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Physiochemical analysis of wheat and buckwheat blended flour

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Abstract
This research work had been carried out to study the effects and benefits of buckwheat flour. Buckwheat carry essential nutrient to study the benefits of these nutrients in daily life wheat flour was supplemented with buck wheat flour. The basic purpose of this research is to study the physiochemical attributes of the buckwheat flour. Physiochemical analysis of flours, treatments and product was carried out. Significant difference was observed in protein fat ash and fat acidity of the flours. Buckwheat enhanced the protein content of product. The basic purpose of this research is to study the physiochemical (moisture, ash, crude protein, fat, fiber and fat acidity) of both flour i.e wheat and buckwheat flour. Both flours were blended in different proportions. The treatments were T_0 (100% wheat flour), T_1 (90:10), T_2 (80:20), T_3 (75:25) and T_4 (70:30). Physiochemical analysis of flours. Protein content was observed in wheat was (11.13%) while in buckwheat flour (12.21%) of protein content was observed. Similarly buckwheat flour contained more amount of fat content (0.77%) ash (1.37%) and acidity (0.18%) while (0.44%) fat, (1.26%) ash and (0.16%) fat acidity was observed in wheat flour. Buckwheat enhanced the protein content of product. The highest amount of protein 12.24% was observed in treatment T4 (70% wheat and 30% buckwheat).

Keywords: proximate analysis, physicochemical properties, wheat, buckwheat

1. Introduction
Buckwheat (*Fagopyrum esculentum*) use as a cover crop and its plant is well known for its grain like seed. In Asia, Central and Eastern Europe buckwheat is cultivated as conventional crops (Wijngaard and Arendt, 2006) [35]. It shows both the similarities as well as differences with cereal s that's why well known as pseudo cereal. (*Fagopyrum esculentum* Moench) is the most common buckwheat grown species. It is the major source of dietary minerals like zinc, copper and manganese (Ikeda and Yamashita, 1994) [15]. It is alsorich in dietary fiber which has a positive physiological effect in the gastrointestinal tract and also significantly influences them metabolism of other nutrients (Halbrecq *et al*., 2005) [11]. Common buckwheat (*Fagopurum esculentum* Moench) contains essential amount fiber minerals and proteins. Proteins in buckwheat have some valuable cholesterol lowering properties which are good and remarkable health promoting units for the consumers. With the different survey reports it has been concluded the nutritional characteristics and other applications of buckwheat as a functional food such as wheat bread enriched with buckwheat flour gluten free egg pasta analogues containing buckwheat flour as well as buckwheat flour as an ingredient in some biscuit formulations (Mirjana *et al*., 2013) [26]. There is no gluten present in Buckwheat seeds and it is very helpful and safe for those people who are suffering with celiac disease (Skerritt, 1986). In spite of the name, it is not correlated to the wheat, it is not considered as a grass butas an alternative; it is considered as sorrel, knotweed, and rhubarb. By the adaptation of nitrogen fertilizers yield of other staple crops increased and buckwheat cultivation declines day by day in 20th century. In the Himalayas an interrelated species like *Fagopyrum tataricum* (Tartary buckwheat) is grown asa grain. (Ohnishi, 1993). As compare to the other traditional cereals, buckwheat proteins contain high lysine, which makes it inspiring from a nutritional point of view and also gluten free. Therefore, it can be use as a replacement of wheat in gluten less food for those who are suffering from celiac diseases. (Eggum *et al*., 1980; Javornik *et al*., 1984) [14]. It also comprises of some important and essential nutrients at high rate. Therefore, it can be a potential source of such essential nutrients. Because of its useful effects on human health (Sugiyama *et al*., 2003) special attention has been paid in growing buckwheat as a functional food (Sugiyama *et al*., 2003).
5 to 11% range of the total dietary fiber studied in buckwheat according to different research studies.

(Joshi and Rana, 1995; Zheng *et al*., 1998; Steadman *et al*., 2001; Izydorczyk *et al*., *al*., 2002) [37, 39, 28]. About 13-16% of dietary fiber had been examined in bran fractions that are utilized through milling, but buckwheat flours contain considerably lower amounts of fiber 1.7-8.5% as compared to its bran. (Steadman *et al*., 2001) [28]. The key component of buckwheat is starch. According to studies buckwheat grains are major source of special type of starches. (Soral-Smietana *et al*., 1984; Acquistucci & Fornal, 1997) [3]. Different scientific researchers had been shown that, only 4-7% portion oppose hydrolysis while mostly common buckwheat starch is digest readily. (Skrabanja *et al*., 1998; Skrabanja and Kreft, (1998) [20]. It has been shown that boiled buckwheat groats and baked bread that contain 50% of buckwheat significantly lowers down the posprandial blood glucose and insulin level as compared to white bread. (Skrabanja *et al*., 2001). Observation showed the presence of non-starch polysaccharides which form the viscous solution when dissolved in water because of its high molecular weight.

Minerals

As compare to other cereals buckwheat have higher level of zinc, copper, magnesium and manganese. (Ikeda *et al*., 1998; Steadman *et al*., 2001) [20, 28]. From the studies it has been shown that only 100 g of buckwheat flour can supply about 13-89% of the recommended dietary allowance for essential components like It has been concluded from the studies that 100g (RDA) for zinc, copper, magnesium, and manganese. Bran of buckwheat contained higher concentration of minerals as compared to its endosperm. The intake of buckwheat is helpful in lowering the high blood pressure because of its composition of essential minerals.

Protein

Buckwheat contains high quality protein and high level of arginine as well as lysine which make it equivalent to the cereals and vegetable proteins. Protein content in Buckwheat flour contains 22.7% glutelin, 0.8% prolamine, 43.3% globulin, 18.2% albumin and 5.05 other nitrogen residues. (Ikeda and Asami, 2000; Ikeda *et al*, 199l; Javornik and Kreft, 1984) [16, 14]. The anti-nutritional factors present in common buckwheat, as well as protease inhibitors (such as trypsin inhibitors) and tannins (Ikeda *et al*., 1991). It has been also studied that buckwheat protein along with dietary fiber can resolved constipation (Kayashita *et al*., 1995) [24]. Buckwheat proteins and its dietary fibers can suppress growth of colon cancer it has been concluded from the epidemiological studies. (Lipkin *et al*., 1999; Cassidy *et al*., 1994) [25]. According to the research 'Resistant proteins' are also present in buckwheat that is helpful in lowering the blood cholesterol level. Carroll *et al* 1975 reported the ratio of lysine and arginine is lower in buckwheat flour as compared to other plant protein and it's the main reason of lowering blood cholesterol level.

Wheat

Wheat crop is considered the major cereal crop in many parts of the world. It belongs to the Triticum family, of which there are many thousands of species (Kent and Evers, 1994), with *T. aestivum* subspecies Vulgare and the hard wheat *T. durum* being the most important commercially (Macrae *et al*., 1993). In most developing countries including Pakistan wheat (*Triticum aestivum*) is taken as the most common food for man and it constitutes the major source of diet. The studied showed the wheat grain contain almost 10% to 18% of the protein contents calculated in overall dry mater. (Zuzana *et al*., 2009). As staple food wheat is consumed in Pakistan most commonly utilized in the form of chapatti as well as in other products. (Wahab *et al*., 2004) [34]. Wheat is most commonly used as a main source of carbohydrates and protein. Observations had made in wheat showed that it is also a potential source of minerals and other trace elements. (Hepper, 1956) [12]. Wheat (*Triticum aestivum*) is the most important crop for the manufacturing of bread as it is utilized most commonly. 70% wheat is utilized in the form of chapattis in Pakistan. Nan and tandoori roti (baked inside a mud oven) includes in the types of chapattis. (Chaudri and Muller, 1970) [6]. In our country Pakistan the most vital and cheapest source of nutritional protein and calories is wheat. Wheat bread constitutes 5.9% of the net dietary protein calories and can provide the daily need of protein for adults if consumed in an adequate amount (Khan and Eggum, 1978) [22]. It has been observed in proximate analysis of the whole wheat flour that 100 g of whole wheat flour contained moisture; 12.0, protein, 10.0, lipids (fat) 1.6, carbohydrate; 72.6, fiber; 1.3, and ash; 1.4 g. While white wheat flour contained 43 mg Ca, 284 mg P and 45 mg iron. (Hussain 1985). According to the studies about 14.5% of the kernel weight is rich in protein (14%), minerals (5%), fat (6%) and B-vitamins are found in wheat bran. (Kent and Evers 1994). According to Belderok *et al* 2000 0.5% of ash and 1.5% of dietary fibers are observed. It has been studied according to the nutritional aspects wheat is major provider of protein content of daily diet; therefore its concentration is important in daily diet to get adequate amount of protein as well as its great significance for baking quality (Anjum, 1976) [2]. The wheat production is estimated that per person per day utilizes about 250 grams of wheat. It can supply 800 calories and 30 g of protein per person were evenly distributed worldwide in its untreated state. (Davis, 1981). Of the daily energy requirements only 20% of the wheat based foods are now supply to the US citizen but only (30%) use as a main source of dietary fiber in the USA (Anderson, 1985). The longer shelf life, pleasant flavor and its unique gluten forming ability make it different and most popular grain for bread making. (Thomas 1976). Research revealed that cereal grains and legumes are very important because they supply the nutrients as well as over 70% of the daily energy requirements of over two thirds of the world's population (Edwards *et al*., 1971).

2. Materials and Methods

Sample of wheat grains was brought from market, while buckwheat grains was obtained from Skardu Baltistan (Northern area of Pakistan)and after cleaning from dust and foreign materials both were grinded separately in flour mill. The wheat flour and buckwheat flour both were analyzed for their proximate composition according to their respective methods described in AOAC (2005).

Preparation of Composite Flours

Both flours of wheat and buckwheat were blended for preparation of bread sticks as per treatments shown below.

Treatments

W_0= W.F 100% + B.W.F 0%

WBF_1= W.F 90% + B.W.F 10%
WBF_2 =W.F 80% +B.W.F 20%
WBF_3 =W.F 75% + B.W.F 25%
WBF_4 =W.F 70% + B.W.F 30%

Proximate analysis of flours
The flours wheat and buckwheat were analyzed for moisture, crude ash, crude fiber and crude protein, by the methods of AOAC (2005).

Moisture
The moisture content of the wheat flour and buck wheat both were analyzed for moisture content. The moisture of flours was resolute by taking the 2g sample in the Petri dish in triplicate. The Petri dish was weighed earlier. The dishes were then placed in the oven 150 ℃ for. After that dishes were distant and placed in desiccators at room temperature and then weighed the sample. The loss in weight is % moisture.

$$\% \text{ Moisture} = W1 - W2 \div W1 \times 100$$

Here,
W1 = initial weight of sample
W2 = final weight of sample
Crude Ash
Ash of flour samples was determined. The 3 g sample was taken in the china dish in triplicate and burned over flame to complete smoke. The sample then placed in muffle furnace at 500 ℃ for 24 hours or until constant weight was obtained. The % ash content was calculated was using following formula.

$$\% \text{ Ash} = \frac{\text{ash weight} \times 100}{\text{Wt of sample}}$$

Crude protein

Procedure
The protein content of the flour samples was determined by taking the 1 g sample. The weighed sample then dissolved in solution of 1g cuso4, 7g K_2So_4, and 12-15 ml of H_2So_4. The sample was then digested at heater for three hours until it became transparent. After digestion 5 ml distilled water was added and neutralized with 40% NaOH. Solution turned into blackish in color and samples were taken for the distillation. In flask 30 ml 40% boric acid added for distillation process. After distillation yellow color was appeared.

Reagents
1. 0.1 N Hcl
2. Concentrated sulphuric acid
3. 40% sodium hydroxide
4. 4% boric acid
5. Methyl red indicator

Titration
After distillation titration of sample was taken out. In titration the yellow color of the sample changed into pink. For distillation 20 ml boric acid was and phenolphthalein was taken in flask. Pink color indicates the protein content in sample reading was carried out from the burette by taking the volume of 0.1 N HCl used in titration.

% Protein = (s-b)×n of acid×0.014×dilution×100 ÷ wt of sample × digested liquor taken for distillation

Here,
S= Sample titration reading
B stands for Blank titration reading
Nitrogen was taken as milliequivalent that is equal to 0.14

Crude fat
Crude fat of the sample was determined by Soxhelt apparatus. Wheat flour and buckwheat flour samples were weighed separately 2 g of each flour was taken into thimble and fat was extracted with diethyl either between boiling pint of 50-60 ℃. Process was completed in 5 hours. After completion of the process thimble was removed from the extractor heated the flask so that all the solvent was collected for further use. Flask was dried cooled and weighed again. The % oil content of the sample was calculated by using following formula.

$$\% \text{ oil} = \frac{(\text{wt of Flask+fat extracted}) - (\text{wt of empty flask}) \times 100}{\text{Weight of sample}}$$

Crude fiber
The flour samples were analyzed for the fiber contents. For fiber 2 g sample was taken. The samples were digested with h2so4 and then Noah. The residues were collected after digestion. The loss of weight during ignited is taken as crude fiber.

Reagents
a) HCl
b) NaOH

Fat acidity of product
Fat acidity of flours and product was carried out by adopting procedure described in AOAC (2005) method. 5-10 g of the fat was extracted from flours and from the product in 250 ml Erlemyer flask. It was then dissolved in 50-150 ml of 1:1 mixture of ethanol and diethyl ether neutralized to phenolphthalein. Titration was done while shaking with the 0.5 M ethanolickoh solution until the color of the solution changes.

$$\%\text{acidity} = \frac{aMw}{10p}$$

Where
A= number of ml of ethanolickoh solution used
M= exact molarity of the ethanolickoh solution
W= molecular weight of adopted
P= weight of sample in gram

As the product contained wheat and buckwheat that is a highly nutritionist product brown sugar was added to ease for the diabetic patients. The buckwheat is highly helpful for colonic cancer patients. Little amount of salt was added as per taste.

Proximate analysis of flour
1. Moisture of flours
The moisture content of the wheat flour and buck wheat both were analyzed for moisture content. The moisture of the flour was determined by taking the 2 g sample in the Petri dish in triplicate. The Petri dish was weighed earlier.

The dishes were then placed in the oven 150 ℃ for. After that dishes were distant and placed in desiccators at room temperature and then weighed the sample. The loss in weight is % moisture.

$$\text{Moisture \%} = W1 - W2 \setminus W1 \times 100$$

Here,
W1 = initial weight of sample
W2 = final weight of sample

Crude Ash

Ash of the flour samples was determined. The 3 g sample was taken in the china dish in triplicate and burned over flame to complete smoke. The sample then placed in muffle furnace at 500 ℃ for 24 hours or until constant weight was obtained. The % ash content was calculated was using following formula.

$$\% \text{ Ash} = \frac{\text{ash weight} \times 100}{\text{Wt of sample}}$$

Crude protein

Reagents

1. 0.1 NHCl
2. Concentrated Sulphuric acid
3. 40% Sodium hydroxide
4. 4% Boric acid
5. Methyl red indicator

Procedure

The protein content of the flour samples was determined by taking the 1 g sample. The weighed sample then dissolved in solution of 1 g cuso 4, 7 g K_2So_4, and 12-15 ml of H_2So_4. The sample was then digested at heater for three hours until it became transparent. After digestion 5ml distilled water was added and neutralized with 40% NaOH. Solution turned into blackish in color and samples were taken for the distillation. In flask 30 ml 40% boric acid added for distillation process. After distillation yellow color was appeared.

Titration

After distillation titration of sample was taken out. In titration the yellow color of the sample changed into pink. For distillation 20 ml boric acid was and phenolphthalein was taken in flask. Pink color indicates the protein content in sample reading was carried out from the burette by taking the volume of 0.1 N HCl used in titration.

% Protein = (s-b)×n of acid×0.014×dilution×100 ÷ wt of sample × aliquot of digest taken for distillation

Here,
S= Sample titration reading
B= Blank titration reading
0.14= Milliequivalent of nitrogen

Crude fat

Crude fat of the sample was determined by Soxhelt apparatus. Wheat flour and buckwheat flour samples were weighed separately 2 g of each flour was taken into thimble and fat was extracted with diethyl either between boiling pint of 50-60 ℃. Process was completed in 5 hours. After completion of the process thimble was removed from the extractor heated the flask so that all the solvent was collected for further use. Flask was dried cooled and weighed again. The % oil content of the sample was calculated by using following formula.

$$\% \text{ oil} = \frac{(\text{wt of Flask + fat extracted}) - (\text{wt of empty flask}) \times 100}{\text{Weight of sample}}$$

Crude fiber

The flour samples were analyzed for the fiber contents. For fiber 2g sample was taken. The samples were digested with H_2So_4 and then Noah. The residues were collected after digestion. The loss of weight during ignited is taken as crude fiber.

Reagents

a) Hcl
b) Noah

Procedure

2 g of wheat flour and 2 g of buckwheat flour were taken separately in 500 ml beaker. Then sample was added to 200 ml Hcl and boiled for 30 minutes. After 30 minutes the sample was filtered through cloth the residues were collected in beaker and 200 ml Naoh was added solution kept for another 30 minutes for boiling. The residues were filtered again and were kept in crucible in oven for 30 minutes at 150 c. After that the samples were placed in furnace at 500 c until the desired mass obtained. Fiber was calculated by using following equation.

$$\text{Crude fiber \%} = \frac{W1\text{-}W2 \times 100}{\text{Wt of sample}}$$

Here,
W1 = weight after drying in oven
W2 = weight after drying in furnace

Fat acidity

Fat acidity plays an important role in baking quality of flours Saeeda Raza *et al* (2010). During the storage period, flour properties changed by the effect of unsaturated fatty acid generated by its own lypolytic activity. (Chen and Schofield, 1990). Fat acidity of both flours was observed. Fat acidity value of wheat flour was observed 0.2-0.3%. In 1957 Baker *et al* had determined the fat acidity value of wheat flour and corn flour with calorimetric method. They showed the graphical presentation of values. There was no specific work had been done yet on fat acidity value of buck wheat flour but an approximate fat acidity value of buckwheat was observed nearly closed to wheat flour. Buckwheat flour contained about 0.18% of free fat acid values. As there was no research had done yet on the determination of buckwheat's free fat acid values. There was no (<0.05) significant difference was observed in all treatments except T_1 whole wheat flour (0.16%) and T_5 whole buckwheat flour (0.18%). Supplementation didn't affect the free fat acid value of composite flours.

Table 1: Proximate analysis of flour

Treatments	Moisture	Ash	Protein	Fat	Fiber	Fat acidity
T0	12.71b	1.26a	11.13b	0.44d	0.11c	0.16d
T1	12.96ab	1.27de	11.15a	0.45d	0.11c	0.19c
T2	12.72b	1.28c	11.18a	0.47c	0.12bc	0.20b
T3	12.75b	1.24cd	11.21a	0.50a	0.12c	0.21a
T4	12.74b	1.37b	12.21a	0.51b	0.14ab	0.22b
T5	13.22a	1.41e	7.14c	0.77b	0.15a	0.18e

Conclusion

From this research it has been concluded that buckwheat contained much amount of essential nutrients that should be utilized in bakery products like cake bread biscuits and breakfast cereals. Buckwheat supplemented bread sticks had better nutritional quality and high level of protein. Other countries had done a lot of utilization on buckwheat flour and product as it has been used for gluten free bread manufacturing in many countries. It contained many essential minerals as compared to other cereals. In Pakistan it should be introduced at industrial as well as at market level for awareness of its consumption in daily life. It has been studied that buckwheat contains flavonoid that are very help full in treatment of different cardiovascular diseases. Buckwheat supplemented product had better texture and color due to its dark color flour. Buckwheat cultivation should also be promoted in different areas of Pakistan from being now it's only cultivated in northern areas of Pakistan. Buckwheat supplemented product can be stored for long time without preservatives at room temperature as it has less moisture as compared to other cereals. Development and utilization of such type of functional foods can help those who are suffering from degenerative diseases and con also enhance their nutritional status.

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