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Utilization of the Whole Cowpea Pod and Barley Husk in The Production of Nutritionally Enriched Composite Flour

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ABSTRACT

Background: Cowpea is a climbing annual crop from *Fabaceae family* which is grown for its edible seeds and pods. Cowpea is rich in various nutrients such as fibre, protein, iron, potassium and is low in fat and calories. It has been observed that non-Communicable diseases are increasing at a rapid rate in India as well as globally. The need of the hour is to control the rate of diseases through modification in dietary practices. This study has focused on formulation of whole cowpea pod enriched composite flour by including more fibre and various nutrients in the diet.

Methods: In the study, composite flour using whole cowpea pod flour, barley husk flour and whole wheat flour was developed. The nutritional characteristics of composite flour and barley husk were analyzed. Storage study with two different packaging materials was also done.

Result: The composite flour was found to have good nutritional properties as it contained valuable amount of protein, energy and crude fibre. It was also found that the flour had higher content of iron, magnesium and calcium while barley husk had higher content of manganese. Laminated aluminium pouches found to be more suitable for use as a packaging material.

Key words: Composite Flour, Cowpea pod, Fibre, Non-Communicable Diseases, Protein.

INTRODUCTION

Cowpea [*Vigna unguiculata* (L.) Walp.] is a member of the Phaseoleae tribe of the Leguminosae family. As it is harvested before cereal crops, it is called the “hungry-season crop”. Cowpea has an annual worldwide production of about 4.5 million metric tons and thus provides food for millions of people, in developing countries. Cowpea is also said to be a good source of soluble and insoluble dietary fibre, phenolic compounds, minerals and many other functional compounds, including B group vitamins. It also aids in reduction of several diseases such as cardiovascular diseases, gastrointestinal disorders, hypercholesterolemia, obesity, diabetes and several types of cancers (Jayathalike *et al*., 2018). In rain fed areas, cowpea can be easily grown with minimum and maximum temperatures of 28 and 30°C (night and day) Best yields of cowpea can be obtained in well-drained sandy loam to clay loam soils having pH between 6 and 7 (Dugje *et al*., 2009).

Barley (*Hordeum vulgare*) is one of the antiquated cereals grown today. After wheat, rice and maize, barley stands at fourth position in the top most cultivated crops. Barley helps in prevention of many diseases such as high blood pressure, chronic heart disease and gallstones. According to Idehen *et al*. (2017) barley is credited for its health benefits especially due to high content of β-glucan fibre. Around 10-13 per cent weight of total barley is due to its husk however it is not used in value added applications in spite of its high hemicellulose content. Arabinoxylan is a significant hemicellulose found in barley husk.

Wheat is the most important staple crop used for human consumption and its demand is increasing globally due to industrialization and urbanization. Hexaploid specie that is “*Triticum aestivum*”, also called “common” or “bread” wheat is the major species of wheat grown world wide (Shewry and Hey, 2015). In India only three types of wheat are produced that is bread, durum and dicoccum due to different food habits and environmental conditions.

Consumption of a mixture of different flours which provide nutrients from natural sources is gaining popularity. Multigrain food items constitute a combination of flours of many grains such as wheat, oat, barley, maize, millets, rice, flax *etc*. Such flours make a positive contribution to the nutritive value taste and texture of products. They help in making the digestive system healthier, control weight,

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decrease the chances of diabetes and cardio vascular diseases and prevent cases of bowel cancer Malik *et al.* (2015).

Non communicable diseases are becoming a major concern now a days. To prevent these diseases, fundamental transformation in food systems is needed so that qualitative, nutritious and affordable diets are available worldwide. Therefore, the present study was planned to formulate, a fibre and protein rich whole cowpea pod and barley husk enriched composite flour.

MATERIALS AND METHODS

The investigation was conducted in the Department of Foods and Nutrition, College of Home Science, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand. The purpose of the research was to develop whole cowpea pod and barley husk enriched composite flour for health benefits. After review of high fibre foods available in the region, cowpea, barley husk and wheat flour were selected for the development of the composite flour. The final ratios of the three different flours were determined through sensory evaluation. For the preparation of composite flour, whole cowpea pod flour and barley husk flour were mixed in the ratio of 1:1. The whole wheat flour and the above mixture were then mixed in the ratio of 8:2. The prepared flour was stored in plastic air tight containers of 5 kg. All the nutritional estimations were determined in triplicates. Proximate composition comprising of moisture, crude protein, total ash and crude fat was analyzed by AOAC (1995) standard method. Total carbohydrate was calculated by subtracting the sum of percentage of protein, fat, ash and moisture from 100. Physiological energy value was calculated by multiplying the amount of protein, fat and carbohydrate per 100 gram of food sample by 4,9 and 4 respectively and summing up the three values. For mineral estimation, ash solution was prepared by method of Raghuramulu *et al.* (2003). Phosphorus was estimated colorimetrically according to the method of Fiske and Subba Rao (1925) described by Ranganna (1991). The calcium content was determined using the AOAC. (1970) titrimetric method, whereas the magnesium content was assessed using the Gravimetric method. Wong's approach, cited by Raghuramulu *et al*., 2003 was used to determine iron colorimetrically. Atomic Absorption Spectrophotometry (AAS) method was used to determine manganese. Total dietary fibre was estimated by the method prescribed by AOAC (1995). Antinutrients comprising of phytic acid and tannins were analyzed according to the method of Wheeler and Ferrel (1971) and Folin-denis method given by Schanderl (1970). For antioxidant analysis, the sample was prepared by the method prescribed by Bhatt and Patel (2013). Flavonoids content was determined by using Aluminium Chloride Spectrophotometric Method (Zhishen *et al.,* 1999) while Folin Ciocalteu Spectrophotometric method was used to estimate total phenolic content (Singleton *et al*., 1999).

The shelf life of the flour was also evaluated. Storage study was done for 90 days for which the flour was packed in 12 pouches. For packaging 6 aluminium laminated pouches of dimension-18.5 × 13 × 0.2 cm, capacity-313 g and 6 polythene pouches of 125 microns, 492.1 gauge and capacity 1 kg were used and stored at room temperature. One pouch of each packaging was opened fortnightly for estimations. The storage quality evaluation was done on the basis of sensory evaluation, moisture content, reducing sugars, free fatty acids, peroxide value and total bacterial count. For sensory evaluation, chapatti was prepared. Two scales were used for organoleptic evaluation that is Nine Point Hedonic Scale and Score Card (Amerine *et al*., 1965). A Semi trained panel consisting of 30 members (Aggarwal and Premchand, 2008) from the Department of Foods and Nutrition did the sensory evaluation. Moisture was estimated by the procedure as used in proximate composition. Free fatty acid and peroxide value was determined by AOAC 2000 method. Nelson-Somogyi (Somogyi 1952) method was used to estimate reducing sugars. Total bacterial count was determined using standard plate count (SPC) technique (APHA, 1992).

Statistical design

The objective of the statistiical analysis was to identify significant or non- significant difference in the nutrient content and storage period of the composite flour and barley husk. For nutritional content, storage study and sensory evaluation all estimations were done in triplicate and mean ± SD was calculated. One way ANOVA (Analysis of Variance) was used as the analytical tool for comparison of mean nutrient content for 3 treatments (3 different types of composite flour mix made with different proportion of cowpea pod powder, barley husk and whole wheat flour) as well as barly husk.

Nutritive value of the composite flour was also compared with the values of wheat flour reported in literature.

RESULTS AND DISCUSSION

Development of composite flour

Three combinations of whole cowpea pod, barley husk and wheat flour were tried for the development of composite flour. Of the 3 developed flours, flour having 20% incorporation of barley husk powder and cowpea pod powder (1:1 ratio) was selected for further study due to its high sensory quality. (Table 1 and 2).

Proximate composition

Table 3 shows the proximate composition of the selected composite flour and barley husk. The composite flour was found to have lower moisture content when compared with the values reported by Bhatt and Gupta (2015) that is 12.5 per cent. Whereas barley husk had higher moisture content in comparison to that one found by Biswas *et al.* (2017). In comparison to the current study, Jothilakshmi *et al.* (2016) observed the total ash content to be lower (1.7 g) and crude protein to be higher (15.15 g) in multigrain mix as compared to the total ash and crude protein content of composite flour in the study. Garrote *et al*. (2008) estimated ash and protein content in barley husk. The ash content was found to be 19.81 per cent which was higher than the ash content in the current study. The crude protein in wheat husk was 6 per cent according to the study of Bledzki *et al*. (2009) which was found to be lower while the crude fat was higher than that reported in the present study. Similar results were found by Bhatt and Gupta (2015) in their study on composite flour. When compared with the study of Malshe *et al*. (2014), the crude fibre content in composite flour was found to be same whereas physiological energy was observed to be higher. In contrast, Ekwe (2013) found higher crude fibre content in rice husk as compared with the fibre content of barley husk in the present study. Carbohydrate in composite flour evaluated by Itagi and Singh (2012) was found to be higher than the results obtained in the present study Ekwe (2013) observed a lower physiological energy and carbohydrates content in rice husk in comparison to the results of barley husk in the present study.

Micronutrient composition

The micronutrient analysis of composite flour and barley husk is shown in Table 4. According to Adegunwa *et al*.

Table 1: Composition of 3 composite flours.

Composite flours	Weight of whole wheat flour (g)	Weight of barley husk powder (g)	Weight of cowpea pod powder (g)	Total weight of composite flour (g)
A	80	10	10	100 g
B	70	15	15	100 g
C	60	20	20	100 g

A: whole wheat flour: barley husk powder: cowpea pod powder: 80:10:10; B: whole wheat flour: barley husk powder: cowpea pod powder: 70:15:15; C: whole wheat flour: barley husk powder: cowpea pod powder: 60:20:20.

Table 2: Sensory evaluation of roti prepared from 3 composite flours.

Parameters	A	B	C
	Mean±SD	Mean±SD	Mean±SD
Colour	7.55±0.52	7.27±0.79	6.36±1.12
Flavour	7.82±0.60	6.95±0.96	6.09±1.58
Texture	7.50±0.59	6.64±0.67	5.61±0.94
Taste	7.64±0.50	7.05±0.91	5.95±1.46
Appearance	7.73±0.47	7.09±0.70	6.09±0.70
Overall acceptability	7.55±0.82	7.05±0.79	6.32±1.01

A: whole wheat flour: barley husk powder: cowpea pod powder::80:10:10; B: whole wheat flour: barley husk powder: cowpea pod powder:: 70:15:15, C: whole wheat flour: barley husk powder: cowpea pod powder:: 60:20:20.

Table 3: Proximate composition of the selected composite flour(A) and barley husk.

Proximate composition (%)	Composite flour	Barley husk	CD @ 5%	SEM±	F value
Moisture	9.13±0.16	12.08±0.41	0.72	0.18	*
Total ash	2.19±0.31	12.20±0.96	1.62	0.41	*
Crude protein	12.97±0.69	8.13±0.59	1.46	0.37	*
Crude fat	1.17±0.19	2.7±0.48	0.83	0.21	*
Crude fibre	14.57±0.53	23.05±0.16	0.90	0.23	*
Carbohydrate by difference	59.95±0.57	41.82±1.17	2.09	0.53	*
Physiological energy (Kcal/100 g)	321±6.45	204±3.66	11.90	3.03	*

Values are the mean of triplicate observations±SD, *-Significant.

Table 4: Minerals composition of composite flour (A) and Barley hus k (mg/100 g).

Minerals	Composite flour	Barley husk	CD @ 5%	SEM±	F value
Phosphorus	23.66±0.72	11.16±0.84	1.78	0.45	S
Iron	17.66±0.98	2.46±0.23	1.63	0.41	S
Magnesium	31.98±0.62	1.73±0.11	1.01	0.26	S
Calcium	81.33±2.30	4±0	3.70	0.94	S
Manganese	9.43±0.38	14.21±0.50	1.02	0.26	S

Values are the mean of triplicate observations±SD, S-Significant.

Table 5: Total dietary fibre (TDF) in composite flour (A) and barley husk.

Samples	Composite flour	Barley husk	CD @ 5%	SEM±	F value
Total dietary fibre (g/100 g)	21.39±1.02	37.94±3.64	11.51	1.89	S

Values are the mean of duplicate observations±SD, S-Significant.

Table 6: Antinutrient content in composite flour(A) and barley husk (mg/100 g).

Antinutrients (mg/100 g)	Composite flour	Barley husk	CD @ 5%	SEM±	F value
Phytic Acid	191.5±0.90	3.66±0.45	1.29	0.33	S
Tannins	2.38±0.38	5.04±0.09	0.64	0.16	S

Values are the mean of triplicates observations±SD, S-Significant.

Table 7: Total polyphenols and flavonoid content in composite flour and barley husk.

Antioxidant properties	Composite flour	Barley husk	CD @ 5%	SEM±	F value
TPC (mg of GAE/g)	438.44±2.00	302.84±3.81	6.90	1.76	S
TFC(mg of RE/g)	24.55±3.03	35.08±3.04	6.89	1.76	S

Values are the mean of triplicates observations±SD, S-Significant.

(2017) the phosphorus content of composite flour was higher in comparison to the results of present study. The iron content in composite flour and barley husk was found to be higher when compared with the results of Tangariya *et al.* (2018) and Raheem and Kareem (2017) respectively. The magnesium, calcium and manganese content in composite flour was found to be lower in comparison to the study of Bhatt and Gupta (2015), Tangariya *et al*. (2018) and Yuvarani *et al*. (2016). The phosphorus, magnesium, calcium and iron values were found to be higher in barley husk, when compared with the results of Raheem and Kareem (2017), Hashim *et al*. (1996), Slither (2008) and Korotkova *et al*. (2016).

Table 5 shows the total dietary fibre content of composite flour and barley husk. The total dietary fibre in multigrain flour prepared by Pande *et al*. (2017) was found to be similar as reported in the current study that is 21.89 per cent. Fadaei and Salehifar (2012) found higher value of dietary fibre in rice husk (44.66g) than that of barley husk evaluated in this study.

Antinutrients

The results showed that the phytic acid content of composite flour (191.05 mg) differs significantly from that of barley husk (3.66 mg) Parmar and Dahiya (2013) analyzed the phytic acid in wheat flour (between 167.18 to 241.63 mg), which was similar to the result of the present study. Perea *et al.* (2019) measured the phytic acid level in barley husk and found it to be 2.32 mg, which was higher than the value reported in this study. Tannins content of composite flour was 2.38 mg whereas in barley husk, it was found to be 5.04 mg. Bhatt and Gupta (2015) analyzed the tannin content of composite flour in their study which was 0.159 per cent and was lower than the result of present study. Chikwendu *et al*. (2014), studied the tannin content in cowpea husk (3.05 mg) which was lower than that of barley husk in the study (Table 6).

Antioxidants

Total phenolic content of composite flour and barley husk was 438.44 mg of GAE/g and 302.84 mg of GAE/g respectively. The difference between the two was significant. When compared to the study of Tangariya *et al.* (2018) the total phenolic content (549.70 mg of GAE/g) was higher than that reported in current study. However total phenolic concentration in barley husk was similar to that of Perea *et al.* (2019). Total flavonoid content in composite flour and barley husk was 24.55 mg of RE/g and 35.08 mg of RE/g respectively. The values differed significantly. Total flavonoid content of composite flour was higher than that reported in the study of Bhatt and Gupta (2015) *i.e* 48 µgQE/mg. The total flavonoid content of barley husk was higher than that reported by Perea *et al.* (2019) (Table 7).

Storage stability of composite flour

The study revealed that both the packaging materials are shelf stable up to 90 days. However, laminated aluminum pouches gave better results.

Statistical analysis revealed significant difference between composite flour and barley husk in overall nutritional estimations.

CONCLUSION

The composite flour developed under the present research had superior nutritional quality since it contained a significant quantity of protein, energy, total dietary fibre, calcium and antioxidants as compared to wheat flour. The nutritional potential of the developed flour has been enhanced due to the incorporation of whole cow pea pod and barley husk. Barley husk too was found to be a good functional food with high fibre, ash and manganese content. Laminated aluminum pouches gave better results thus were found to be a better option for packaging. The study has established the use of the entire pod of cowpea and barley husk for preparing a nutritionally enriched composite flour, that can be promoted as a healthy alternative for management of non-communicable diseases.

Conflict of interest: None.

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