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SUITABILITY OF WHEAT VARIETIES/LINES FOR THE PRODUCTION OF LEAVENED FLAT BREAD (NAAN)

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Abstract: Wheat is the staple food for the people of Pakistan. Its various varieties/lines vary in their characteristics, which ultimately affect the quality of the end product. The physical, chemical, rheological and flour characteristics of the wheat varieties/lines explored various technological aspects of studies. On the basis of the information got out of this study, it was found that wheat variety LU-26 was ranked best by a panel of judges for the production of an improved quality textured naan.

Keywords: Leavened flat bread, *Triticum aestivum*, physical, chemical, rheological and flour characteristics

INTRODUCTION

Wheat (*Triticum aestivum*) is a major source of dietary energy and protein for people whose daily diet is composed of cereal products. It is a staple food, consumed world wide in the form of bread, biscuits etc. It is the predominant cereal produced and eaten in Pakistan. It is the main staple diet of the people of Pakistan [Economic survey 2000-2001]. It contributes 68-75% of the total food intake in the daily diet and provides 75% of the total protein requirements [Aslam *et al.* 1982]. In Pakistan, dietary pattern varies widely from one region to another but tends to weigh largely in favour of cereals (wheat, rice etc.), pulses and meat. Large quantity of wheat is milled into atta (a high-extraction flour), which is used for the production of flat breads, especially chapaties and Naans.

Wheat quality can be improved if both genetic as well as biochemical composition influencing technological properties are known. Both protein quantity and quality are considered important in estimating the potential of flour for its end use quality. The rheological characteristics of flour vary between varieties [Wrigley 1993, 1994]. A review of available information indicates some inadequacy in quality of the diet of the average Pakistani particularly with respect to protein, vitamins and minerals, and serious nutritional problems for the most vulnerable sector of the population [Anonymous 1972].

In Pakistan, the most commonly consumed least expensive products are chapaties and rotis, using almost 80% of the total wheat production. These are the primary, and cheapest, source of protein and calories in the diet [Anjum *et al.* 1991]. In Punjab and Sindh provinces chapatti and roti doughs are unleavened while in Baluchistan and Frontier provinces fermented roties are prepared.

Among these foods, naan has better digestibility and greater storage life.

It is mostly consumed at breakfast, while it is also available at luncheon and dinner with specific dishes. Old people are the special age group who may prefer to eat naan in their meals due to softness and better digestibility. This research proposal was planned in order to provide better nourishment to the specific group of people consuming naan. For this purpose, physico-chemical, rheological and sensory analysis of wheat varieties/lines was conducted.

MATERIALS AND METHODS

PROCUREMENT OF RAW MATERIALS

Wheat varieties LU – 26, LU – 31 and lines 4072, 4770, 4943, 5039 and 6500 were taken from the department of Plant Breeding and Genetics, University of Agriculture, Faisalabad.

PHYSICAL CHARACTERISTICS OF WHEAT

The grains of each wheat variety and line were tested for thousand kernal weight and weight per unit volume according to the standard procedure [AACC 1983].

MILLING OF WHEAT

After tempering, wheat samples were milled using Quadrumate Senior Mill following the standard method [AACC 1983]. As a result, four products were obtained namely, reduction flour, break flour, bran and shorts. Reduction and break flour were mixed to obtain straight grade flour in order to perform further tests.

GENERAL CHARACTERISTICS OF STRAIGHT GRADE FLOUR

The flour obtained from the wheat varieties/lines was subjected to the study of flour characteristics by determining particle size index, damaged starch, SDS-sedimentatioin and pelshenke values, following the standard methods [AACC 1983].

CHEMICAL ANALYSIS OF STRAIGHT GRADE FLOLUR

The wheat varieties/lines were analyzed for moisture content, ash, crude fat, crude protein, crude fiber and nitrogen free extract (NFE) according to their respective methods [AACC 1983].

RHEOLOGICAL CHARACTERISTICS OF STRAIGHT GRADE FLOUR

Rheological characteristics of wheat flours were determined by performing the following studies.

Amylographic Studies

Diastatic activity of each sample was determined with Brabender Amylograph [AACC 1983].

Farinographic Studies

The straight grade flour samples of each wheat variety/line were run through Brabender Farinograph equipped with a bowl of 50 g capacity. The dough behaviour for water absorption, arrival time, dough development, dough stability, dough resistance, tolerance index and softening of the dough was determined according to the standard procedure [AACC 1983].

PREPARATION OF LEAVENED FLAT BREAD (NAAN)

The production of traditional plain naan was based on natural fermentation and naan dough disc was baked in a tanoor (mud oven) by following the local method.

SENSORY EVALUATION

The naans were evaluated for texture by the standard method [Kulp *et al.* 1983].

STATISTICAL ANALYSIS

The data obtained was statistically analyzed using analysis of variance technique [Minitab 1991, Snedecor *et al.* 1991].

RESULTS AND DISCUSSSION

PHYSICAL CHARACTERISTICS OF WHEAT VARIETIES/LINES

Table 1 represents mean values of thousand kernal weight and test weight of the wheat varieties/lines. Thousand kernal weight varied between 44g and 37g for line 5039 and variety LU-31 respectively. For test weight Line 5039 showed maximum weight (85 kg/hl) followed by the variety LU-26 (82kg/hl). The analysis of variance (Table 2) shows that the results for thousand kernal weight were highly significant ($P<0.01$) and for test weight significant ($P<0.05$).

Thousand kernal weight and size are not genetically controlled only but also affected by growing conditions [William 1986]. In the present studies, differences in the thousand kernal weight are attributed to the differences in the genetic make up of the wheat varieties/Lines.

GENERAL CHARACTERISTICS OF STRAIGHT GRADE FLOUR

Particle Size Index

Mean values for particle size are given in Table 3. Maximum value was observed as 22.2% in the case of variety LU-26 followed by 21.7% in case of line 4943. Analysis of variance (Table 2) shows that the values for particle size were non-significant among all the wheat varieties/lines ($P>0.05$). These results are in conformity with previous findings [Ken *et al.* 1991].

Table 1: Comparison of means for physical characteristics of wheat varieties/lines.

Characteristics	Variety LU-26	Variety LU-31	Line 4072	Line 4770	Line 4943	Line 5039	Line 6500
Thousand kernal weight (%)	43.70a	37.11c	40.71b	38.76bc	39.24bc	44.38a	40.84b
Test weight (%)	82.00ab	78.00b	81.00b	79.00b	80.00b	85.00a	81.00b

Means with the same letter are not significantly different.

Table 2: Analysis of variance for various characteristics of wheat varieties/lines.

Characteristics	MS	F	P
Thousand kernal weight	20.67	4.97	0.006
Test weight	15.43	2.92	0.046
Moisture	0.10254	55.64	0.000
Ash	0.00364	8.79	0.000
Protein	2.48079	1908.30	0.000
Fat	0.00829	4.50	0.010
Fibre	0.00364	3.27	0.032
NFE	2.30284	249.15	0.000
Particle size index	10.88	1.38	0.288
Damaged starch	5.093	7.55	0.001
SDS-Sedimentation	6.18	7.43	0.001
Pelshenke value	191.7	9.19	0.000
Amylographic value	01200.00	1408.40	0.000
Water absorption	5.264	2058.66	0.000
Arrival time	0.152	0.35	0.900
Dough development	0.964	12.00	0.000
Resistance to dough	106.75	23.93	0.000
Dough stability	101.817	313.86	0.000
Softening of dough	600.00	6.22	0.002
Tolerance index	871.00	5.55	0.004
Texture	8.032	12.2222	0.000

d.f = 6

Table 3: Comparison of means for general characteristics of straight grade flour of wheat varieties/lines.

Characteristics	Variety LU-26	Variety LU-31	Line 4072	Line 4770	Line 4943	Line 5039	Line 6500
Particle size index (%)	22.20a	20.80a	17.20c	20.10ab	21.70a	17.70bc	19.40abc
Damaged starch (%)	10.00a	8.45b	7.00c	8.65b	9.75a	7.15c	7.77bc
SDS-sedimentation (ml)	21.00a	19.00b	18.00bc	17.00c	17.50bc	17.50bc	17.00c
Pelshenke value (min)	187.00a	180.00ab	165.00d	179.00ab	168.00cd	176.00bc	168.00cd

Means with the same letter are not significantly different.

Damaged starch

Mean values for this parameter of study are given in Table 3. Maximum value for damaged starch was observed as 10.5% in thecase of variety LU-26 followed by 9.75% in case of line 4943. In an earlier study the damaged starch of the wheat cultivars ranged from 6.0 to 9.0% for optimal bread quality [Ken *etal.* 1991]. Analysis of variance (Table-6)

shows that the values for damaged starch were highly significant (P<0.01) among all the wheat varieties/lines.

SDS-Sedimentation Test

Mean values for SDS-sedimentation are given in Table 3. The maximum value of SDS-sedimentation was observed as 21 ml for variety LU-26 and the minimum was 17.00 ml for line 6500. The values for SDS-sedimentation test for all the wheat varieties/lines were highly significant (P<0.01) as shown by Analysis of variance (Table 2). These results were in range with previous findings [Corbellini *et al.* 1999]. They also stated that the differences in SDS-sedimentation values due to differences in locations are reflected by the variations in total protein content.

Pelshenke Test

Table 3 depicts mean values for this parameter. The maximum value of Pelshenke was observed as 187 minutes for variety LU-26 and the minimum was 165 minutes for line 4072. In a study [Branlard and Dardevet 1985] the Pelshenke value was found as 155. So, the results of the present study are not far off from that study. The values for Pelshenke test for all the wheat varieties/lines were highly significant (P<0.01) as shown by Analysis of variance (Table 2).

CHEMICAL ANALYSIS OF STRAIGHT GRADE FLOUR

Mean values for chemical analysis of the straight grade flour are shown in Table 4. The maximum moisture content was observed in the wheat sample Line 4943 that was 12.57% followed by Line 4770 as 12.53%. The maximum ash content was observed in Line 4770 that was 0.60% while the lowest content was found in Line-6500 as 0.50%. The average protein content in all wheat varieties ranged from 12.03 to 10.00% for the variety LU-26 and Line 4072 respectively.

Table 4: Comparison of means for chemical analysis of straight grade flour of wheat varieties/lines.

Characteristics	Variety LU-26	Variety LU-31	Line 4072	Line 4770	Line 4943	Line 5039	Line 6500
Moisture (%)	12.50a	12.05d	12.40b	12.53a	12.57a	12.30c	12.25c
Ash (%)	0.58ab	0.56bc	0.55bcd	0.60a	0.53cde	0.52de	0.50e
Protein (%)	12.03a	12.00a	10.00d	10.12c	11.86b	11.84b	11.85b
Fat (%)	1.30bcd	1.40a	1.33abcd	1.35abc	1.37ab	1.25d	1.28cd
Fibre (%)	0.38ab	0.36abc	0.35abcd	0.40a	0.33bcd	0.32cd	0.30d
NFE (%)	85.71d	85.68d	87.77a	87.53b	85.91c	86.07c	86.07c

Means with the same letter are not significantly different.

The maximum fat content was observed as 1.40% in variety LU-31 and the minimum was found as 1.25% in Line 5039. The maximum fibre content was of Line 4770 that was 0.40% followed by variety LU-26 as 0.38%. The maximum value of NFE was 87.77 and minimum as 85.68 that of Line 4072 and variety LU-31 respectively. The range of protein

content of flour samples varies from 2 to 12.7% and the range of ash content from 0.35 to 0.42% [Ken *et al.* 1991]. Chemical analysis of straight grade flours of wheat varieties/lines showed highly significant ($P<0.01$) results as shown in the analysis of variance Table 2.

RHEOLOGICAL CHARACTERISTICS OF STRAIGHT GRADE FLOUR

Amylographic Studies

Mean amylographic values are given in Table 5. Maximum value of Brabander amylograph was observed in case of wheat variety LU-26 that was 860 B.U, followed by line 6500 as 610 B.U. Analysis of variance (Table 2) shows that the results of amylographic characteristics of all the wheat varieties/lines were highly significant ($P<0.01$). In the present study, differences in the peaks of the flours of different wheat varieties/ lines were due to differences in the amylase activity. The peak viscosity of whole wheat flour is affected by wheat variety and nature [Siddique 1989].

Table 5: Comparison of means for rheological characteristics of straight grade flour of wheat varieties/lines.

Characteristics	Variety LU-26	Variety LU-31	Line 4072	Line 4770	Line 4943	Line 5039	Line 6500
Amylographic value (B.U)	860.00a	530.00d	0.00e	560.00c	600.00b	550.00cd	610.00b
Water absorption (%)	55.30e	58.00a	57.30b	56.20d	54.80f	56.60c	54.40g
Arrival time (minutes)	2.00a	1.75a	1.50a	1.50a	1.50a	1.75a	2.00a
Dough development(min)	2.50b	3.75a	2.25b	2.00b	2.25b	2.50b	2.5b
Resistance to dough (min)	19.75a	11.00c	10.45c	15.00b	4.00d	5.50d	4.00d
Dough stability (Minutes)	17.25a	7.25c	8.20c	13.00b	1.75de	3.00d	1.50e
Softening of dough (B.U)	40.00b	50.00b	80.00a	40.00b	50.00b	50.00b	40.00b
Tolerance index (B.U)	40.00bc	40.00bc	30.00c	20.00c	60.00ab	40.00bc	70.00a

Farinographic Studies

Second parameter of rheological studies was farinograph. Table 5 shows mean values of farinographic characteristics. Water absorption is considered to be an important characteristic of wheat and composite flour [Sollars and Rubenthaler 1975]. It ranged from 54.40 to 58.00% for wheat line 6500 and variety LU-31. In the present study, the results of water absorption are very close to the results of earlier researcher [Borghi *et al.* 1996] in which water absorption ranged from 53 to 60% and was positively correlated with protein content ($r = 0.67^{**}$).

Variation in the arrival time of different wheat varieties/lines reflects differences in the rheological behaviour of the wheat varieties/lines. Maximum arrival time was observed in wheat variety LU-26 and line 6500 (2 minutes).

The dough development time also varied among all the wheat varieties/lines and the results were in line with the previous findings [Lukow and Bushuk 1984]. It ranged from 2.00 to 3.75 minutes for line 4770 and variety LU-31 respectively. There exists a range of dough development time for hexaploid wheats from <90 seconds to 240 seconds [Corbellini 1999]. The results of the present study were also close to those findings. Developed doughs have higher complex moduli than the undeveloped doughs.

As far the time for resistance of the dough was concerned, the longer the time the stronger the flour. The resistance of various doughs in the present study depicted the same situation. It varied among all the wheat varieties/lines showing a range from 4.00 to 19.75 minutes for line 6500, 4943 and variety LU-26.

Maximum dough stability (17.25 minutes) was observed in case of variety LU- 26 and minimum (1.50 minutes) for line 6500. In an earlier study dough stability of whole-wheat flour was found as 4.5 minutes [Siddique 1989]. The dough stabilities in the present study were approximately in range with that finding.

The values of the softening of the dough also differed for all the wheat varieties/lines. According to a study by Corbellini *et al.* [1999], the degree of softening was 50 B.U. that is very close to the results of the present study in which there existed a range from 40.00 to 80.00 B.U for lines 4770, 6500, variety LU-26 and line 4072 respectively.

In general, flours that have good tolerance to mixing have low tolerance index and the higher the tolerance index value, the weaker the flour. In the present study, wheat line 6500 had maximum (70.00 B.U) tolerance index and line 4770 minimum (20.00 B.U). The results of the present study were similar to the result of Ciacco and D'Appolonia [1982] that was 40 B.U for sound wheat flour. Similarly, this value for Neepawa sound wheat flour was found as 50 B.U [Lukow and Bushuk 1984]. Analysis of variance (Table 2) showed highly significant ($P<0.01$) results for all the parameters of farinographic characteristics.

PRODUCTION OF LEAVENED FLAT BREAD (NAAN) FOR ENHANCED ACCEPTABILITY

Texture of the naans was the main attribute of sensory evaluation. It was evaluated by a panel of five judges. The highest score for the texture was 8.20, which was achieved by variety LU-26 followed by 8.00 which was got by the variety LU-31 (Table 6). The results for the texture of the leavened flat breads of all the wheat varieties/lines were highly significant ($P<0.01$) as shown by the analysis of variance (Table 2).

Wheat starch and gluten have limited effect on tortilla texture [Wang and Flores 1999]. The flour protein and water absorption affect tortilla texture [Wang and Flores 1999]. Softness in chapatti texture is highly correlated with flour color and consequently bran content; this may be due to

increase in water absorption [Navickis and Nelsen 1992]. Generally it was observed that wheat variety LU-26 was ranked at number one for the texture of the naans and the variety LU-31 at number two.

Table 6: Comparison of mean scores for sensory evaluation of naans of wheat varieties/lines.

Characteristics	Variety LU-26	Variety LU-31	Line 4072	Line 4770	Line 4943	Line 5039	Line 6500
Texture (score)	8.20a	8.00a	6.73b	6.53b	6.93b	6.57b	6.53b

Means with the same letter are not significantly different.

CONCLUSION

Physico-chemical and rheological characteristics of wheat varieties/lines affect the quality of the end product. Flour characteristics of wheat varieties/lines have a bearing on the texture of the leavened flat bread (naan). Wheat variety LU-26 was ranked high for the production of leavened flat bread (naan).

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