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RESEARCH ARTICLE :

Evaluation of quality characteristics of bread from horsegram

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SUMMARY : Horsegram incorporated breads were standardized by incorporating horsegram flour at 15, 20 and 25 per cent levels. The developed bread was evaluated for their sensory attributes and it was acceptable at 15 per cent level of horsegram incorporation. The developed products were analyzed for their physico-chemical properties. The incorporation of horsegram flour increases the bread characteristics such as height, weight, specific volume, water absorption and decreases the dough extensibility. The bread samples partially substituted with horsegram had significantly lower L* value compared to control (100% maida). By increasing the amount of horsegram in bread, darkness gradually increases with significant difference among all combinations. Where as a* and b* value increases as the level of incorporation increases and gradually decreases during storage. Horsegram bread is nutritious with high contents of calcium, fibre and protein when compared to control sample. The shelf-life of the bread was 7 days under ambient condition in different packaging materials and the microbial population was within the safer limit during the storage period.

KEY WORDS :
Horsegram flour, Bread, Sensory evaluation, Texture analysis, Physico-chemical properties

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BACKGROUND AND OBJECTIVES

Horsegram is high in protein and iron, which makes it a wholesome food that should be added to our diet frequently. It has calcium, molybdenum, polyphenols, flavonoids, which have high antioxidant capacity. Apart from these, it has carbohydrates, fats, minerals, phosphorus, carotenes and nicotinic acid. Major health benefits are it helps in regulating fever, reduces weight and lowers cholesterol. In bakery products refined maida is used which has less nutritional value therefore by incorporating horsegram flour the nutritive value can be enhanced and also it has health benefits. The present study was carried out on developing healthy and highly nutritious horsegram bread.

RESOURCES AND METHODS

Horsegram grains were procured from local market. The grains were cleaned to remove dust and other foreign materials and grinded in a commercial domestic flour mill. The flour was sieved using a BS 40 mesh sieve to obtain fine flour and was stored in stainless steel containers.

Preparation of horsegram bread :

Ingredients:

Maida and horsegram (30:70, 50:50, 70:30, 90:10 and control), sugar, fat, milk powder, salt, yeast and water.

Procedure:

– Disintegrate yeast in 100 ml of luke warm water with a pinch of sugar and rest apart for 5 min with a cover for the ferment to develop

– Dissolve the salt and sugar in the remaining water and filter through a strainer

– Sieve the maida on the working table and make depression in the centre

– Add salt and sugar water in the centre of the depression of the flour and mix roughly

– Add the ferment and knead to a soft and smooth dough along with water and milk

– Knead fat, rest the dough under thick cloth for a hour or till it becomes double the size

– Divided the dough into pieces of 55 g each round it

– Mould into bread and place it in the bread moulds

– Again rest and proof till it acquires full size as required

– Bake at 220 C for about 10-15 min.

The bread were cooled and packed in thermally sealed polypropylene (200 gauge) and low density polyethylene (200 gauge) for 7 days at room temperature (27-35°C) and relative humidity of 65-85 per cent. The horsegram bread samples were analyzed for their physico-chemical properties, textural profiles and sensory qualities during storage period.

Sensory quality :

Horsegram bread samples were evaluated for their sensory attributes by a panel of trained members using 9 point hedonic scale (Watts *et al*., 1989).

Texture analysis:

Texture analysis of horsegram bread samples were done by Texture Analyzer (Make Stable Micro System, UK). TA test was done for measuring the cutting force of baked nippattu (Bourne, 1978).

Nutrient analysis :

Best formulations of horsegram bread samples were analyzed for moisture (Ranganna, 1995). Protein (Micro kjeldaha, N×6.25), Fat (solvent extraction), Ash (muffle furnace – dry ash), Calcium (titration), Crude fibre (acid and alkali) were determined by the method of Sadasivam and Manickam (1996). Micronutrients by Flame photo meter.

Statistical analysis :

Analyses of variance (ANOVA) to distinguish the responses of different levels of substitution were performed using Completely Randomized Design (CRD). The level at which significant difference are reported as $P \leq 0.05$.

OBSERVATIONS AND ANALYSIS

Five different combinations of Horsegram bread samples were evaluated for their sensory attributes by a panel of trained members using 9 point hedonic scale. The mean sensory scores for attributes *viz.*, colour/ appearance, texture, flavour, taste and overall acceptability are presented in Table 1.

Formulations:

– A : 30 % horsegram flour + 70 % maida
– B : 50 % horsegram flour + 50 % maida
– C : 70 % horsegram flour + 30 % maida
– D : 90 % horsegram flour + 10 % maida
– E : 100 % maida.

Sensory scores revealed that 30 per cent incorporation was the maximum acceptable level compared to the other combinations hence, the level of incorporation was restricted to 30 per cent. The second experiment study of three different combinations (15%,

Table 1 : Mean sensory scores of horsegram bread

Sample	Combination (HG:M)	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
A	30:70	6.64	6.53	6.64	5.92	6.37	6.45
B	50:50	6.20	6.30	6.34	5.89	5.85	5.96
C	70:30	6.17	6.03	5.92	5.55	5.80	5.92
D	90:10	5.34	4.87	4.64	4.12	4.25	4.37
E	Control	8.12	7.95	7.77	7.68	7.81	7.98

20% and 25%) was carried out along with control (100% maida).

– A : 15 % horse gram flour + 85 % maida
– B : 20 % horse gram flour + 80 % maida
– C : 25 % horse gram flour + 75 % maida
– D : Control.

The dough weight was kept constant for all formulations (140 g each). Whereas the water absorption was more for horsegram incorporated formulations compared to control (refined wheat flour). The high water absorption is due to the characteristics of more fibre present in horsegram flour.

The baked weight of horsegram bread varied with one another, the least was observed in sample D (control) and the highest was observed in sample C (high level of horsegram). Samples of bread length and breadth exhibited slight difference in behavior with increasing incorporation level of horsegram. This adverse effect intensified along with increase in horsegram flour. The length and breadth of bread showed a marked difference, which shows the inability of the horsegram flour added dough to prove well, because of the diluted refined flour.

The height of control (refined wheat flour) sample was 9.5 cm where as the highest level of incorporated horsegram (Table 2) sample C was 8.5 cm.

The data in the present study indicated that the height and specific loaf volume reduced where as the loaf weight and volume of bread increases as the level of incorporation of horsegram increased (Table 2 and 3). As less wheat gluten in the formulation may retain less fermentation gas, this may be the primary reason for the decline in both loaf volume and height in bread containing horsegram flour than control (Karuppasamy *et al*., 2013).

Table 2: Physical properties of horsegram bread

Sample code	Dough weight (g)	Baked bread weight (g)	Bread length (cm)	Bread breadth (cm)
A	140	130	9	5.8
B	140	130	9	5.5
C	140	132	8.5	5.2
D	140	128	9.5	6.8

Table 3 : Bread volume and specific volume of horsegram bread

Sample code	Bread volume (cm^3)	Bread specific volume (cm^3/g)
A	213.33	0.57
B	181.67	0.46
C	165.00	0.35
D	309.00	0.78
C.D. value	6.14	0.020
CV	0.375	0.514
F test	S	S

S= Significant

Effect of incorporation of horsegram on sensory characteristics of horsegram bread :

The control bread was rated as highest among all the treatments in terms of external, internal and taste properties, respectively. The external properties scores decreased slightly with increasing level of horsegram flour. Sample A (7.55) was acceptable more for all attributes compared to the other two combinations. Panelists agreed that eatablility of high horsegram incorporated bread did not reach appealing values because of their chewy crusts and gummy crumbs. Similar observation was recorded by Iwuoha *et al*. (1997).

Mean value for effect of storage on crust and crumb colour of horsegram incorporated bread

The colour L*, a* and b*characteristics of baked nippattu samples are given in Table 5. The lightness of control bread had lighter crumb (79.13) and crust (67.82) colour compared to horsegram incorporated bread (for sample A – 71.07 and 55.37, sample B – 66.77 and 53.80,

Table 4: Mean sensory scores of horsegram bread

Sample	Combination (HG:M)	Appearance	Colour	Texture	Flavour	Taste	Overall acceptability
A	15:85	7.55	7.32	7.48	7.27	7.45	7.55
B	20:80	7.03	6.85	6.98	6.63	7.00	7.05
C	25:75	6.87	6.87	6.83	6.63	7.10	6.75
D	Control	8.20	8.30	8.05	8.05	8.40	8.37
	CD	9.01	8.80	9.08	8.59	9.41	9.35
	CV	2.97	2.93	3.03	2.94	3.07	3.08
	F test	NS	NS	NS	NS	NS	NS

NS= Non-significant

sample C – 63.14 and 52.73). As can be seen, bread samples partially substituted with horsegram had significantly ($p<0.05$) lower L* value compared to control. By increasing the amount of horse gram in bread, darkness gradually increased with significant difference among all combinations. Where as a* and b* value increases as the level of incorporation increases and gradually decreased during storage. The least was observed in control sample followed by sample A, B and C. As the storage period increases the colour value L* increases and a*, b* decrease in both packaging materials. Better retention of colour was noticed in PP cover compared to LDPE cover.

Mean value for texture profile analysis of bread :

The data on texture profile of the bread is given in Table 6. The initial crumb hardness was 362.95 for Sample A which increased to 962.15 in PP cover and 965.10 in LDPE cover. Similar increase trend for noticed for all samples. The higher addition of fibre usually leads to firm crumb and crust. Keetals (1996) stated that crumb hardness and an increase in crumbliness have a negative impact on the eating quality of bread. Springiness and cohesiveness were decreased over seven days where as gumminess increases.

Nutrient analysis of horsegram bread :

The nutrient content of the horsegram incorporated

Table 5: Mean values for effect of storage on crust and crumb colour of horsegram incorporated bread

Colour value		A		B		C		D		C.D. (P=0.05)	CV	F test
Crumb		P_1	P_2	P_1	P_2	P_1	P_2	P_1	P_2			
L*	I	71.07	71.07	66.77	66.77	63.14	63.14	79.13	79.13	0.04	0.003	S
	F	72.34	73.42	69.34	71.64	64.53	63.58	80.46	80.75			
a*	I	3.90	3.90	4.55	4.55	4.97	4.97	1.32	1.32	0.03	0.04	S
	F	3.01	2.98	3.77	3.01	4.81	4.76	0.87	0.64			
b*	I	20.74	20.74	20.74	20.74	20.41	20.41	22.44	22.44	2.81	0.72	S
	F	18.51	18.13	18.77	15.72	19.61	19.36	18.90	18.51			
Crust												
L*	I	55.37	55.37	53.80	53.80	52.73	52.73	67.82	67.82	0.03	0.002	S
	F	59.09	61.01	60.73	61.95	56.53	62.54	70.23	71.72			
a*	I	15.50	15.50	13.23	13.23	13.44	13.44	12.60	12.60	0.03	0.012	S
	F	11.83	9.61	11.83	11.28	12.20	10.66	11.95	9.57			
b*	I	37.02	37.02	33.45	33.45	31.81	31.81	36.94	36.94	0.150	0.022	S
	F	31.54	29.35	32.60	32.33	31.45	31.18	36.81	34.23			

P_1 - Poly propylene, P_2 – Low density polyethylene

Table 6 : Mean value for texture profile analysis of bread

Treatments		A		B		C		D	
	Days	P_1	P_2	P_1	P_2	P_1	P_2	P_1	P_2
Crumb hardness (g)	1	362.95	362.95	610	610	637.45	637.45	295	295
	7	962.15	965.10	1215	1235	1312.6	1315.4	698.3	702.4
Crust hardness (g)	1	492.8	492.8	860.5	860.5	938.5	938.5	316.5	316.5
	7	1012.0	1013.0	1430	1432	1505.5	1507.0	715.4	718.2
Springiness	1	2.47	2.47	2.08	2.08	1.79	1.79	3.38	3.38
	7	0.85	0.80	0.80	0.75	0.78	0.72	0.92	0.85
Cohesiveness	1	0.80	0.80	0.85	0.85	0.88	0.88	0.72	0.72
	7	0.40	0.45	0.30	0.32	0.25	0.28	0.50	0.52
Gumminess	1	290.6	290.6	518.5	518.5	560.95	560.95	212.4	212.4
	7	384.56	434.25	364.50	395.2	328.15	368.31	349.15	365.24

P_1 - poly propylene, P_2 – low density polyethylene

Table 7: Nutrient changes in the optimized horsegram incorporated bread during storage (Per 100 g)

Nutrient		A		B		C		D		CV (0.05)	F test
	Days	P_1	P_2	P_1	P_2	P_1	P_2	P_1	P_2		
Moisture(g)	I	30.17	30.17	29.98	29.98	28.68	28.68	30.67	30.67	0.064	S
	F	29.68	28.34	29.97	28.05	27.77	27.69	29.20	28.82		
CHO (g)	I	49.04	49.04	48.74	48.74	49.02	49.02	49.35	49.35	0.03	NS
	F	49.00	48.85	48.71	48.62	49.00	48.81	49.03	48.94		
Protein (g)	I	10.29	10.29	10.78	10.78	11.78	11.78	10.26	10.26	0.113	S
	F	1016	10.11	10.66	10.33	11.68	11.55	10.22	10.17		
Fat (g)	I	7.94	7.94	7.84	7.84	7.56	7.56	8.08	8.08	0.040	S
	F	7.92	7.92	7.80	7.77	7.45	7.39	7.99	7.97		
Crude fibre (g)	I	0.96	0.96	1.02	1.02	1.28	1.28	0.25	0.25	0.155	S
	F	0.93	0.91	0.99	0.97	1.24	1.23	0.23	0.22		
Ash (g)	I	1.60	1.60	1.64	1.64	1.69	1.69	1.39	1.39	0.100	S
	F	1.51	1.49	1.56	1.52	1.69	1.65	1.35	1.31		
Calcium (mg)	I	0.98	0.98	1.02	1.02	1.15	1.15	0.64	0.64	0.038	S
	F	0.95	0.92	0.98	0.97	1.01	0.99	0.62	0.58		
Iron (mg)	I	26.54	26.54	31.31	31.31	31.62	31.62	22.38	22.38	0.250	S
	F	26.12	25.93	31.39	29.80	31.14	30.14	22.28	20.65		
Copper (mg)	I	9.03	9.03	8.16	8.16	8.10	8.10	9.32	9.32	0.257	S
	F	8.80	8.64	7.88	7.17	7.98	7.87	8.90	8.25		
Zinc (mg)	I	22.14	22.14	20.68	20.68	23.62	23.62	20.18	20.18	0.40	S
	F	21.09	19.67	20.52	19.83	18.09	17.86	19.05	17.86		
Mn (mg)	I	19.38	19.38	19.57	19.57	20.01	20.01	17.00	17.00	0.102	S
	F	18.05	17.91	17.75	17.25	19.30	19.26	16.89	15.96		

P_1 - Poly propylene, P_2 - Low density polyethylene S= Significant NS= Non-significant

bread is presented in Table 7. The horsegram bread had high crude fibre, calcium, protein and iron than control. Highly significant difference was noted for all parameters at 5 per cent level in treatment, packaging and storage.

Conclusion :

Based on the physical characteristics of the dough, sensory and nutritional characteristics of the horsegram incorporated bread; 15-20 per cent incorporation level was found to be highly acceptable. Horsegram bread is highly nutritious with high calcium, fibre and protein content compared to control sample. The shelf-life of horsegram bread is upto 7 days in different packaging materials.

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