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EVALUATION OF BISCUITS PREPARED FROM COMPOSITE FLOUR CONTAINING MOTHBEAN FLOUR

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Mothbean flour at levels of 10, 15, 20 and 25% was used in whole wheat flour for the production of biscuits to improve the quantity and quality of protein, mineral content and fiber. The biscuits were subjected to physical, chemical and biological evaluations. The protein content in biscuits increased from 6.97% (100% white flour) to 9.48% in composite flour containing 25% mothbean flour. Similarly, crude fiber and mineral contents increased from 0.28 to 1.36% and 0.46 to 0.91 % respectively. Physical studies exhibited a decrease in the width and spread factor and an increase in the thickness of the biscuits with rising levels of supplementation. The sensory evaluation showed that the quality score decreased with increasing levels of supplementation. However, in case of 10% and 15% supplemented biscuits, the score remained at fairly good level for all the parameters. Net protein utilization, protein efficiency ratio, biological value and feed efficiency value increased with higher levels of supplementation. A decrease in digestibility was observed as a result of various treatments. Storage of biscuits for 4 weeks did not remarkably affect the quality of the product.

INTRODUCTION

Biscuits are an important product in human diet and are usually eaten with tea and are also used as weaning food for infants. The school going children who are often under weight (ACC/SCN, 1987) use them a snacks while at school. The primary ingredients of simple biscuits include wheat flour, water, sugar, fat and eggs. The white flour used for the production of biscuits is deficient in several nutrients including some vitamins, mineral elements as well dietary fiber (Awan *et al.,* 1991). Wheat flour by itself lacks certain essential amino acids such as lysine, tryptophan and threonin (Kent, 1975).

Legumes are generally good sources of proteins and contain on an average from 18 to 25 percent. Among such legumes is mothbean, *Phaseolus aconitifolius,* that is widely grown under rain-fed conditions in semi- arid and arid zones in Pakistan. It contains 23.5% protein, 3.9-4.5% dietary fiber, 1.61% fat, 3.31% ash and 59.4% total carbohydrates (Pawar and Ingle, 1988., Kay, 1979). It contains all essential amino acids including methionine and lysine. Hence the protein present in these beans is of good quality.

Use of composite flours for the production of bread, cakes, buns and biscuits to increase and improve the protein content has been carried out by several workers. Siddique (1989) used eight different legume flours, including mothbean, for the production of 'chapati' and observed marked improvements in the quality of the fortified wheat flours. Similar observations were recorded by Rawat *et al.* (1994) when wheat flour was fortified with defatted soy flour.

Miyamoto (1965) employed bean flour for the production of biscuits and found the product highly digestible and nutritious with pleasant taste. McWatters (1978) substituted wheat flour with peanut, soybean and field pea flours for the production of cookies. It was found that blends of peanut flour did not adversely affect the height, spread factor, textural quality and sensory characteristics of the cookies. Replacement with 20 or 30% soybean flour decreased the spread factor and adversely affected the sensory characteristics. Cookies containing field pea flour did not differ significantly in height, spread ratio and texture measurements except at 30% replacement level where a bean-like flavour was detected. Ranhotra *et al.* (1980) used composite flour containing a combination of soy flour and peanut butter for the production of biscuits. Sensory evaluation for colour, flavour, aroma and general acceptability was done after one, two and 16 weeks of storage. The authors reported that the biscuits were acceptable.

Composite flours thus are advantageous in the sense that the inherent deficiencies of essential amino acids in wheat flour (lysine, tryptophan and threonine) are supplemented from other sources. The main objective of this project was, therefore, to prepare composite flour with different levels of mothbeans and to evaluate its suitability for the production of biscuits.

MATERIALS AND METHODS

Wheat variety LU-26 was used in these studies. It was cleaned and milled in China mill to obtain whole wheat flour (WWF). White flour (WF) was obtained by tempering the wheat grains to 14% moisture and milling in a Quadrumate Senior Experimental Mill.. Mothbean was purchased from the local market, cleaned and milled in China Mill..

Preparation of composite flours: The composite flour containing different proportions of wheat and mothbean flours were prepared as follows:

Treatment	White Flour (WF)	Whole Wheat Flour(WWF)	Mothbean Flour (MF)
Tt	!m	0	0
T2	0	HR)	0
T3	0	YO	10
T4	0	X5	15
TS	0	S0	20
T6	0	75	25

Preparation and storage of biscuits: Biscuits were prepared according to the method described by Sultan (1976) and packed in polythene bags. These were stored for four weeks at ambient temperature (20 - 25°C) inside a laboratory shelf..

Chemical and physical studies: The flour and biscuits were analyzed to determine moisture, protein, fat, crude fiber, ash and nitrogen free extract (NFE) according to AACC (1976) methods. The AACC (1976) methods were also used to determine width, thickness and spread factor of the biscuits.

Sensory evaluation: Fresh and stored biscuits were evaluated for colour, taste, flavour, texture and overall acceptability at weekly intervals for four weeks by a panel of 7 to 10 judges as described by Larrnond (1977).

Biological evaluation: The biscuits were subjected to biological evaluation as described by Hulse *et al.* (1977) using weanling albino rats at 6% protein level to determine digestibility, net protein utilization (NPU), biological value (BV), protein efficiency ratio (PER) and feed efficiency (FE).

Statistical analysis: Data obtained were statistically analyzed to find out the difference between various levels of supplementation according to the methods described by Steel and Torrie (1980). The comparisons of means was carried out by Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

Chemical composition of raw materials: The raw materials, i.e., white flour (WF), whole flour (WWF) and moth bean flour (MF) were analyzed for proximate composition and the data are presented in Table 1. White flour contained 12.46% moisture, 11.58% protein, 0.58% crude fiber, 1.18% crude fat, 0.85% ash and 85.81 % NFE. Owing to the extraction of bran and germ from whole wheat flour, it contains lesser amount of protein, fiber, fat and ash. These results do not differ much from those reported by Tahir (1974). Whole what flour was richer in crude protein, crude fiber, crude fat and ash as compared to WF. The values obtained for proximate composition of WWF are within the range reported by Sajid (1984) and Taneja *et al.* (1983). Average protein content in the moth bean flour was 24.03%, crude fiber 4.18%, crude fat 1.69% and ash 3.38%, which is similar to that reported by Pawar and Ingle (1988).

Physical evaluation of biscuits: Physical characteristics of the biscuits including width, thickness and spread factor are presented in Table 2. It is evident from this table that width of the biscuits decreased from 278.2 to 241.3 mm with increasing level of supplementation. These findings were on the same lines as observed by Claughton and Pearce (1989). The thickness of the biscuits was affected positively, i.e., there was an increase in the thickness from 53.6 to 58.1 mm. by increasing levels of supplementation. Spread factor, like that of width, 'also decreased with increasing levels of supplementation. Such a decrease occurs also when fat content is lowered in soft dough biscuits (Srivastva and Haridas Rao, 1993). These results were in close agreement

Table 1. Proximate composition of raw materials.

Sample	Moisture %	Protein %	Fiber %	Fat %	Ash %	NFE %
White Flour	12.46	11.58	0.58	1.18	0.85	85.81
Whole wheat Flour	10.25	13.07	2.24	2.19	1.25	81.25
Mothbean Flour	9.25	24.03	4.18	1.69	3.38	66.72

Table 2. Physical characteristics of biscuits.

Characteristics	Treatment					
	T_1	T_2	T_3	T_4	T_5	T_6
Width (mm)	278.20	270.00	258.20	254.50	247.50	241.30
Thickness (mm)	57.00	53.60	54.00	56.30	56.60	58.10
Spread factor (mm)	48.80	50.40	47.80	46.30	43.73	41.24

Table 3. Proximate composition of biscuits.

Sample	Moisture %	Protein %	Fiber %	Fat %	Ash %	NFE %
T_1	6.28	6.97	0.28	26.25	0.46	66.04
T_2	5.87	8.01	1.12	26.49	0.64	63.74
T_3	5.86	8.60	1.21	27.50	0.72	61.97
T_4	5.79	8.91	1.24	27.46	0.81	61.58
T_5	5.80	9.15	1.31	27.41	0.86	61.27
T_6	5.75	9.48	1.36	27.38	0.91	60.87

T_1 = 100%WF
T_2 = 100%WWF
T_3 = 90% WWF + 10% MF
T_4 = 85% WWF+ 15% MF
T_5 = 80% WWF + 20% MF
T_6 = 75% WWF + 25% MF

Table 4. Physical characteristics of biscuits.

Characteristics	Treatment					
	T_1	T_2	T_3	T_4	T_5	T_6
Colour	7.70	6.88	5.88	4.87	4.17	3.57
Taste	7.76	7.57	7.37	7.22	4.96	4.31
Flavour	7.86	7.12	6.38	6.65	5.17	4.52
Texture	7.65	7.13	6.15	5.16	4.87	4.00
Overall acceptability	7.77	7.22	7.02	5.93	4.30	3.82

with those of Hoojjat and Zabik (1984). In general, width and spread factor decreased while thickness increased with increasing amount of crude fiber and crude protein.

Chemical composition of biscuits: The results of proximate composition of biscuits prepared with various flours like WF, WWF and composite flours with different levels of mothbean are presented in Table 3. The data revealed a significant increase in the protein content of the biscuits ranging from 6.97% (T_1) to 9.48% (T_6). The protein of the composite flour biscuits would be of better quality as compared to that of WF biscuits because mothbean flour contains sufficient amount of lysine, tryptophan and threonine (Siddique, 1989). Similar tendency of increase in protein and fiber content was noted by Hoojjat (1982) during supplementing navybean and sesame flours in wheat flour for the production of biscuits.

Sensory evaluation of fresh biscuits: Fresh biscuits were evaluated for colour, taste, flavour, texture and overall acceptability. The data presented in Table 4 revealed a significant difference among the colour of various samples. Highest quality score (7.70) was obtained by T_1 (WF) and the lowest score

of 3.57 by 1'6 (25% MF). Treatment 3 (10% MF) and 1'4 (15% MF) got fairly high quality scores, which showed that although 1'1 was preferred by the judges, yet 1'3 and 1'4 were also liked. Claughton and Pearce (1989) observed similar effect (darkness) on colour when they substituted WF with different levels of sunflower protein isolate for the production of biscuits.

The data for quality score of taste revealed that judges placed sample 1'] at top position (7.96) and rejected 1'6 (4.31). The biscuits 1'3 and 1'4 also scored high and were liked by the judges. The samples 1'5 and 1'6 scored very Iow as the judges complained of excessive bean-like flavour in them. Rajpoor (1988) made similar observations during supplementing wheat flour with mustard protein concentrate and cotton seed flour for the production of cookies.

Table 4 also reveals that the average quality Score obtained for the flavour of biscuits possesses same order as in case of colour and taste. 1'] scored highest (7.86), while lowest score of 4.52 was obtained by *1'6'* Quality score for 1'3 and 1'4 was close to 1'] and *1'2'* which revealed that the light bean-like flavour was liked by the judges. Claughton and Pearce (1989) also found a considerable reduction in the flavour quality when they used sunflower protein isolate for the production of cookies.

Texture quality score was highest in 1'3 (6.15) followed by 1'4 (5.16) among the composite flour biscuits. However it was considerably lower when compared to standard 1'1 and 1'2 biscuits. These results are similar to the findings of Hoojjat (1982) and Rajpoot (1988).

The mean quality scores for the overall acceptability of different samples are also presented in Table 4. It is obvious from this table that 1'3 and 1'4 were liked by the judges next to 1'1 and 1'2 and were placed. at top position among the composite flour biscuits. Decrease in overall acceptability Score was also noted by Hoojjat and Zabik (1984) when they supplemented wheat flour with sesame flour at different levels for the production of cookies.

Table 5. Biological studies of the experimental diets

Diet	Digestibility	NPU	BV	PER	FE
A	94.20	43.72	46.41	0.98	6.71
B	93.15	46.91	50.40	1.02	6.21
C	91.25	48.60	53.25	1.10	5.98
D	90.90	48.71	53.60	1.26	5.61
E	90.80	51.42	56.53	2.48	5.11
F	95.60	59.51	62.25	3.33	4.01

A =]OO%WWF
B = 90% WWF+ 10% MF
C = 85% WWF+]5% MF
D = 80% WWF + 20% MF
E = 75% WWF + 25% MF
F = Casein diet

Effect of storage on sensory characteristics: Biscuits packed in polythene bags and stored

for four weeks were placed for sensory evaluation at weekly intervals for judging colour, taste, flavour, texture and overall acceptability. The judges observed no quality deterioration during storage at room temperature (20 to 25°C). Similar observations were reported by Sirokman and Soboleva (1977).

Biological evaluation of biscuits: The results regarding biological evaluation (Table 5) showed that the digestibility value for casein diet was 95.60%, followed by 94.20% for the diet containing whole wheat flour. The digestibility was further observed to decrease with increasing level of supplementation. Net protein utilization of whole wheat flour was 43.72% which increased to 51.42% in flour containing 25% mothbean (T6) showing an improvement in the diet. Biological value of whole wheat flour was 46.41%. An improvement in biological value occurred as a result of substitution of whole wheat flour with moth bean flour. Protein efficiency ratio was 0.98% for whole wheat flour. It progressively increased as a result of substitution. It was 1,02, 1,10, 1,26 and 2,48 respectively for 10, 15,20 and 25% substitution. Maximum weight gain in rats was observed with minimum consumption of diet containing 25% mothbean flour. This showed an improvement in the diet as a result of substitution. These results confirm the findings of Siddique (1989)

CONCLUSIONS

The results for this study revealed that the judges preferred biscuits prepared from white flour, followed by those from whole wheat flour. From among the composite flour biscuits, preference was given to those made with the addition of 10 or 15% mothbean flour. There is marked improvement in the biological value of biscuits as a result of the substitution with mothbean flour. Using this study as a base, further investigations are required to evaluate some biscuit improvers that would result in a product of more acceptable quality.

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