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Keeping Quality of Sorghum Soybean Supplemented Wheat Flour *Ladoos*

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Abstract The present study was done to assess the keeping quality of value added *ladoos* developed from newly released wheat varieties (WH-1129 and HD-2967) flours supplemented with sorghum and soybean flours. The control *ladoo*s had mean score of overall acceptability 7.46 whereas all other types of *ladoos* made from combinations of wheat, sorghum and soybean flours had mean scores of overall acceptability ranging from 7.86 to 8.62, which were significantly higher ($P \leq 0.05$) than that of control *ladoos*. The protein and fat content in control *ladoo*s were 9.06 and 20.14 per cent, respectively which significantly ($P \leq 0.05$) increased in composite flour ladoo of WH-1129 wheat flour to 11.39 and 23.00 per cent, respectively and to 10.89 and 25.02 per cent, respectively in that of HD-2967 flour. The crude fibre and ash contents in control *ladoos* were 1.22 and 1.39 per cent, respectively which significantly ($P \leq 0.05$) increased in composite *ladoos* of WH-1129 flour to 4.16 and 1.77 per cent, respectively. All types of *ladoos* were organoleptically acceptable upto 90 days of storage and fell in the category of' 'liked moderately' to 'liked very much'. The total bacterial count of *ladoo* of WH-1129:SGF:SBF (60:30:10) and (40:40:20) varied from 0 to 10×10^2 and 0 to 7×10^2 cfu/g of *ladoo,* respectively while that of HD:SGF:SBF (60:30:10) and (40:40:20) ranged from 0 to 9×10^2 and 0 to 10×10^2 cfu/g of *ladoo*, respectively. The total bacterial count of *ladoo* was within the permissible limit upto 45 days of storage.
Keywords *Composite Flour; Ladoos; Supplementation; Nutritive Value; Keeping Quality*

1. Introduction

Ladoo is a sweet relished equally by people of all age groups and is energy and protein dense food. The basic ingredients of *ladoo* are wheat flour, ghee, grounded sugar and sesame seeds. Wheat flour is an important source of not only energy and protein but also provides substantial amounts of vitamins and minerals in human diets specially low income group people. It has been extensively and widely used for the preparation of various types of value added *sev*, bakery products like biscuits, cakes, cookies, bread etc., traditional products like *ladoo, chapatti* etc., throughout the world (Pandey, 2015). It is commonly known that the main nutritional drawback of cereals is lack of essential amino acid lysine which can be easily compensated by supplementing cereals with oilseeds like soybean. Soybean has great potential as an exceptionally nutritive and very rich protein food. It can supply the much needed protein to human diets, because it contains above 40 per cent protein of superior quality and all the essential amino acids particularly glycine, tryptophan and lysine, similar to cow's milk and animal proteins. Soybean also contains about 20 per cent oil with an important fatty acid, lecithin and Vitamin A and D. The 4 percent mineral salts of soybeans are fairly rich in phosphorous and calcium. Soybean has great potential in overcoming protein calorie malnutrition because it contains 38 to 40 per cent protein and 18 to 20 per cent fat (Rastogi and Singh, 1989). Incorporation of soybean flour into a staple food like wheat and coarse cereal like sorghum is a feasible means of increasing the nutritive value of people's diet. Sorghum is important crop for food security in semi-arid and arid regions due to their high nutritional quality and low production inputs. Sorghum is gluten free and can be important food source to millions of people who are intolerant to gluten (celiac disease), including diabetic patients, in both developed and developing countries (Masilamani et al., 2012). It is established in literature that cereal, coarse cereal and soybean flours 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 (Yang et al., 2009; Goerke et al., 2012; Cao et al., 2011; Masilamani et al., 2012). In the present study efforts were made to develop nutrient rich *ladoos* by incorporating wheat, sorghum and soybean flours and were evaluated for organoleptic acceptability, nutritional characteristics and keeping quality.

2. Material and Methods

2.1. Procurement of Raw Material

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. Soybean flour along with other ingredients required for the development of value added *ladoos* were procured from local market.

2.2. Processing of Material

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.

2.3. Development and Organoleptic Characteristics of Value Added *Ladoos*

The preparation method of value added *ladoos* 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 *ladoos* were developed. 100% wheat flour *ladoos* prepared from C-306 were kept as control. The *ladoos* 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 *ladoos* rated higher for organoleptic characteristics were selected for further study.

Table 1: *Ingredients and Preparation Method for Development of Ladoos*

Supplementation level (%)	Wheat flour (g)	Sorghum flour (g)	Soybean flour (g)	Ghee (g)	Sugar (g)	Gingelly seeds (g)
Control(100%WF)	100	-	-	55	50	30
WF : SGF : SBF						
60 : 30 : 10	60	30	10	55	50	30
40 : 40 : 20	40	40	20	55	50	30

Method

1. Roasted wheat, sorghum and soybean flours separately in skillet and mixed together.
2. Then added roasted and grounded gingelly seeds and ghee.
3. Allowed the mixture to cool.
4. Added grounded sugar and mixed well and made the *ladoos*.

2.4. Nutritional Characteristics of Value Added *Ladoos*

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

2.5. Keeping Quality of Value Added *Ladoos*

For studying the keeping quality/shelf –life the most acceptable value added *ladoos* were stored for 3 months in air tight plastic containers at room temperature. The *ladoos* were evaluated for sensory parameters using 9 point hedonic scale by a panel of ten judges and total bacterial count at regular intervals of 0, 15, 30, 45, 60, 75 and 90 days.

For the most acceptable were stored for 3 months in air tight plastic containers at room temperature. The *ladoos* were evaluated for at regular intervals of 0, 15, 30, 45, 60, 75 and 90 days.

2.5.1. *Estimation of Total Bacterial Count*

Composition of PCA Media (g/l)

Peptone - 5g
Yeast Extract - 2.5g
Dextrose - 1.0g
Agar - 20.0g
Distil water - 1000ml

Sterilization of Media and Glassware

Plate count agar media was prepared in distilled water and autoclaved at 121.6˚C (15psi) for 15 min. All the glassware were sterilized in hot air oven at 160˚C for 2 hour.

Procedure

One g of sample was dissolved into 9.0 ml of sterilized distilled water blank and shaken thoroughly. One ml of 10^{-1} dilution was taken and dissolved into another 9.0 ml sterilized water blank. This was 10^{-2} dilution. Similarly 10^{-3} dilution was made. 0.1ml of 10^{-1}, 10^{-2} and 10^{-3} dilutions were poured in petri plate containing PCA media. Plates were incubated at 30±2˚C for 24-48 hours. Numbers of colonies were counted and colony forming unit (cfu) was calculated by using formula:-

No. of colonies × dilution factor × 10 = cfu /g of sample

2.6. Statistical Analysis

The data were statistically analysed in complete randomized design for analysis of variance, mean, standards deviation and critical difference according to the standard method (Sheoran and Pannu, 1999).

3. Results and Discussion

3.1. Organoleptic Characteristics

The mean scores of organoleptic acceptability of value added *ladoos* are presented in Table 2. The control *ladoo*s had mean score of overall acceptability 7.46 whereas all other types of *ladoos* made from combinations of wheat, sorghum and soybean flours had mean scores of overall acceptability ranging from 7.86 to 8.62, which were significantly higher (P≤0.05) than that of control *ladoos*. All types of *ladoos* were organoleptically acceptable and their scores belonged to category 'liked very much'. Our findings were in agreement with those of Singh (2003), Singh and Sehgal (2008), Rajbala (2010), Chandel (2014) and Rana (2015) who reported that on the basis of organoleptic evaluation, the mean scores of overall acceptability of different value added products i.e. l*adoo, sev, chapati, matar, parantha*, biscuit and pasta were higher than that of (100%) wheat flour products.

Table 2: *Mean Score of Organoleptic Acceptability of Value Added Ladoos*

Ladoos	Colour	Appearance	Aroma	Texture	Taste	Overall acceptability
Control (100% WF)	7.40±0.27	7.30±0.30	7.70±0.21	7.50±0.27	7.40±0.34	7.46±0.07
Type I	8.30±0.15	8.20±0.20	7.90±0.23	7.80±0.25	7.80±0.13	8.00±0.10
Type II	8.80±0.13	8.80±0.13	8.50±0.17	8.20±0.20	8.80±0.14	8.62±0.10
Type III	7.90±0.18	7.70±0.15	7.90±0.10	7.60±0.16	8.20±0.20	7.86±0.10
Type IV	8.30±0.15	8.20±0.13	8.20±0.14	7.50±0.15	8.60±0.16	8.16±0.18
CD (P≤0.05)	0.52	0.56	0.50	N.S	0.60	0.36

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

3.2. Nutritional Composition of Value Added *Ladoos*

The data pertaining to proximate composition of most acceptable *ladoos* is presented in Table 3. The protein and fat content in control *ladoo*s were 9.06 and 20.14 per cent, respectively which significantly (P≤0.05) increased in composite flour ladoo of WH-1129 wheat flour to 11.39 and 23.00 per cent, respectively and to 10.89 and 25.02 per cent, respectively in that of HD-2967 flour. The crude fibre and ash contents in control *ladoos* were 1.22 and 1.39 per cent, respectively which significantly (P≤0.05) increased in composite *ladoos* of WH-1129 flour to 4.16 and 1.77 per cent, respectively. As for supplemented ladoos prepared from HD-2967 flour the crude fibre content increased to 3.90 per cent but ash content (1.29 %) was almost similar to control. WH-1129 wheat flour *ladoos* contained significantly (P≤0.05) higher amount of protein, crude fibre and ash as compared to HD-2967 flour *ladoos* supplemented with sorghum and soybean flours. HD-2967 wheat flour *ladoos* were found to possess highest fat content as compared to all other types of *ladoos*. These results are in agreement with those of earlier workers (Gupta, 2001; Rani et al., 2008; Punia and Gupta, 2009 and Sangwan and Dahiya, 2013), who found that proximate composition of value added products were higher than that of control products developed from 100 per cent wheat flour. The difference in proximate composition of value added products developed from two different wheat varieties was basically due to difference in the proximate composition of wheat varieties.

Table 3: *Proximate Composition of Composite Flour ladoos (%, on dry matter basis)*

Supplementation level (%)	Moisture	Protein	Fat	Crude fibre	Ash
Ladoo					
Control (100% WF)	10.22±0.07	9.06±0.04	20.14±0.60	1.22±0.02	1.39±0.03
Type II	11.13±0.05	11.39±0.22	23.00±0.57	4.16±0.03	1.77±0.08
Type IV	10.87±0.05	10.89±0.26	25.02±0.51	3.90±0.05	1.29±0.02
CD(P≤0.05)	0.21	0.71	1.99	0.14	0.18

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

3.3. Keeping Quality of Value Added *Ladoos*

The effects of storage period on organoleptic acceptability and total bacterial count of value added *ladoos* are shown in Table 4 and 5.

Mean scores of overall acceptability in control, WH-1129: SGF: SBF (60:30:10 and 40:40:20), and HD:SGF:SBF (60:30:10 and 40:40:20) showed gradual decline during storage. The acceptability score for control *ladoos* declined from 7.46 (zero day) to 6.24 (90^{th} day), for WH-1129:SGF:SBF (60:30:10 and 40:40:20), it declined from 8.00 (zero day) to 6.60 (90^{th} day), 8.62 (zero day) to 6.80 (90^{th} day) and for HD:SGF:SBF (60:30:10 and 40:40:20), it declined from 7.86 (zero day) to 6.54 (90^{th} day) and 8.20 (zero day) to 6.76 (90^{th} day), respectively during storage. On the mean basis all types of *ladoos* were organoleptically acceptable upto 90 days of storage and fell in the category of' 'liked moderately' to 'liked very much'.

The total bacterial count of the control *ladoo* from zero to 45^{th} day of storage, varied from 0 to 10×10^2 cfu/g of *ladoo*. The total bacterial count of *ladoo* of WH-1129:SGF:SBF (60:30:10) and (40:40:20) varied from 0 to 10×10^2 and 0 to 7×10^2 cfu/g of *ladoo,* respectively while that of HD:SGF:SBF (60:30:10) and (40:40:20) ranged from 0 to 9×10^2 and 0 to 10×10^2 cfu/g of *ladoo*, respectively. The total bacterial count of *ladoo* was within the permissible limit upto 45 days of storage (Table 5). These findings are in agreement with those of several other workers (Gurusu et al., 1997; Sangwan and Dahiya, 2013; Chandel, 2014; Rana, 2015) who found that the value added products developed from composite flour could be stored upto 90 days.

Table 4: *Effect of Storage Period on Overall Acceptability Scores of Wheat, Sorghum and Soybean Composite Flour Ladoos*

Supplementation Level (%)	Storage Period (days)							
	0	15	30	45	60	75	90	Mean
	Overall Acceptability							
Control (100% WF)	7.46±0.09	7.32±0.13	7.16±0.15	6.96±0.21	6.78±0.22	6.54±0.13	6.24±0.10	6.89±0.12
WH-1129:SGF:SBF (60:30:10)	8.00±0.16	7.90±0.23	7.70±0.21	7.54±0.16	7.36±0.28	7.14±0.21	6.60±0.15	7.44±0.12
WH-1129:SGF:SBF (40:40:20)	8.62±0.17	8.50±0.10	8.30±0.30	7.94±0.20	7.78±0.22	7.42±0.17	6.80±0.12	7.79±0.09
HD-2967:SGF:SBF (60:30:10)	7.86±0.01	7.72±0.10	7.60±0.16	7.42±0.22	7.22±0.20	7.04±0.15	6.54±0.18	7.35±0.10

HD-2967:SGF:SBF (40:40:20)	8.20±0.12	8.00±0.11	7.86±0.18	7.68±0.20	7.50±0.21	7.40±0.15	6.76±0.18	7.58±0.23
Mean	8.03	7.89	7.72	7.51	7.33	7.11	6.59	

Table 5: *Total Bacterial Count (Cfu/G) Of Composite Flour Ladoos at Different Storage Period (On Dry Weight Basis)*

Supplementation Level (%)	Storage Period (days)						
	Total Bacterial Count (cfu/g)						
	0	**15**	**30**	**45**	**60**	**75**	**90**
Control (100% WF)	0	2×10^{2}	7×10^{2}	10×10^{2}	21×10^{2}	41×10^{2}	54×10^{2}
Type II	0	3×10^{1}	4×10^{2}	7×10^{2}	25×10^{2}	33×10^{2}	48×10^{2}
Type IV	0	3×10^{1}	6×10^{2}	10×10^{2}	35×10^{2}	43×10^{2}	52×10^{2}

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 cfu=colony forming unit

4. Conclusion

The utilisation of alternative sources of food specially less utilised coarse cereals and refinement of technology is need of the hour. From the present study it is concluded that coarse cereals like sorghum and protein rich soybean can be utilised for supplementing the wheat flour which is staple diet of the population. The development and utilization of the composite flour *ladoos* on one hand will promote value addition of the products and on the other hand will provide low cost nutritious alternatives specially in poor developing countries for combating malnutrition among children and vulnerable sections of the society. Setting up of small scale industries for production of *ladoos* by rural women will ensure the economic, food and nutrition security and it will also encourage utilisation of low input, sustainable crops, together with staple crops.

References

AOAC, 2000: *Official Methods of Analysis of Association of Official Analytical Chemists*. Washington, D.C.

Cao, Z., Sun, L., Cao, X., and He, Y. *Antioxidant Activity of Soybean Peptides*. Advanced Materials Research. 2011. 233; 854-865.

Chandel, J., 2014: *Development, Acceptability and Nutritional Evaluation of Linseed Supplemented Value-Added Products*. M.Sc. Thesis, CCS Haryana Agricultural University, Hisar, India.

Gupta, S., 2001: *Utilization of Vegetable Powder for Value Added Baked Product.* M.Sc. Thesis, CCS Haryana Agricultural University, Hisar, India.

Gurusu, O., Earcan, R. and Denli, E. *Effect of the Addition of Soyflour on Quality and Shelf-Life of Biscuit*. Gida. 1997. 22 (2) 95-103.

Goerke, M., Eklund, M., Sauer, N., Rademacher, M., Piepho, H.P., and Mosenthin, R. *Standardized Ileal Digestibilities of Crude Protein, Amino Acids, and Contents of Antinutritional Factors, Mycotoxins, and Isoflavones of European Soybean Meal Imports Fed to Piglets*. Journal of Animal Science. 2012. 90; 4883-4895.

Masilamani, M., Wei, J., and Sampson, H.A. *Regulation of the Immune Response by Soybean Isoflavones.* Immunological Research. 2012. 54; 95-110.

Pandey, L., 2015: *Nutritional Evaluation of Wheat (Triticum Aestivum) Varieties and Development of Value Added Products Using Wheat-Sorghum-Soybean Flour Blends.* M.Sc. Thesis, CCS Haryana Agricultural University, Hisar, India.

Punia, D. and Gupta, M. *Sensory Characteristics, Nutrient Composition and Storage Studies of Value Added Products for Children*. Journal of Nutrition and Food Science. 2009. 39 (5) 503-510.

Rajbala, 2010: *Improvement in Nutritional Status of School Children through Micronutrient Rich Dietary Supplements.* Ph.D. Thesis, CCS Haryana Agricultural University, Hisar, India.

Rana, N., 2015: *Nutritional Evaluation and Acceptability of Value Added Products Based on Composite Flour (Pearl Millet-Sorghum-Mungbean-Marwa).* Ph.D. Thesis, CCS Haryana Agricultural University, Hisar, India.

Rani, V., Grewal, R.B., and Khetarpaul, N. *Sensory and Nutritional Evaluation of Soy Supplemented Nutritious Baked Products.* Journal of Dairying Foods and Home Sciences. 2008. 27 (3/4) 209-215.

Rastogi, A. and Singh, G. *Effect of Addition of Full Fat Soyflour of Different Varieties on Quality Characteristics and Bread Making Quality of Wheat Flour*. Bull. Grain Technology. 1989. 27; 26-34.

Sangwan, V. and Dahiya, S. *Physico-Chemical and Nutritional Properties of Wheat-Sorghum-Soybean Composite Flours and Their Biscuits*. Asian Journal of Dairy and Food Research. 2013. 32 (1) 65-70.

Sheoran, O.P, Tonk, D.S., Hasija, R.C., and Pannu, R.S., 1998: *Statistical Software Package for Agricultural Research Workers in Recent Advances in Information Theory, Statistics and Computer Application.* Hooda D.S. and Hasija R.C.(eds.) 139-143.

Singh, G., 2003: *Development and Nutritional Evaluation of Value Added Products from Pearl Millet (Pennisetum glaucum).* Ph.D. Thesis, CCS Haryana Agricultural University, Hisar, India.

Singh, G. and Sehgal, S. *Nutritional Evaluation of Ladoo Prepared from Popped Pearl Millet.* Journal of Nutrition and Food Science. 2008. 38; 310-315.

Yang, L., Browning, J.D., and Awika, J.M. *Sorghum 3-Deoxyanthocyanins Possess Strong Phase II Enzyme Inducer Activity and Cancer Cell Growth Inhibition Properties.* Journal of Agricultural and Food Chemistry. 2009. 57 (5) 1797-804.