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CHARACTERIZATION OF FUNCTIONAL, PHYSICAL AND ORGANOLEPTIC ATTRIBUTES OF COMPOSITE FLOURS

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ABSTRACT
The process of combining wheat flour with cereals or legumes to economically produce high-quality food products using locally available raw materials is known as composite flour technology. The investigation done to come out to standardize the processing parameters and conditions of sprouting and blending, study the effect of blending ratio on physical and biochemical composition flour mix and the microbiological safety and storage quality. The FFA% was highest for Sprouted Brown Rice Flour (SBRF) (4.21%) after 60 days of storage and for sprouted wheat flour (SWF) and (SMF) sprouted mung flour was recorded to be 0.84% and 0.56%. Among the all combinations B5 (50%SWF+20%SBRF+30%SMF) scored the highest in overall acceptability, it scored the highest for colour 9, taste 8.8, texture 8.8 and flavor 8.9 and the blends of composite sprout mix were acceptable to the entire panelist and were well liked in terms of colour, texture, flavour and taste.

KEYWORDS: Sprouts, composite flours, pulse, functional food, shelf life and sensory.

INTRODUCTION

Malnutrition is a problem in India, especially for children under five. Flour rich in protein and other micronutrients may address the problem. The study is aimed to develop a composite blend from wheat, brown rice and mung. The rate of malnutrition among teenage girls, pregnant women, and nursing mothers in India is on the rise as per UNICEF and WHO (Narayan et. al., 2019). The diet of Indian women does not meet their nutritional requirements. Addressing women's malnutrition brings forth healthy women who play multiple roles in society which helps them raise the socio-economic status of the country. It can be overcome with a good diet and enough exercise. Consuming dietary fibre helps lower blood pressure, enhance serum cholesterol levels, and minimize the risk of type II diabetes and cardiovascular diseases (Kumari and Sangeetha, 2017) and (Aleixandre and Miguel, 2016).

It is an association between legume consumption and reduced prevalence of cancer, diabetes, and cardiovascular diseases (Kaur et. al., 2011). Isoflavone compounds especially genistein found in soybean can be very beneficial to diabetic patients particularly those suffering from Non-Insulin dependent diabetes mellitus. Cereal grains are good source of protein, minerals like calcium, iron, phosphorus, zinc, vitamins of group B and contain amino acid too (Kavi Kishor et. al., 2021). Pulses rich in proteins and are good sources of fibre, gives protection against diabetes and coronary heart diseases and help in weight control (Maphosa and Jideani 2017). Whole cereals and legumes complement each other. Cereal grains are deficient in certain essential amino acids, especially lysine (Iqbal et al., 2006). Conversely, legumes are low in methionine but high in lysine (Chardigny and Walrand et. al., 2016). A clever selection of the ingredients will help to deliver good nutrition to the public (Kushi et. al., 1999) and (Birketvedt et. al., 2005).

The practice of combining wheat flour with cereals or legumes to economically produce high-quality food items using locally available raw materials is known as composite flour technology. It has been discovered that adding mung bean and chickpea flour to wheat flour improves the acceptability of composite flour baked products while also increasing the protein and resistant starch content (Noor et. al., 2012). Composite flour technology refers to the process of mixing various flours to make use of local raw material to and is vital for development of value-added products with optimal functionality (Rehman et. al., 2007).

The term 'sprouting' is also known as germination and malting. Sprouting endorsed the activity of the phytase enzyme which minimizes the development of the phytate complex and increases mineral availability. In addition, the mobilization of reserve nutrients required for the growth of plant seedlings helps in the removal of anti-nutritional factors. These are excellent providers of protein, vitamins and minerals (Desai et. al., 2010).

A variety of sprouts from cereals and pulses are finding a place in the daily dietary. There is a growing trend to include sprouts from cereals and pulses but all sprouts have a short shelf life of not more than two days. Introduction of sprouts in the diet stimulates metabolism and haematopoiesis and also has been found to boosts immunity. In recent years there has been an increase in consumer's demands (Rosas and Escartin, 2000). Sprouted grains flours are incorporated in breakfast cereals, snacks, drink concentrates, ready meals, nutritional powders and drinks etc. and this has resulted in improved products.

MATERIALS AND METHOD

The investigation was conducted at the Department of Post Harvest Process and Food Engineering, COAE, JNKVV, Jabalpur (MP).

Procurement of raw material and sample preparation: - Mung bean, de-husked brown rice and wheat grains were procured from the local market, Jabalpur (MP).

Experimental methods: - *Soaking and sprouting of grains*:-To minimize microbial contamination during sprout development without compromising seed viability, a chemical surface sterilization procedure was implemented by following the standard procedure of Patil et. al., (2011).

Preparation of blends: Codes were done as shown in table 1 where *SWF*=Sprouted Wheat Flour, *SMF*=Sprouted Mung Flour, *SBRF*=Sprouted Brown Rice Flour.

Composite flour Preparation:-Equal amounts (w/w) of germinated brown rice and germinated mung flours were mixed thoroughly, in different ratios, and incorporated with whole wheat flour to prepare five distinct variations (Table 1). The mixed composite flour was sieved through a mesh size of 60 µm to ensure uniform mixing.

Proximate composition and physical property of Composite Sprouts Flour: - *Moisture, Protein, Fat, Carbohydrates and Ash content*: - Different parameters in the sample were estimated by the procedure indicated in the AOAC (1984). *Free Fatty Acid* (FFA):- It was determined as per the method of AOAC (1992). *Oil Absorption Capacity*: - The oil absorption capacity was also determine was the method of Sosulski et, al., (1976). *Germination percentage*: - 100 seeds were spread in a Petri dish having filter paper soaked with distilled water and maintained at 25°C for 3days the germination percentage was calculated by counting germinated seeds. Germination% = (number of seeds germinated/ total number of seeds) X100.

***Bulk Density*: -** The bulk densities of blend were analyzed as per Wang and Kinsella (1976).

Microbiological analysis of Sprouted Flour: - *Total Plate Count*: - The total plate count in stored Sprout Flour was determined by following the standard procedure as described by Ranganna (1986). **Sensory evaluation of Composite Sprout Flour**: - The sensory evaluation of was done by panel of 10 judges as described by Amerine et. al., (1965). **Hunter Colour Measurement**: - Colour measurement of different Sprout flour as well as mix sprout flour prepared from it was done by using a Hunter colour measuring system according to the Kramer A. (1976). *Whiteness Index:* - The WI represents the over- all whiteness of food products it indicates the degree of whiteness. *Yellowness Index:* - Yellowness is associated with scorching, soiling, and general product degradation by light, chemical exposure and processing both index were analyzed as per Rhim et. al., (1999). **Statistical analysis of data**: - The experiment was conducted in complete randomized design (CRD) using WASP, Version 1.0 (http://icargoa.res.in/wasp) and following the procedure as described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Physical, nutritional and colour characteristics of composite flour:- The nutritional and physico-chemical qualities of the composite flour optimized by sensory reactions were then assessed. Table 2 shows the optimized flour's approximate composition. The bulk density of the blends of the composite sprouted flour mix varied from 0.73g/ml to 0.80 g/ml. It is evident from the table 2 that as the bend of B1 had the least bulk density and as the quantity of brown rice was increased it increased the bulk density of the flour. This might be due to the variation in the grain type. Similar trend has also been found by Rana et. al., (2015). Oil absorption % the blend of B3 recorded the highest oil absorption percentage (31) followed by B1 and B2 (30) and (30). As depicted in Table 2 Moisture content (%, w.b.) ranged from 10.5% to 11.5% in the different blends. The moisture content in the flour was recorded after the sprouts were dried in a hot air oven results were supported by Uwaegbute et. al., (2000). The Protein content was highest in B2 (16%) followed by B5 (15%), it so been found that 19.15% increase in crude protein content of pulse after 28 hours of sprouting similar trend were observed by Mehta et. al., (2007). Table 2 presents the data of fat content was highest in B (2.64%) followed by B4 (2.6%). B1 (1.75) and B2 (1.74) recorded the least among all the blends. Fat content is depleted due to the catabolic activities of the seeds during sprouting findings were close to Onimawo and Asugo (2004). The carbohydrate content as per table 2 was highest in B4 (76%) followed by B3 (75%) B1 recorded the least among all the blends 53. It was observed that carbohydrate decreased due to sprouting. 2.34% decrease in carbohydrate after 24 hours of sprouting in cowpea and results were in accordance with Jirapa et. al., (2001). Fibre contents was highest in B4 (3.5) followed by B6 (3.2) B1 recorded the least among blends 2.88 Increase improved fibre as reported by Uppal and Bains (2012) in the range of 20% to 24% after sprouting cowpea. Ash content ranged from 1.5% to 1.8%. B5 recorded the highest ash content i.e. 1.8% from the data of table 2 results was similar to findings of Farzana et. al., (2017).

Table 1.0 Blends ratio of composite flour of sprouted wheat, brown rice and mung.

S. No.	Treatments	Blend ratio %		
		SWF	SBRF	SMF
1	B1	75	-	25
2	B2	70	-	30
3	B3	-	75	25
4	B4	-	70	30

5	B5	50	20	30

The Calcium content the combination B3 recorded the highest calcium content i.e. 90 mg. It was seen that calcium content was at par in B4 and B5 i.e.79 mg and 24 to 64% increase in calcium content of cowpea after sprouting it also observed by Dave et. al., (2008). Data from table 2 of the Ascorbic acid cleared that the trial B1 recorded the least Ascorbic acid content i.e. 53 mg. It was seen that as the quantity of sprouted mung flour was increased in proportion to the sprouted brown rice there was an increase in the Ascorbic Acid content to the range of 75mg to 76mg and longer the sprouting periods significantly enhanced the ascorbic acid content in mungbean similar data were reported Uppal and Bains (2012).

Table 2.0 Physical and nutritional profile of composite flour.

S. No.	Treatments	Bulk density (g/ml)	% Oil absorption	Moisture %	Protein %	Fat %	Carbohydrate %	Fibre %	Ash %	Calcium %	Ascorbic acid (mg/100 g)
1	B1	0.73	30	11.5	14.5	1.75	53	2.88	1.5	72	53
2	B2	0.75	30	11.5	16	1.74	55	3	1.6	57.5	55
3	B3	0.76	31	10.5	12.5	2.64	75	3.1	1.65	90	75
4	B4	0.78	27	10.5	12.5	2.6	76	3.5	1.6	79	76
5	B5	0.8	28	11.5	15	2	62	3.2	1.8	79	62
	SEM	0.01	0.021	0.021	0.39	0.021	0.03	.021	0.021	0.029	0.021
	CD@5%	0.03	0.071	0.071	1.13	0.061	0.09	.061	0.061	0.089	0.071

Colour of composite sprout flour Mix (CSFM):- The Chroma value presented in the table 3 expressed that it was also high 16.2 so with respect to composite blends. B1 recorded the highest whiteness index (81.53) among all the composite blends but there was a decrease in the yellowness index YI 21 which was the lowest recorded for the blends' also recorded the highest FCI 70.54. Whiteness index represents the overall whiteness of food products that may indicate the extent the discoloration during the drying process and at par results were reported by Hsu et. al., (2003).

Table 3.0 Effect of blend ratios on colour of composite sprout flour Mix (CSFM)

S. No.	Code	L*	a*	b*	Whiteness Index (WI)	Croma C*	Flour Colour Index	Yellowness Index (YI)
1	SWF	75.74	0.25	16.23	73.30	16.23	59.51	30
2	SMF	75.62	-0.01	15.08	73.42	15.08	60.54	28
3	SBRF	79.34	1.75	14.81	77.28	14.91	64.53	26
4	B1	83.1	0.75	12.56	81.53	12.58	70.54	21
5	B2	79.12	1.62	14.64	77.09	14.72	64.48	26
6	B3	79.07	0.92	15.79	76.82	15.81	63.28	28
7	B4	78.59	1.26	14.79	76.52	14.84	63.8	26
8	B5	79.15	1.26	13.93	77.25	13.98	65.22	25

Sensory attributes of blend ratios of composite sprout flour Mix (CSFM):- The most important aspect to take into account when developing a new product is its sensory qualities. For the study, one pulse and two grains were employed. 100% sprouted brown rice flour scored the highest in terms of overall acceptability over SMF (100% sprouted Mung bean flour) and SWF (100% sprouted wheat flour). B5 scored the highest in overall acceptability among all the blends, it scored the highest for colour 9, taste 8.8, texture 8.8 and flavor 8.9. This was followed by B1 and B4 which were liked by all scoring 8.6 and 8.7 in overall acceptability. B2 scored the least scores 7.5 for overall acceptability. B5 recorded the highest scores (8.9) for flavor and colour (9.0) and taste (8.9). The blends of composite sprout mix were acceptable to the entire panelist. It was well liked in terms of colour, texture, flavour and taste findings were in accordance with Chandra et. al., (2015).

Table 4.0 Effect of blend ratios of composite sprout flour Mix (CSFM) on sensory attributes

S. No.	Code	Colour	Taste	Texture	Flavour	Overall Acceptability
1	SWF	7.8	7.7	7.8	7.9	7.8
2	SMF	7.7	7.6	7.9	8.1	7.9
3	SBRF	8.2	7.7	8	8.2	8
4	B1	8.6	8.7	8.7	8.6	8.6
5	B2	7.9	7.8	7.9	7.8	7.8
6	B3	8.6	8.5	8.7	8.6	8.6
7	B4	8.7	8.6	8.6	8.8	8.7

8	**B5**	**9**	**8.9**	**8.8**	**8.9**	**8.8**
SEM		0.14	0.15	0.20	0.24	0.18
CD@5%		0.41	0.43	0.58	0.70	0.52

Changes in the free fatty acid during storage: - Values from table 5 shown changes in free fatty acid % in storage of the composite flour mixes at 40°C for 30 and 60 days. The FFA% was highest for Sprouted Brown Rice Flour (4.21%) after 60 days of storage and FFA% for sprouted wheat flour (SWF) and (SMF) sprouted mung flour was recorded to be 0.84% and 0.56%. Blending SBRF in blends showed that the FFA% was highest 2.52% in B4 followed by B3 and B5 which recorded 1.97% respectively. Sprouted wheat flour blended with sprouted mung flour has the least FFA % (1.39%) among all the blends. It shows that increasing the blend ratio of SBR in the composite flour mix results in increasing the free fatty acid percentage results were consistent with Andago et. al., (2015).

Table 5.0 Effect storage on Free fatty acid % of composite blend, packed in metallic pouch for 30 and 60 days at 40°C

S. No.	Code	FFA% at 30days	FFA% at 60 days
1	SWF	0.72	0.84
2	SMF	0.48	0.56
3	SBRF	2.56	4.21
4	B1	1.02	1.39
5	B2	1.50	1.96
6	B3	1.13	1.97
7	B4	3.08	2.52
8	B5	0.75	1.97
SEM		0.024	0.19
CD@5%		0.073	0.58

Microbial characteristics:- The different blends were kept for storage for a period of sixty days and examined for total plate count at interval of 30 days and 60 days. There was a presence of Rhizopus, Aspergillus niger, A. nigericans, Candida, Fusarium and Bacterial colonies findings were supported by the Berghofer et. al., (2003) and Aydin et. al., (2009).

Table 6.0 Microbial characteristics of composite flour of sprouted wheat, brown rice and mung

S. No	Code	Blend ratio	0 Days	30Days	60Days
1	**B1**	75%SWF+25%SMF	Rizopus log(4×106×510) Bacteria log(8×106×510)	Rizopus log(2×106×510)	Rizopus log(4×106×510) Candidbacteria
2	**B2**	70%SWF+30%SMF	A. nigerican log(6×106×510) Rizopuslog(5×107×510)	Slimy Bacteria log(6×106×510) Aspergillus log(8×106×510)	White Bacteria log(2×106×510) Rizopuslog (104×510)
3	**B3**	75%SRF+25%SMF	Fusarimlog(2×106×510) Rizopus log(4×106×510) Bacterialog(2×106×510)	Rizopus log(3×105×510) Bacterialog(2×106×510) Bacterialog(2×106×510)	Rizopus log (64×104×510) A. niger log(2×106×510)
4	**B4**	70%SRF+30%SMF	Rizopus log(4×106×510) Bacterialog ((102×512)	Bacterialog(2×106×510) Flavus Aspergillus log(4×106×510)	Rizopus log(3×105×510) Aspergillus log(107×510)
5	**B5**	50%SWF+20%SRF+ 30%SMF	Aspergillus log(102×512) Rizopus log(6×106×510) Bacterialog (102×512)	Bacterialog (107×510) Rizopuslog(6×106×510) Aspergillus TDS log(2×106×510)	Rizopus log ((2×106×510) Bacterialog(2×106×510) Aspergillus log (16×106×510)

CONCLUSION

The goal of the current study was to create and improve composite flour pre-mix. It was made by mixing a few nutrient-dense, reasonably priced, and locally accessible cereals, pulses, and oilseeds. From the findings it was conclude that blending SBR in the composite flour Increases the free fatty acid composition. The Chroma Value (1.70), Whiteness index (79.77), Colour analysis of sprouted flours from wheat rice and mung bean resulted in Sprouted mung flour (SMF) which recorded the highest WI (77.28) and FCI (64.53) but the lower Chroma (14.91) and YI (28) can be attributed to lesser damages to the flour during processing. B1 (70% SMF + 30%SBRF) recorded the highest whiteness index (81.53) among all the composite blends but there was a decrease in the yellowness index YI 21 which was the lowest recorded for the blends' also recorded the highest FCI 70.54. Out of all the blends, B5 received the highest overall acceptance score of 9 for colour, 8.8 for taste, 8.8 for texture, and 8.9 for flavor. B1 and B4, which received an overall acceptance score of 8.6 and 8.7 from everyone, came next. B2 received the lowest overall acceptability score of 7.5. In terms of taste (8.9) and flavor and colour (9.0), B5 scored the highest (8.9).

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