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Evaluation of nutritional and functional properties of partially substituted whole wheat flour with taro root and lotus seed flour (Composite flour)

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Abstract
The present study was undertaken to develop composite flour by blending taro root and lotus seed flours with whole wheat flour in different variations. 80:10:5 (VI), 80:10:10(VII) and 75:15:10 (VIII) were prepared respectively. Physico-chemical, mineral estimation and functional properties were studied on composite flour variations. Nutritional evaluation shows that the incorporation of taro root and lotus seed flour in regular wheat flour increases its quality. The functional properties of composite flours were analyzed. Water absorption capacity and oil absorption capacity was increased while foam capacity, emulsion activity, decreased with increasing the level of incorporation of other flours. The functional properties of composite flours ranged from 146.56%(±0.01)-156.22%(±0.06), 92.10%(±0.10)-101.37%(±0.15), 10.12%(±0.02)-5.99%(±0.25), 40.12%(±0.02)-36.88%(±0.01) for water absorption capacity, oil absorption capacity, foaming capacity and emulsion capacity respectively. The mineral content observed in the range of 8.00(±0.06)-9.29(±0.04), 145.5(±0.16)-172.32(±0.01), 0.119-0.144 mg/100gm. Relevant statistical analysis was done to analyze mean and standard deviation for all tested parameters.

Keywords: Composite flour, taro root and lotus seed, functional properties, mineral estimation

Introduction

Composite flour as a mixture of flours, starches and other ingredients intended to replace wheat flour totally or partially in bakery and pastry products. The composite flours used were either binary or ternary mixtures of flours from some other crops with or without wheat flour [1]. wheat flour prepared from mixtures of flours from cereals, roots, tubers, legumes, or other raw materials, to be used for traditional or novel products [2].There are several advantages of composite flours. It gives a better supply of protein for human nutrition and better overall use of domestic agriculture production. Several institutions, including the Food and Agriculture Organization (FAO), have been involved in research designed to find ways of partially substituting wheat flour with those from other sources or replacing wheat. The ingredients used in composite flours depend on the availability of raw materials in the country concerned. The goal is to minimize cost of production compared to the cost of imported wheat because this would enable affordability of the final product by consumers [3].

Taro (*Colocasia esculenta*) is a vegetative propagated tropical root having its origin from South-east Asia.the root crop belongs to the genus *colocasia* in the plant family called Araceae.It occupies 9th position among world food. Taro tubers are important sources of carbohydrates as an energy source and are used as staple foods in tropical and sub-tropical countries [4]. It has two specie which are known as *Colocasia esculenta* and *Colocasia antiquorum.* Taro root vegetable originally cultivated in Asia but now used around the world. These roots are the good source of fiber and other nutrients and offers a variety of health benefits, including improved blood sugar level gut and heart health. With a digestibility of about 98.8%, taro root is appropriate for use in infant food, food for elderly and the sick. People who are often allergic to cereals and babies who are intolerant to milk can easily consume food prepared from taro [5].

Lotus (*Nelumbo nucifera)* is an aquatic perinnial plant belonging to family *Nelumbonaceae.* The species is of significance in South East Asia and the seeds and leaves are also eaten in this region. Lotus seeds are edible, medicinally versatile and used as an important raw material of traditional Ayurvedic medicine to treat many ailments such as tissue inflammation, cancer, diuretics, skin diseases and poison antidote. The seeds are sold in shelled and dried form [6]. In recent years there has been an increase in research on Lotus seeds both nationally and internationally, with its edible value, nutritional value, and commodity value beginning to be recognized. However, research into Lotus seeds mainly focuses on the full ripe stage, and includes seed appearance, nutritional and health properties, processing quality, and starch quality. In a study on the nutritional ingredients present in Lotus seeds, it was found that the seeds contain a certain amount of resistant starch. Resistant starch is a type of starch that can not be absorbed and used by a healthy small intestine, but can be fermented or partly fermented in the colon by coliform bacteria, resulting in decreased blood sugar and insulin levels, which, in turn, may help to prevent diabetes, hyperlipidemia and colon metabolic diseases [7].

Materials and Methods

Preparation of raw material

The good quality Taro roots without any bruises, lotus seed and whole wheat flour were purchased from the local market of Gwalior city. The composite flour was prepared after preparing the raw materials. The raw taro was washed in running water to clean the dirt and peeled. The roots were diced, washed and socked for an hour. The socked sample was steamed, mashed and dried at 40 C for 6-7 hours until completely dried. The dried samples were milled using laboratory grinder and passed through sieve to get the uniformity. The lotus seeds were socked overnight to loosen the outer shell, dried at 40 C for 3-4 hours to remove the moisture, milled and sieved. The obtained flours were packed in sealed plastic bags at ambient temperature till further used.

Table 1: Composition of Composite flour

Variations	Whole wheat flour (%))	Taro flour (%)	Lotus Seed flour (%)
Control	100	-	-
V-I (15%)	85	10	5
V-II (20%)	80	10	10
V-III (25%)	75	15	10

Proximate analysis of Composite flour

Proximate analysis was conducted on the control cookies and cookies prepared from the substituted flour. According to AACC standard methods, moisture content was carried out based on AACC method (44-19.01) [8]. The hot air oven was set at a temperature of 135°C.The crude fat content was determined by soxhlet extraction method described in AACC (2000), method [30-25.01] [9]. Crude fiber analysis was conducted based on AACC method [32-10-01] [10]. The crude protein content was determined by the method described in AACC method (46-10.01) [11]. The ash content was determined by the method described in AACC (2000), Method no. (08-01.) [12]. Carbohydrate content was calculated using the following equation.

Carbohydrate Content: Carbohydrate content was calculated using the following equation**.**

% Carbohydrate = 100% - (Moisture + Crude fat + Ash + crude protein) %

Functional properties of Composite flour

Water absorption capacity- A 2 g sample of composite flour was dispersed in 20 ml of distilled water. The contents were mixed for 30s every 10 min using a glass rod and after mixing five times, centrifuged at 4000 g for 20 min (slightly modified). The supernatant was carefully decanted and then the contents of the tube were allowed to drain at a 45° angle for 10 min and then weighed. The water absorption capacity was expressed as percentage increase of the sample weight [13].

WAC (%) = [{W2-W1}/Weight of sample] × 100

Foaming capacity

Two grams of composite flour sample and 50ml distilled water were mixed at room temperature. The suspension was mixed and shaken for 5 minutes at 1600rpm. The content along with the foam was poured into a 100ml graduated measuring cylinder. The total volume of foam was recorded after 30seconds.The content was allowed to stand at room temperature for 30 minutes and the volume of foam only was recorded [13]

$$FC\ (\%) = \frac{\text{Vol. of foam after whipping -Vol. of foam before whipping}}{\text{Vol. Of foam after whipping}} \times 100$$

Oil absorption capacity: The method of was used to determine oil absorption capacity. 10 ml. vegetable oil was added to 1 gm. of each sample. The samples were stirred at 1000 rpm. The mixture was then centrifuged at 3,500 rpm for 30 minutes. The absorbed oil was expressed as the percentage of oil bound by 100 g sample [14].

$$\text{Weight \%} = \frac{\text{(Vol. of absorbed oil x100)}}{\text{Weight of sample}}$$

Emulsion activity: The emulsion activity and stability described and followed as the emulsion (1 g sample, 10 ml distilled water and 10 ml soybean oil) was prepared in calibrated centrifuged tube. The emulsion was centrifuged at 2000 ×g for 5 min. The ratio of the height of emulsion layer to the total height of the mixture was calculated as emulsion activity in percentage [13]

Results and Discussions

Physico-chemical properties that reflect the complex interaction between the composition, structure, confirmation and physico-chemical properties of protein and other food components and the nature of environment in which these are associated and measured. In this research different functional and physico-chemical properties of composite flour were analyzed by using standard procedures.

Nutritional analysis

Analysis of taro root and lotus seed flours

The moisture content of wheat flour, taro flour and lotus seed flours were analyzed and found as 10.2% (±0.06) and 9.7% (±0.05). The ash and crude fiber content was observed 4.32%

(±0.01) (taro root flour) 10.00% (±0.11) (lotus seed flour) and 2.81% (±0.01) (taro root flour) 2.66% (±0.02) (lotus seed flour) respectively. The fat content of taro root flour was found lower than lotus seed flour. It was observed 0.093% (±1.15) in taro flour and 0.186% (±1.00) in lotus seed flour. The protein content of both flours were measured in good range. It was reported as 8.316 % (±0.05) in taro root flour and 14.80% (±0.20) in lotus seed flour. The higher carbohydrate content was attributed in taro root flour. It can be stated from the observations that the higher carbohydrate content of taro root is because of the higher starch content present in root. Its was found 72.26% (±0.01) in taro root flour and 62.65% (±0.01) in lotus seed flour respectively.

Analysis of Composite flours

The moisture content of composite flours are presented in Table III which ranged from 8.4% (±0.12) -7.45% (±0.01). It is clear from the results that the moisture content decreased with increased in proportions of taro and lotus seed flours when compared to the standard wheat flour. The highest moisture content was observed for variation I 8.4 % (±0.12) and lowest for variation II 7.45% (±0.01). The crude fiber content of composite flours were found increased when compared with wheat flour the fiber content of standard wheat flour was observed 1.54%(±0.02). The crude fiber content ranged from 1.66(±0.03)-1.74(±0.03) %. The VII (20% substitution) had the highest ash content 1.72% (±0.03) while the lowest value 0.96% (±0.025) was observed in VIII (25% substitution). The increased ash content in composite flour may be attributed to the higher mineral content of taro root and lotus seed. The ash content of standard was found lower than the composite flours, I was reported as 0.77 % (±0.01). The crude fat content of 15% substitution (VI) is the lowest among the other two variations. It is found in the range of 0.183% (±0.01)-0.352% (±0.01). The fat content of the flour was relatively high because of lotus seeds but it is lower than the fat content of standard wheat flour. The fat content of wheat flour was found 2.43% (±0.01). The fat percent was found highest in 25% substitution (VIII). The protein content of composite flour increased with increasing lotus seed flour in the mix (if compared to taro flour).It was found in the range from 11.32% (±0.04)-12.12% (±0.18). The variation third (25% substitution) has the highest crude protein content but the protein content of the blended flours were observed lower than standard wheat flour (shown in table III.)

The carbohydrate content of standard wheat flour67.39% (±0.59) was observed lower than the substituted wheat flour due to the presence of taro root flour and lotus seed flour. The carbohydrate content was observed in variation third (25% substitution). The carbohydrate content increased with increased in the proportion of taro root flour. The carbohydrate content (as shown in table III), In variation first (15% substitution) and variation second (20% substitution) there is no significant difference in carbohydrate content.

Table 2: Proximate analysis of flours

Type of Flour	Composition %					
	Moisture	Ash	Crude fiber	Crude fat	Crude protein	Carbohydrate
Taro flour	10.2±0.06	4.32±0.01	2.81±0.01	0.093±1.15	8.316±0.05	74.26±0.01
Lotus seed flour	9.7±0.05	10.00±0.11	2.66±0.02	0.186±1.00	14.80±0.20	62.65±0.01

*Data represented are mean ± standard deviation for (n =3)

Table 3: Proximate analysis of composite flours.

Variations	Composition %					
	Moisture	Ash	Crude fiber	Crude fat	Crude protein	Carbohydrate
Control (C)	9.7±0.22	0.77±0.01	1.54±0.02	2.43±0.01	14.2±0.12	67.39±0.59
VI	8.4±0.12	1.63±0.02	1.66±0.03	0.183±0.01	11.32±0.04	76.82±0.05
VII	7.99±0.05	1.72±0.02	1.67±0.01	0.340±0.01	11.93±0.56	76.37±0.04
VIII	7.45±0.01	0.96±0.025	1.74±0.03	0.352±0.01	12.12±0.18	77.37±0.25

*Data represented are mean ± standard deviation for (n =3)

Functional properties of composite flour

The functional properties are those essential parameters that determine the applications of food material for various food products. The functional properties of flour were analyzed i.e. water absorption capacity (WAC %), oil absorption capacity (OAC%), foaming capacity (FC%) and emulsion activity (EA%).The water absorption capacity given in Table IV. The WAC was ranged from 146.56% (±0.01)-56.22% (±0.06). The WAC% was observed highest in VIII 156.22% (±0.06) and lowest in VI 146.56% (±0.01). The water absorption capacity (WAC %) of flour is affected because of the addition of taro root and lotus seed flour. The variations in the presence of non-polar side chain, which might bind the hydrocarbon side chain of the oil among the flours. As mentioned in Table IV, the Oil absorption capacity (OAC %) was ranged from 92.10%(±0.10)-101.37% (±0.15). The highest value was found in VIII 101.37% (±0.15), while the lowest in VI 92.10% (±0.10). The major chemical component affecting OAC% is protein which is composed of both hydrophilic and hydrophobic parts. Non-polar amino acid side chains can form hydrophobic interaction with hydrocarbon chains of lipids [15]. Foam capacity (FC %) Foam capacity of protein refers to the amount of interfacial area that can be created by the protein. Foam is a colloidal of many gas bubbles trapped in a liquid or solid. Small air bubbles are surrounded by thin liquid films [15]. The Foam capacity of composite flours were observed in the range of 10.12% (±0.02)-5.99 % (±0.25). It was observed that as the level of substitution increases, the values for foam stability kept decreasing. Hence, it is not a native proteins crops, it’s expected to have lower stability. Control (100% wheat flour) had the highest stability than other flour blends. Emulsion capacity of flour depends on many factors like protein capacity, pH, concentration and stability. In this study we found that the emulsion capacity decreased with the increased levels of taro and lotus seed flours. As shown in Table IV, Protein are the surface active agents they form and stabilize the emulsion by creating electrostatic repulsion on oil droplet surface. The emulsion activity of different flours ranged between 40.12% (±0.02)-36.88% (±0.01).

Table 4: Functional properties of Composite flour

Variations	WAC (%)	OAC (%)	FC (%)	EA (%)
Control	130.32±0.36	88.23±0.02	12.92±0.01	47.12±0.01
VI	146.56±0.01	92.10±0.10	10.12±0.02	40.12±0.02
VII	155.34±0.01	98.21±0.03	6.20±0.15	39.56±0.56
VIII	156.22±0.06	101.37±0.15	5.99±0.25	36.88±0.01

*Data represented are mean ± standard deviation for (n =3)

The amount of calcium was found in the range of 8.04(±0.06)-9.29(±0.04) mg/100gm in different (as shown in Table V).In taro flour and lotus seed flour the calcium content was observed 12.00(±0.11) and 4.26(±0.20) mg/100 gm. respectively, whereas 0.217(±0.001) mg/gm in wheat flour. Other than calcium potassium and sodium was also analyzed individually as well as in composite flours. The amount of potassium was found in the range of 145.5(±0.16)-172.32(±0.01) mg/100gm.and sodium in the range of 0.119(±0.003)-0.144(±0.001) mg/100gm respectively. In taro root and lotus seed flour potassium was found 254.00±0.58mg/100gm.and 16.30(±0.15) mg/100gm whereas sodium 0.127(±0.001) mg/100gm and 0.122(±0.001) mg/100gm (Table V).

Table 5: Mineral estimation of Flours

Minerals (mg/100g)	Control	Taro flour	Lotus seed flour	VI	VII	VIII
Calcium	0.217±0.05	12.00±0.11	4.26±0.20	8.04±0.06	9.22±0.06	9.29±0.04
Potassium	1.762±0.48	254.0±0.58	16.30±0.15	145.5±0.16	159.22±0.11	172.32±0.01
Sodium	1.541±0.001	0.127±0.001	0.122±0.001	0.119±0.003	0.140±0.001	0.144±0.001

*Data represented are mean ± standard deviation for (n =3)

Conclusion

Composite flour is a mixture of flours, starches and other ingredients intentionally added to replace wheat flour totally or partially to enhance the overall quality of regular wheat flour. It gives a better supply of nutrients for human nutrition and better overall use of domestic agriculture production. According to the following results the substitution of wheat flour by adding taro root flour and lotus seed flour increasing the nutritive value. It is observed that the protein content of flour has decreased when compared with wheat flour, due to the addition of taro root. Other than protein, fat content and fiber content and mineral content was found more than wheat flour. The development of such flour blends could improve utilization of indigenous food crops in those countries where wheat is not the main crop as well as to impart the overall nutritional and functional properties of wheat flour.

References

1. Noorfarahzilah M, Lee JS, Sharifudin MS, Mohd Fadzelly AB, Hasmadi M. Applications of composite flour in development of food products, International Food Research Journal. 2014; 21(6):2061-2074.
2. Menon L, Majumdar S, Ravi U. Development and analysis of composite flour bread. Journal of Food Science and Technology. 2014; 52(7):4156-4165. DOI: 10.1007/s13197-014-1466-8.
3. Olusegun A Olaoye, Beatrice IO Ade-Omowaye, Composite Flours and Breads: Potential of Local Crops in Developing Countries, in Victor R. Preedy, Ronald Ross Watson, Vinood B. Patel (ed.) Flour and Breads and their Fortification in Health and Disease Prevention: Academic Press is an imprint of Elsevier, 2011, pp. 184.
4. Rashmi DR, Raghu N, Gopenath TS, Pradeep Palanisamy, Pugazhandhi Bakthavatchalam, Murugesan Karthikeyan *et al*. (*Colocasia esculenta*): An overview', Journal of Medicinal Plants Studies. 2018; 6(4):156-161.
5. Darkwa S, Darkwa AATARO. *Colocasia esculenta*: It's Utilization in Food Products in Ghana', Journal of Food J Processing & Technology. 2013; 4(5):1-7.
6. Pal I, Dey P. A Review on Lotus (*Nelumbo nucifera*) Seed', International Journal of Science and Research. 2013; 6(14):1659-1666.
7. Ze-Bin Guo, Li-Bin Xu, Wen-Wen Chi, Xiang-Ze Jia, Shaoxiao Zeng. 'Nutrient Composition and *In Vitro* Glycemic Index of Lotus Seeds Harvested At Different Stages of Maturation', Current Topics in Nutraceutical Research. 2015; 13(4):249-258.
8. AACC Method (44-19.01.) Approved Methods of the AACC. American Association of Cereal Chemists, St Paul, MN.
9. AACC. Method [30-25.01]. Approved Methods of the AACC. American Association of Cereal Chemists, St Paul, MN, 2000.
10. AACC Method (32-10-01). Approved Methods of the AACC. American Association of Cereal Chemists, St Paul, MN.
11. AACC method (46-10.01) (Crude protein- Improved Kjeldhal method) Approved Methods of the AACC. American Association of Cereal Chemists, St Paul, MN.
12. AACC. Method (08-01) Approved Methods of the AACC. American Association of Cereal Chemists, St Paul, MN, 2000.
13. Chandra S, Singh S, Kumari D. Evaluation of functional properties of composite flours and sensorial attributes of composite flour biscuits. Journal of Food Science and Technology. 2014; 52(6):3681-3688.
14. Sathe SK, Salunkhe DK. Functional Properties of the Great Northern Bean (*Phaseolus vulgaris* L.) Proteins: Emulsion, Foaming, Viscosity, and Gelation Properties, Journal of Food Science. 1981; 46:71-81.
15. Chandra S, Singh A, Kumari D. Evaluation of functional properties of composite flours and sensorial attributes of composite flour biscuits, Journal of Food Science and Technology. 2014; 52(6):3681-3688.