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Effect of different processing treatments on chemical composition and sensory properties of wheat flour

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Abstract: Three varieties of wheat (Shafaq-06, Faisalabad-08 and Lasani-08) were processed. The processing treatments were germination and fermentation. The processed flour of all varieties were tested and from these flour chapattis were prepared for their sensory evaluation. Different sensory attributes of chapatti such as color, taste, aroma, fold ability and overall acceptability were affected significantly by processing treatments except aroma showed non-significant effect on varieties. It was found that chapattis prepared from germinated wheat flour showed lower scores of sensory attributes as compared to controlled and fermented flour chapattis. The highest scores were obtained by controlled wheat flour chapattis followed by fermented flour. Whereas the chapattis prepared from germinated wheat flour was least acceptable and in all three varieties Shafaq-06 showed better trend to processing treatments as compare to Faisalabad-08 and Lasani-08.

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Key words: wheat flour, chemical composition, sensory properties

Introduction

Pakistan is the 8th largest wheat producer country, contributing about 3.17 % of the world wheat production from 3.72% of wheat growing area (GOP, 2008; Ali *et al*., 2019). Wheat (*Triticum aestivum*) is a major source of dietary energy and protein for people whom daily diet is composed of cereal products. It is the world's most important crop in terms of production and consumption. (FAO, 2009). The main wheat producing countries are USA, China, Russia, India, Pakistan, Canada, Argentina, Australia and some countries of European Union. Wheat ranks first among the cereals in Pakistan and is associated with growth and survival of the people of the country. It accounts for 36% of cropped area and 30% of value added by major crops (Hussain *et al*., 2004). More than 60% of the total daily requirements of protein and calories are met through wheat (Butt *et al*., 1997).

Wheat is used to make flour for flat and steamed breads, biscuits, cookies, cakes, pasta, noodles and for fermentation to make beer, alcohol, and vodka. Wheat holds a unique position due to its ability to form dough and in Pakistan about 80% of the wheat flour produced is utilized in the form of unleavened flat bread locally known as chapatti and other culinary purposes (Hussain *et al*., 2004).

During germination certain changes occur as the quantity and type of nutrients within the seed. These changes can vary depending on the type of vegetable, the variety of seed and the condition of germination (Dhaliwal and Aggarwal, 1999). An increase in bioavailability of minerals and weight has been observed due to germination. Germinated seeds are good source of ascorbic acid, riboflavin, choline, thiamine, tocopheroles and pantothenic acid (Sangronis and Machado, 2007). Traditional methods as germination and fermentation tend to improve the nutrient quality of foods. Fermented food is widely exploited source of value-able protein. Fermentation causes degradation of grain components, especially starch and soluble sugars, by both grain and fermented media enzymes. Fermentation is associated with many chemical changes that enhance organoleptic response, contents of free sugars and vitamins, as well as bioavailability of minerals (Akpapunam and Achinewhu, 1985), and results in the breakdown of some of the antinutritional endogenous compounds. Fermented cereal products are widely consumed in India and many countries of central and southern Africa. Fermentation usually involves malting and souring by mixed cultures of yeast and lactobacilli.

The simple traditional household technologies have been used to process the cereal in order to

improve the nutritional quality (Nout, 1992) which includes roasting, germination and fermentation, cooking and soaking. The application of such technological processes provokes changes physicochemical characteristics of the components. As far as it concerned germination (Nout, 1992) when grains are hydrated in ambient conditions, endogenous enzymes start to modify the grains constituents in particular, changes in soluble (Katina *et al*., 2007) sugars, protein and activities in enzymes. Germination has profound effect on nutritional quality of the cereal. (Chavan and Kadam, 1989). Wheat grains are traditionally processed by germination and fermentation prior to consumption. In cereals the plant hormone gibberllins is an important regulator of germination and it has been reported to stimulate the release of different ions and also to enhance the synthesis and secretion of enzymes particularly alpha amylase in the aleurone cells of the endosperm (Jacobsen and Chandler, 1990). Germination is a natural biological process of all superior plants by which the seeds come out of latency stage once. The minimal environmental conditions such as humidity, temperature and nutrients need for its growth and development (Sangronis and Machado, 2007).

Sprouting improve the extractability of Ca, Fe and P to varying extent (Saharan *et al*., 2001). The most effective treatments are fermentation and sprouting to improve the extractability of minerals but their application remains limited because of additional workload they imply or the particular organoleptic characteristics they produce. Fermentation decreases the level of antinutrients in food grains and increases mineral extractability (Badau *et al*., 2005). Up to now there is no such data about germination and fermentation effects on nutritional composition of wheat are present. So the present project was undertaken with the following objectives;

- To prepare chapattis from different flour and their sensory evaluation.

Materials and methods

Procurement of raw material

Wheat varieties (Faisalabad-08, Shafaq-06 and Lasani-08) were procured from Wheat Research Institute of Ayub Agricultural Research Institute (AARI), Faisalabad.

Cleaning of wheat

Wheat grains were cleaned manually to remove broken seeds, dust and other extraneous materials.

Sample preparation

After cleaning each lot of wheat grains was divided into three parts for three treatments as control (with out any treatment), germinated and germinated fermented.

Germination

The cleaned wheat grains were immersed in water overnight. The grains were spread on trays lined with cloth and kept wet by frequent spraying of water for 36 hours. The germinated grains were sun dried and ground to pass through 0.4 mm sieve according to method as followed by Eltayeb *et al*. (2007).

Natural fermentation

The milled grains were mixed with distilled water (1:3w/v). The mixture was incubated at 37°C and then the fermented mixture was dried at 60^0C for 12 hours to obtain natural fermented flour and ground to pass through 0.4 mm screen according to method as followed by Eltayeb *et al*. (2007).

Milling of grains

All treatments such as control, germinated and germinated + fermented were milled into china grinder and sieved to obtain whole grain flour. The flour was stored for further analysis.

Preparation of unleavened flat bread (Chapattis)

The chapattis were prepared from whole wheat flour containing raw, germinated and germinated fermented according to method described by Haridas Rao *et al*. (1986). The dough was prepared by mixing 200g of flour with predetermined amount of water for 3 minutes in mixer. The dough was allowed to rest for one hour at room temperature. A dough piece weighing 80g was rounded and turned into chapatti by using specially designed platform. The rolled dough was then cut into a circle of 18cm in diameter using a die with a sharp edge preparing chapattis of uniform thickness (3mm) then were baked on a thermo statistically controlled hot plate at a temperature of 210^OC for 1.5 minutes.

Sensory evaluation

The product was presented to panel of judges and sensory evaluation was carried out for color, taste, aroma, fold ability and overall acceptability according to method described by Land and Shepherd (1998).

Statistical analysis

The obtained data from the analysis was subjected to statistical analyses to determine the level of significance according to method described by Steel *et al*. (1997).

Results and discussion

Sensory evaluation

Sensory evaluation is an important criterion for quality assessment in new product development and to meet the consumer requirements. Any new product must give satisfaction and pleasure to the consumer if it has to be part of their eating habits. For this reason chapatti prepared from wheat flour after processing treatments germination and fermentation are evaluated for various sensory attributes.

Sensory evaluation of chapattis

The sensory evaluation of chapattis for various sensory attributes such as color, taste, aroma, fold ability and overall acceptability was carried out by a panel of judges. The product was scored on hedonic scale and the results are described below.

Taste

The taste is a sensation perceived by the tongue and influenced by the texture flavor and composition of food. The statistical analysis regarding taste of chapattis has been presented in Table 4.43. The results indicated that taste of chapattis varied significantly among different wheat flours due to different processing treatments. The results further revealed that varieties showed significant effect on taste of chapattis prepared from different wheat flour. The interactive effect of treatments and varietals difference was found to be non-significant for taste. Mean values for taste of chapattis are presented in Table 2. It is evident from results that taste of chapattis differs significantly with change in treatments. Germinated flour chapattis scored highest for taste (7.24) followed by controlled (7.17) and chapattis prepared from germinated and fermented flour scored minimum (6.15) for taste. Controlled and germinated flour chapattis did not differ significantly in taste but differ significantly from germinated fermented flour chapattis. Chapattis prepared from Faisalabad-08 scored highest (6.93) for taste followed by (6.83) chapattis prepared from Shafaq-06. Chapattis from Lasani-08 scored same and did not differ from Shafaq but differ significantly from Faisalabad-08. Results were close to observation of (Khetarpaul and Chauhan, 1991) who prepared chapattis from fermented pearl millet flour and were organoleptically acceptable. Similar results were observed by (Khetarpaul and Goyal, 2008). He did the organoleptic evaluation of chapattis which indicated that the developed chapatti was acceptable to human palate.

Aroma

Perception of aroma is synthesis of taste and smells impressions along with texture and is even influenced by appearance. The statistical analysis regarding aroma of chapattis has been presented in Table 3. The results indicated that aroma of chapattis varied significantly among different wheat flours due to different processing treatments. The results further revealed that varieties showed significant effect on aroma of chapattis prepared from different wheat flour. The interactive effect of treatments and varietals difference was found to be non significant for this parameter. Mean values for aroma of chapattis are presented in Table 4. It is evident from results that aroma of chapattis differs significantly with change in treatments. Germinated fermented flour chapattis scored highest (7.67) for aroma followed by controlled (7.27) and chapattis prepared from germinated flour scored minimum (6.71) for aroma. Chapattis from all treatments differ significantly in aroma. Chapattis prepared from Shafaq-06 scored highest (7.27) for aroma followed by (7.23) chapattis prepared from Faisalabad-08. Chapattis from Lasani-08 scored minimum (7.16). Shafaq-06 and Fasalabad-08 did not differ significantly from each other but differ significantly from Lasani-08. Results were close to observation of (Khetarpaul and Chauhan, 1991) who prepared chapattis from fermented pearl millet flour and were organoleptically acceptable. Similar results were observed by (Khetarpaul and Goyal, 2008). He did the organoleptic evaluation of chapattis which indicated that the developed chapatti was acceptable to human palate.

Table 1: Analysis of variance for taste in chapattis affected by processing techniques

Source	df	SS	MS	F value
Treatment	2	0.0819	0.0409	4.59*
Variety	2	6.65	3.32	373.08**
Treat. x Var.	4	0.3833	0.0958	10.75**
Error	18	0.1605	0.0089	
Total	26	7.28		

*= Significant ($p<0.05$)
**= Highly Significant ($p<0.01$)

Table 2: Mean values for taste affected by processing treatments in chapattis

Treatment	V_1	V_2	V_3	Mean
T_0	7.27	7.02	7.22	7.17a
T_1	7.44	7.30	7.00	7.24a
T_2	6.09	6.10	6.27	6.15 b
Mean	6.93a	6.83b	6.811b	

Means carrying the same letters in a column are not significantly different from each other
T_0= Controlled flour
T_1= Germinated flour
T_2= Germinated and fermented flour

Table 3: Analysis of variance for aroma in chapattis affected by processing techniques

Source	df	SS	MS	F value
Treatment	2	0.0642	0.0321	0.91 $^{N.S}$
Variety	2	4.18	2.09	59.59**
Treat. x Var.	4	0.4011	0.1003	2.85 $^{N.S}$
Error	18	0.6327	0.0351	
Total	26	5.28		

**= Highly Significant (p<0.01)
$^{N.S}$ = Non-significant (p>0.05)

Table 4: Mean values for aroma affected by processing treatments in chapattis

Treatment	V_1	V_2	V_3	Mean
T_0	7.28	7.12	7.41	7.27b
T_1	6.76	6.86	6.52	6.71c
T_2	7.64	7.85	7.54	7.67a
Mean	7.23a	7.27a	7.16a	

Means carrying the same letters in a column are not significantly different
T_0= Controlled flour
T_1= Germinated flour
T_2= Germinated and fermented flour

Color

In baking color serves as a cue for the doneness of foods and is correlated with changes in aroma and flavor. The statistical analysis regarding color of chapattis has been presented in Table 5. The results indicated that color of chapattis varied significantly among different wheat flours due to different processing treatments. The results further revealed that varieties showed significant effect on color of chapattis prepared from different wheat flour. The interactive effect of treatments and varietals difference was found to be significant for this parameter. Mean values for color of chapattis are presented in Table 6. It is evident from results that color of chapattis differs significantly with change in treatments. Controlled flour chapattis scored highest (7.82) for color followed by germinated flour chapattis (7.62) and chapattis prepared from germinated fermented flour scored minimum (7.44) for color. Chapattis from all treatments differ significantly in color. Chapattis prepared from Shafaq-06 scored highest (7.74) for color followed by (7.65) chapattis prepared from Faisalabad-08. Chapattis from Lasani-08 scored minimum (7.49). Fasalabad-08 did not differ significantly from Shafaq-06 and Lasani-08 but both of them differ significantly from each other. Results were close to observation of (Khetarpaul and Chauhan, 1991) who prepared chapattis from fermented pearl millet flour and were organoleptically acceptable. Similar results were observed by Khetarpaul and Goyal (2008). He did the organoleptic evaluation of chapattis which indicated that the developed chapatti was acceptable to human palate.

Table 5: Analysis of variance for color in chapattis affected by processing techniques

Source	df	SS	MS	F value
Treatment	2	0.2694	0.1347	4.95*
Variety	2	0.6386	0.3193	11.74**
Treat. x Var.	4	0.4017	0.1004	3.69*
Error	18	0.4896	0.0272	
Total	26	1.7994		

*= Significant (p<0.05)
**= Highly Significant (p<0.01)

Table 6: Mean values for color affected by processing treatments in chapattis

Treatment	V_1	V_2	V_3	Mean
T_0	7.73	7.91	7.81	7.82a
T_1	7.53	7.80	7.55	7.62b
T_2	7.69	7.69	7.13	7.44c
Mean	7.65ab	7.74a	7.49b	

Means carrying the same letters in a column are not significantly different from each other
T_0= Controlled flour
T_1= Germinated flour
T_2= Germinated and fermented flour

Fold ability

The statistical analysis regarding fold ability of chapattis has been presented in Table 4.49. The results indicated that fold ability of chapattis varied significantly among different wheat flours due to different processing treatments. The results further revealed that varieties showed significant effect on fold ability of chapattis prepared from different wheat flour. The interactive effect of treatments and varietals difference was found to be significant for this parameter. Mean values for fold ability of chapattis are presented in Table 8. It is evident from results that fold ability of chapattis differs significantly with change in treatments. Controlled flour chapattis scored highest (7.13) for fold ability followed by germinated flour chapattis (7.07) and chapattis prepared from germinated fermented flour scored minimum (6.57) for fold ability. Chapattis prepared from controlled and germinated flour did not differ significantly from each other but differ significantly from germinated fermented flour. Chapattis prepared from Shafaq-06 scored highest (7.02) for fold ability followed by (6.95) chapattis prepared from Faisalabad-08. Chapattis from Lasani-08 scored minimum (6.80). Fasalabad-08 and Shafaq-06 did not differ significantly from each other but differ significantly from Lasani-08**.** Results were close to observation of (Khetarpaul and Chauhan, 1991) who prepared chapattis from fermented pearl millet flour and were organoleptically acceptable. Similar results were observed by Khetarpaul and Goyal (2008). He did the organoleptic evaluation of chapattis which indicated that the developed chapatti was acceptable to human palate.

Overall acceptability

The statistical analysis regarding overall acceptability of chapattis has been presented in Table 4.51. The results indicated that overall acceptability of chapattis varied significantly among different wheat flours due to different processing treatments. The results further revealed that varieties showed significant effect on overall acceptability of chapattis prepared from different wheat flour. The interactive effect of treatments and varietals difference was found to be significant for this parameter. Mean values for overall acceptability of chapattis are presented in Table 10. It is evident from results that overall acceptability of chapattis differs significantly with change in treatments. Controlled flour chapattis scored highest (7.30) for overall acceptability followed by germinated fermented flour chapattis (6.92) and chapattis prepared from germinated flour scored minimum (6.20) for overall acceptability. Chapattis prepared from all wheat flours differ significantly from each other. Chapattis prepared from Shafaq-06 scored highest (6.96) for overall acceptability followed by (6.78) chapattis prepared from Lasani-08. Chapattis from Faisalabad-08 scored minimum (6.69). Fasalabad-08 and Lasani-08 did not differ significantly from each other but differ significantly from Shafaq-06**.** Results were close to observation of (Khetarpaul and Chauhan, 1991) who prepared chapattis from fermented pearl millet flour and were organoleptically acceptable. Similar results were observed by Khetarpaul and Goyal (2008). He did the organoleptic evaluation of chapattis which indicated that the developed chapatti was acceptable to human palate.

Table 7: Analysis of variance for fold ability in chapattis affected by processing techniques

Source	df	SS	MS	F value
Treatment	2	0.2249	0.1124	6.15*
Variety	2	1.69	0.8466	46.29**
Treat. x Var.	4	0.7977	0.1994	10.90*
Error	18	0.3292	0.0182	
Total	26	3.04		

*= Significant (p<0.05)
**= Highly Significant (p<0.01)

Table 8: Mean values for fold ability affected by processing treatments in chapattis

Treatment	V_1	V_2	V_3	Mean
T_0	7.09	7.14	7.15	7.13a
T_1	6.74	6.86	6.11	7.07a
T_2	7.01	7.05	7.15	6.57b
Mean	6.95a	7.02a	6.80b	

Means carrying the same letters in a column are not significantly different from each other
T_0= Controlled flour
T_1= Germinated flour
T_2= Germinated and fermented flour

Table 9: Analysis of variance for overall acceptability in chapattis affected by processing techniques

Source	df	SS	MS	F value
Treatment	2	0.3450	0.1725	8.14**
Variety	2	5.55	2.77	131.08**
Treat. x Var.	4	0.2995	0.0748	3.53*
Error	18	0.3814	0.0211	
Total	26	6.58		

*= Significant ($p<0.05$)
**= Highly Significant ($p<0.01$)

Table 10: Mean values for overall acceptability affected by processing treatments in chapattis

Treatment	V_1	V_2	V_3	Mean
T_0	7.03	7.42	7.45	7.30a
T_1	6.09	6.39	6.14	6.20c
T_2	6.94	7.07	6.74	6.92b
Mean	6.69b	6.96a	6.78b	

Means carrying the same letters in a column are not significantly different from each other
T_0= Controlled flour
T_1= Germinated flour
T_2= Germinated and fermented flour

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