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RESEARCH ARTICLE

NUTRITIONAL PROPERTIES AND SHELF LIFE STUDY OF COARSE CEREAL AND SOYBEAN SUPPLEMENTED BISCUITS

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ABSTRACT

The present study was done to assess the organoleptic acceptability, physical characteristics, nutritional composition and shelf life study of value added biscuits developed from newly released wheat varieties (WH-1129 and HD-2967) flours supplemented with sorghum and soybean flours. The overall acceptability scores of four types of biscuits was in the category of 'liked very much'. The thickness of composite flour biscuits increased significantly ($P \leq 0.05$) with the increase in the level of substitution of wheat flour with sorghum and soybean flours. The value added biscuits from prepared from WH-1129 wheat variety had significantly ($P \leq 0.05$) higher contents of protein, crude fibre and ash as compared to biscuits prepared from variety HD-2967 while HD-2967 value added biscuits had significantly had significantly ($P \leq 0.05$) higher fat content than WH-1129 and control wheat flour biscuits. The shelf life study indicated that there were no significant changes in the overall acceptability of the developed biscuits and they were acceptable upto 3 months of storage.

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INTRODUCTION

Global warming and its consequent impact on dwindling food production and availability specially for traditionally utilized food grains and pulses has lead scientists world over to think for other options of less utilized food items for assuring food and nutrition security. This type of scenario wherein there is increase in demand and decrease in availability of food the worst affected lot are the poor of developing countries who cannot afford to purchase the nutritious food items due to high costs. Thus nutritionists and scientists are working on primary and secondary food processing for value addition of conventionally used cereals with less utilized coarse cereals like finger millet, sorghum, pulses and oilseeds like soybean which are rich source of protein and fibre (Vidyavati *et al.*, 2004). Efforts are being made to even utilize the by products from food processing industries for enhancing the nutritive value of food items (Beniwal *et al.*, 2015). There is increase in demand of coarse cereals like sorghum and pearl millet due to potential health benefits among masses.

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It is well established in literature that both sorghum and soybean possess health promoting and protecting neutraceuticals, antioxidant activity, phytochemicals, tannins, phenolic acids, anthocyanins, phytosterols and policosanols and are nutrient dense (Carr *et al*., 2005; Yang *et al.,* 2009). They possess ability to prevent cancer, control diabetes, obesity, promote cardiovascular health considered safe for Celiac disease patients, improve digestive health, build strong bones, promote red blood cell development and boost energy and fuel production (Isaacson, 2005; Cao *et al.,* 2011; Masilamani *et al.,* 2012). Biscuits are widely utilized in India which is basically made from wheat flour or refined flour and are popular among people of all age groups including children, adults and old age people. Value added nutrient rich biscuits can also be prepared from combination of wheat, sorghum and soybean flours in different ratios (Serrem *et al*., 2011, Omoba, 2013) which will have health promoting properties and will also promote utilization of less utilized coarse cereal and encourage the alternative uses of soybean. The development and utilization of the composite flour products on one hand will promote value addition of the conventional bakery products and on the other hand will also ensure the food, nutrition and health security by inclusion of health promoting and protecting food ingredients that are cost effective too. Keeping these facts

in view, the present investigation was undertaken to develop wheat, sorghum and soybean value added biscuits which were assessed for organoleptic acceptability, physical characteristics, nutritional composition and shelf life study.

MATERIALS AND METHODS

Procurement of materials

Two newly released wheat (*Triticum aestivum)* varieties (WH-1129, HD-2967), traditional wheat variety (C-306) and *Sorghum vulgare* (HJ-541) used for product development in the present study were procured in a single lot from the breeders, Department of Genetics and Plant Breeding, CCS Haryana Agriculture University, Hisar. Soyabean flour along with other ingredients required for the development of value added biscuits were procured from local market.

Processing of materials

Triticum aestivum (WH-1129, HD-2967 and C-306) and *Sorghum Vulgare* (HJ-541) were subjected to processing before use to remove dust, dirt and other unhygienic foreign materials. The wheat and sorghum grains were cleaned and ground in an electric grinder (Cyclotec, M/s Tecator, Hoganas, Sweden) and flours thus obtained were sieved through a 60 mesh sieve and packed in airtight plastic containers for product development and further analysis.

Development and organoleptic characteristics of value added biscuits

The preparation method of value added biscuits is presented in Table 1. Using two ratios (60:30:10 and 40:40:20) of each wheat variety flour (WF), sorghum flour (SGF) and soybean flour (SBF) four types of biscuits were developed. 100% wheat flour biscuits prepared from C-306 were kept as control. The biscuits were organoleptically evaluated by a panel of ten judges for sensory parameters like colour, appearance, flavour, texture, taste and overall acceptability using 9 point hedonic scale (1=dislike extremely, 5=neither like nor dislike, 9 to like extremely). Between tasting different samples, participants rinsed their mouth with warm water. On the basis of organoleptic acceptability, from each category the biscuits rated higher for organoleptic characteristics were selected for further study.

Method

- Sieving the flour
- Creaming ghee and sugar
- Add sodium bicarbonate and ammonia, baking powder and mix it well with creamed ghee and sugar.
- Add flour and milk and mix well.
- Place dough for conditioning for 30 minutes in refrigerator.
- Kneading the dough again and rolling it into sheet.
- Cutting in round shape.
- Bake at 160°C for about 25 minutes or till brown colour.

After cooling for 30 minutes, the biscuits were packed in air tight containers and used for evaluation of physical, organoleptic, nutritional and shelf life study.

Physical Characteristics of Biscuits

Diameter: To determine the diameter (D), six biscuits were placed edge to edge. The total diameter of six biscuits was measured in cm by using a ruler. The biscuits were rotated at an angle of 90° for duplicate reading. This was repeated once more and average diameter was recorded in centimeter.

Thickness: To determine the thickness (T), six biscuits were placed on top of one another. The total height was measured in centimeter with the help of ruler. This process was repeated thrice to get an average value and results were reported in centimeter.

Spread ratio: Spread ratio (D/T) was calculated by dividing the average value of diameter (D) by average value of thickness (T) of biscuits.

Nutritional Composition of value added biscuits

The nutritional composition of one most acceptable ratio of biscuits developed from wheat, sorghum and soybean flour blends was assessed. Proximate composition (moisture, crude protein, crude fat, crude fibre and ash) were estimated by employing the standard method of analysis (AOAC, 2000).

Shelf -life study of value added biscuits

For the shelf –life study the most acceptable biscuits were stored for 3 months in air tight plastic containers at room temperature. The biscuits were evaluated for sensory parameters using 9 point hedonic scale by a panel of ten judges at regular intervals of 0, 15, 30, 45, 60, 75 and 90 days.

RESULTS

Organoleptic acceptability

The mean scores of organoleptic acceptability are given in Table 2. The control biscuits had mean score of overall acceptability i.e. 8.08 whereas all other types (Type I to IV) of value biscuits had mean score of overall acceptability ranging from 8.12 to 8.26. The overall acceptability of all types of biscuits was in the category of 'liked very much'. The differences in the organoleptic scores could be due to the varietal difference of wheat flours and due to increase in the supplementation level of both sorghum and soybean flours.

Physical Characteristics

The physical characteristics of organoleptically accepted biscuits is presented in Table 3. The thickness of composite flour biscuits increased significantly ($P \leq 0.05$) with the increase in the level of substitution of wheat flour with sorghum and soybean flours. The average thickness of control biscuit was 0.68cm which was significantly ($P \leq 0.05$) lower than that of Type II and Type IV biscuits. The average width of control biscuits was 4.65 cm which was significantly ($P \leq 0.05$) higher than supplemented biscuits. These results indicated that the addition of sorghum and soybean flour affected the thickness and width and thus the spread ratio of the supplemented biscuits.

Table 1. Ingredients and processing schedule for biscuit preparation

Supplementation level (%)	Wheat flour (g)	Sorghum flour (g)	Soybean flour (g)	Ghee (g)	Milk (g)	Sugar (g)	Sodium bicarbonate (g)	Ammonia (g)	Baking powder (tsp)
Control(100%WF)	100	-	-	70	40	65	5	2	1½
WF : SGF : SBF									
60 : 30 : 10	60	30	10	70	40	65	5	2	1½
40 : 40 : 20	40	40	20	70	40	65	5	2	1½

Table 2. Mean score of various organoleptic acceptability of value added biscuits

Biscuit	Colour	Appearance	Aroma	Texture	Taste	Overall acceptability
Control (100% WF)	8.00±0.26	8.40±0.16	8.20±0.12	7.80±0.20	8.00±0.26	8.08±0.10
Type I	7.90±0.28	8.10±0.28	8.30±0.16	8.00±0.21	8.30±0.15	8.12±0.08
Type II	8.30±0.21	8.40±0.16	8.20±0.18	8.20±0.25	8.20±0.29	8.26±0.04
Type III	8.10±0.23	8.40±0.16	8.10±0.20	8.00±0.26	8.20±0.20	8.16±0.07
Type IV	8.40±0.16	8.30±0.21	8.20±0.14	7.90±0.28	8.20±0.29	8.20±0.08

Values are mean ± SE of ten independent determination Type I (WH-1129: SGF: SBF 60:30:10)
Type II (WH-1129:SGF:SBF 40:40:20) Type III (HD-2967:SGF:SBF 60:30:10) Type IV (HD-2967:SGF:SBF 40:40:20)
WF=Wheat flour (WH-1129 and HD-2967). SGF= Sorghum flour. SBF=Soybean flour

Table 3. Physical characteristics of value added biscuits

Supplementation level (%)	Width (cm)	Thickness (cm)	Spread ratio (W/T)
Control (100% WF)	4.65±0.06	0.68±0.02	6.82±0.05
Type II	4.60±0.07	0.75±0.10	6.51±0.10
Type IV	4.59±0.08	0.74±0.03	6.49±0.19
CD (P≤0.05)	0.01	0.02	0.02

Values are mean ± SE of three independent determination
Type II (WH-1129:SGF:SBF 40:40:20) Type IV (HD-2967:SGF:SBF 40:40:20)
WF=Wheat flour (WH-1129 and HD-2967). SGF= Sorghum flour. SBF=Soybean flour

Table 4. Proximate composition of biscuits (%, on dry matter basis)

Supplementation level (%)	Moisture	Protein	Fat	Crude fibre	Ash
Control (100% WF)	3.35±0.05	8.08±0.06	30.07±0.58	0.98±0.03	1.47±0.02
Type II	4.43±0.06	10.05±0.24	31.85±0.86	3.47±0.08	1.50±0.05
Type IV	4.23±0.04	9.37±0.10	36.00±0.58	2.66±0.06	1.32±0.04
CD(P≤0.05)	0.19	0.55	1.53	0.23	0.14

Values are mean ± SE of three independent determinations
Type II (WH-1129:SGF:SBF 40:40:20) Type IV (HD-2967:SGF:SBF 40:40:20)
WF=Wheat flour (WH-1129 and HD-2967). SGF= Sorghum flour. SBF=Soybean flour

Table 5. Shelf life study of value added biscuits

Supplementation level (%)	Storage period (days)							
	0	15	30	45	60	75	90	Mean
				Colour				
Control	8.00±0.25	7.70±0.21	7.70±0.21	7.60±0.16	7.50±0.13	6.60±0.16	6.10±0.10	7.31±0.24
Type II	8.30±0.21	7.80±0.29	7.80±0.30	7.60±0.22	7.60±0.22	7.60±0.16	7.00±0.02	7.67±0.21
Type IV	8.40±0.16	7.80±0.20	7.80±0.20	7.70±0.15	7.70±0.15	7.50±0.16	6.90±0.10	7.69±0.13
				Appearance				
Control	8.40±0.16	7.50±0..22	7.40±0.16	7.30±0.15	7.30±0.16	6.80±0.13	6.60±0.16	7.33±0.23
Type II	8.40±0.16	8.10±0.31	8.10±0.31	7.70±0.21	7.70±0.21	7.40±0.22	6.50±0.16	7.70±0.18
Type IV	8.30±0.21	7.70±0.21	7.70±0.21	7.60±0.16	7.60±0.13	7.40±0.16	6.70±0.16	7.57±0.16
				Aroma				
Control	8.20±0.24	7.50±0.22	7.10±0.10	7.00±0.07	7.00±0.09	6.60±0.16	6.30±0.15	7.10±0.20
Type II	8.20±0.24	7.80±0.32	7.70±0.30	7.60±0.26	7.40±0.22	6.60±0.14	6.50±0.15	7.40±0.24
Type IV	8.20±0.24	7.70±0.30	7.50±0.22	7.50±022	7.20±0.20	6.50±0.21	6.30±0.22	7.27±0.18
				Texture				
Control	7.80±0.20	7.80±0.20	7.50±0.16	7.40±0.17	7.20±0.20	6.60±0.16	6.10±0.13	7.20±034
Type II	8.20±0.24	7.90±0.31	7.90±0.31	7.70±0.26	7.60±0.22	6.50±0.15	6.30±0.32	7.44±0.11
Type IV	7.90±0.28	7.80±0.29	7.70±0.26	7.60±0.22	7.50±0.22	6.40±0.16	6.20±0.21	7.30±0.10
				Taste				
Control	8.00±0.25	7.80±0.24	7.40±0.20	7.00±0.09	6.70±0.21	6.70±0.08	6.40±0.17	7.14±0.23
Type II	8.20±0.29	8.40±0.15	8.10±0.15	7.80±0.13	7.60±0.14	6.80±0.16	6.80±0.13	7.67±0.21
Type IV	8.20±0.29	8.00±0.25	7.70±0.23	7.50±0.16	7.50±0.15	6.80±0.15	6.70±0.15	7.49±0.13
				Overall Acceptability				
Control	8.08±0.13	7.66±0.15	7.42±0.10	7.26±0.21	71.4±0.21	6.66±0.15	6.30±0.16	7.20±0.11
Type II	8.26±0.12	8.00±0.16	7.92±0.19	7.68±0.09	7.58±0.19	6.98±0.21	6.62±0.13	7.54±0.22
Type IV	8.20±0.19	7.80±0.14	7.68±0.20	7.58±0.23	7.50±0.16	6.92±0.10	6.56±0.12	7.40±0.21

Values are mean ± SE of ten independent determination
Type II (WH-1129;SGF:SBF 40:40:20) Type IV (HD-2967:SGF:SBF 40:40:20)
WF=Wheat flour (WH-1129 and HD-2967). SGF= Sorghum flour. SBF=Soybean flour

Nutritional composition of value added biscuits

Proximate composition

The data pertaining to proximate composition of most acceptable biscuits is presented in Table 4. The moisture, protein, fibre and ash content of Type II and Type IV biscuits were significantly (P≤0.05) higher than control biscuits. The value added biscuits from prepared from WH-1129 wheat variety had significantly (P≤0.05) higher contents of protein, crude fibre and ash as compared to biscuits prepared from variety HD-2967 while HD-2967 value added biscuits had significantly had significantly (P≤0.05) higher fat content than WH-1129 and control wheat flour biscuits. The difference in proximate composition of value added biscuits developed from two different wheat varieties was basically due to difference in the proximate composition of wheat varieties flour and also as the level of substitution of wheat flour with sorghum and soy flour increased the proximate composition of value added biscuits also improved.

Shelf life study of value added biscuits

The effects of storage period on organoleptic acceptability of control and value added biscuits are shown in Table 5. For studying the shelf life the biscuits were stored for a period of 3 months at ambient conditions (room temperature). No remarkable changes in the organoleptic characteristics viz. Colour, appearance, aroma, texture and taste were observed upto 3 months in value added and control biscuits. However, overall acceptability scores of control, Type II and Type IV biscuits declined during storage period from 8.08, 8.26 and 8.20 at zero days to 6.30, 6.62 and 6.56 at 90th days of storage but the decline was non-significant. The results indicated that two types of value added biscuits were acceptable upto 3 months of storage.

DISCUSSION

The results of the present study impress upon that organoleptically acceptable value added wheat sorghum and soybean biscuits can be prepared. The differences in the organoleptic scores of these biscuits could be due to the varietal difference of wheat flours and due to increase in the supplementation level of both sorghum and soybean flours. These results indicated that the addition of sorghum and soybean flour affected the thickness and width and thus the spread ratio of the supplemented biscuits. It was found that moisture, protein, fat, crude fibre and ash content of value added biscuits were significantly (P≤0.05) higher than that of control. This was due to higher content of protein, fat, crude fibre and ash content of soybean flour compared to wheat flour and as the level of substitution of wheat flour with soy flour increased the proximate composition of value added products also improved. It was found that all types of value added biscuits were organoleptically acceptable upto 90 days of storage and the scores for their organoleptic characteristics fell in the category of 'liked very much' to 'liked moderately'.

Conclusion

From the present study it is concluded that it is possible to prepare the value added biscuits using wheat, sorghum and soybean flours. Biscuits developed from composite flours were found to have better nutritive value than control and they could be stored safely upto 90 days. Keeping in view today's scenario of life styles promotion of such types of high protein and fibre rich value added biscuits will go a long way in improving the nutritional status of the masses. It is need of the hour to take up the production and marketing of these value added biscuits as an entrepreneurial activity.

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