacity and stability can be used in bakery products.

3.2.4 Swelling Capacity (SC):

The SC of WCF than BWF. But SC of sample is almost equal. BWF recorded less SC than WCF indicating that WCF have higher value of physic chemical properties. Due to swelling and hydration capacity it is used in several food items as thickening agent like soups.

Table 2: Functional Properties of the samples

Properties	BWF	WCF	S-1	S-2	S-3
WAC %	118	95	105	111	101
OAC (Soybean)%	94	95	97	93	99
OAC (Mustard)%	86	83	88	87	85
EA %	5	1	0.5	5.5	0.5
FC %	5	-	-	10	-
FS %	-	-	-	5	-
SC %	14	16	13	13	12

3.3 Sensory evaluation

As it can be observed from the result the colour, shape, texture, smell, taste and overall acceptability of the product made (Uttapam) are much higher in sample-3 as compare to other two samples. So that it is evident that sample-3 is more acceptable by the consumer. Sample-3 also has good nutritional and functional property than Sample-2 and Sample-1. Biscuit or bread made from BWF supplemented with WF and cookies made from WCF Supplemented with WF and Cassava flour [16]-[17] required cooking technique as well as cooking utensils which are not required for product (Uttapam) made with the present test samples.

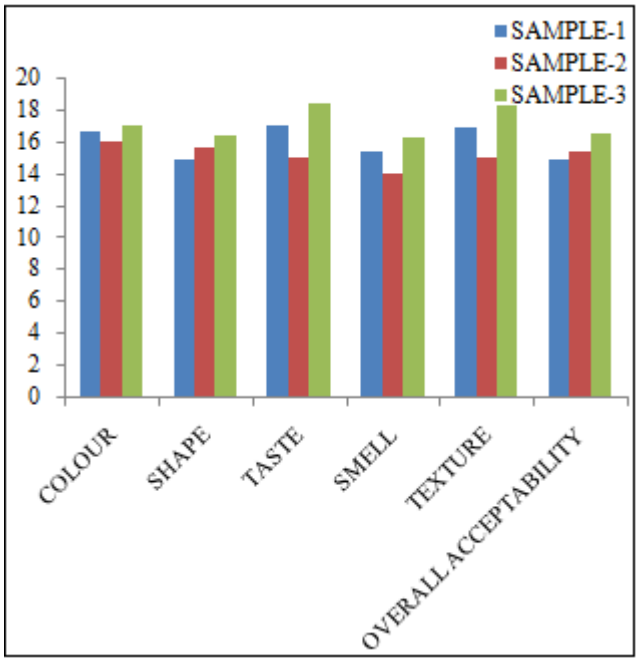

Figure 3: Sensory Evaluation of the Food Products with Flour Variations

4. Conclusion

Present dietary scenario necessitates exploring the possibility of incorporating novel ingredients in commonly consumed foods rather than developing new food product. In

recent years the consumer demand is increasing for composite flour-based food products like ready to make flour mixes or batters as they are most convenient to prepare the required dish in no time. Composite flour mixtures represent an interesting option for the management of disease and cost maintenance associated with single flour dependence in developing countries. With the constant increase in the consumption of bread and other baked products in many developing countries, coupled with ever-growing urban populations, the composite flour mixture from locally available crops could be very useful. The ingredients used in composite flours depend on the availability of raw materials in the country concerned. Indian subcontinent is endowed with an enormous biodiversity of plant resources, which could be exploited for this purpose. This piece of research is oriented towards employing flours made from combination of either two or three cereal flours in different ratios than using single one. Unfortunately, many of these abundant resources remain largely underutilized. Indigenous crops are low-input produce; as such, they are important for agricultural diversification and can provide a unique opportunity to combat food and nutritional insecurity.

Buck wheat and water chestnut were selected for the above-mentioned studies as these are commonly consumed foods in the Indian context. Overall, three ratios 1:1, 1:2, 2:1 (S1, S2, and S3) were selected for the studying the changes or any improvement in nutrient, biochemical, and sensory evaluation for developing ready to use flour in domestic house hold level.S-1 combination high amount of protein without gluten. Thus, it can be easily digested by the patient suffering from celiac disease. It not only helps to improve the condition, but also add variety to the diet of the patient. S-3 combination has low amount of glucose compare to regular wheat flour. So that it can be given to diabetic patients. It helps to maintain the blood glucose level and might improve the diseased condition. Moreover, incorporation of vegetable helps to maintain body weight which is an important factor of diabetes. At the same time S-3 is also low in fat content. It also has unique property of cholesterol lowering activity. So that it helps to maintain weight and also helps to prevent obesity related health diseases. S-2 combination contains low amount of sodium which is important for controlling hypertension. All three combinations more or less contain high amount of dietary fiber as compare to commercial wheat flour. It also helps in the better digestion of food. In short, this product might prevent constipation and help to improve the condition. The study overall indicates that the inclusion of locally available flours like Buckwheat and Chestnut in the daily diet in combinations might help the overall well-being of the population.

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