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ORIGINAL ARTICLE

Suitability of spring wheat varieties for the production of best quality pizza

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Abstract The selection of appropriate wheat cultivars is an imperative issue in product development and realization. The nutritional profiling of plants and their cultivars along with their suitability for development of specific products is of considerable interests for multi-national food chains. In this project, Pizza-Hut Pakistan provided funds for the selection of suitable newly developed Pakistani spring variety for pizza production. In this regard, the recent varieties were selected and evaluated for nutritional and functional properties for pizza production. Additionally, emphasis has been paid to assess all varieties for their physico-chemical attributes, rheological parameters and mineral content. Furthermore, pizza prepared from respective flour samples were further evaluated for sensory attributes Results showed that Anmool, Abadgar, Imdad, SKD-1, Shafaq and Moomal have higher values for protein, gluten content, pelshenke value and SDS sedimentation and these were relatively better in studied parameters as compared to other varieties although which were considered best for good quality pizza production. TD-1 got significantly highest score for flavor of pizza and lowest score was observed from wheat variety Kiran. Moreover, it is concluded from current study that all wheat varieties except TJ-83 and Kiran exhibited better results for flavor.

Keywords Wheat flour · Protein content · Rheological study · Mineral · Pizza

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Introduction

Pizza is categorized among the world's most widespread baked products and it can be defined as flat bread leavened through chemicals or yeast (Redl et al. 2003). Pizza topping consists primarily of tomato products and cheese, with ingredients such as, meat, onions, or peppers added to provide variety. On an average, this topping comprises about 45% of the weight of the finished pizza and 55% is the bread like crust (Esminger et al. 1995). Consumption of pizza dough is increasing notably. Thus, food industries have revealed growing consideration in the production of high quality pizza dough which is strongly influenced by the leavening process, more than by the characteristics of the raw materials and from the course of preparation. Amongst, the quality of wheat is of major consideration (Lehman 1997; Andrea and Aniello 2003).

The production of wheat (quantity) remained prime factor while less emphasize is paid to the improvement in quality of wheat (Sobering et al. 2000). Common wheat is primarily used for the production of yeast breads and hard rolls. Since there is a wide disparity in quality of wheat varieties due to divergence in their genetic make up and production conditions hence flour bakers facing a problem to get flour of consistent quality (Dubois and Juhue 2000). Wheat flour is mainly obtained from hard wheat varieties possessing good quality protein especially for gluten magnification used for the production of pizza. Wheat protein quantity and composition are important parameters for wheat baking quality (Atwell 2001). Gluten mainly consists of two major storage protein fractions, namely gliadin and glutenin (Wang et al. 2007). Gliadin and glutenins both contribute to rheological, structural and baking characteristics of wheat (Ahmed et al. 2008). Gluten's elastic nature helps increase loaf volume by trapping carbon dioxide gas

produced in the fermentation process. Gluten enables hearth breads to retain their shape better while baking and provides the strength needed in baked products to support heavy, high fiber ingredients such as whole grains, raisins, nuts or dried fruits (Wieser 2007). Spring wheat contains higher protein content which is valuable for food supplementation (Ohm et al. 2008; Frant and Bujak 2004). Flour which has highest protein content i.e.; 13 to 14.5% imparts firmness to the crust and this flour called as high gluten flour (Asghar et al. 2007).

Wheat (*Triticum aestivum*) is foremost and imperative food crop as it is mostly consumed in the preparation of all bakery products and confectionary items (Syers et al. 1986). Wheat is inimitable than other cereals owing to visco-elastic opulence of the dough (Yang et al. 2011) and possessing the ability to retain gas which is requisite for the production of light texture in bakery products (Shuaib et al. 2007). Pakistan is the 8th largest wheat producer, contributing about 3.17% of the world wheat production from 3.72% of the wheat growing area. Wheat has been grown on an area of 22.1 million acres producing 23 million tones of grains with a total yield of 2716 kg hectare^{-1} in Pakistan (Hruskova and Smejda 2003).In past few years, there has been superfluous production of wheat and this increasing proportion of wheat is being milled into flour to be used in production of bakery items. Wheat restrains distinctive position in diet by contributing more than 60% of the total protein and caloric requirements in daily diet (GOP 2009–2010).

Standard life of a wheat variety in Pakistan ranges from 5–6 years. It is also crucial that the manufactures of pizza should not depend on a single variety but must have an alternative variety time to time. Individual varieties may vary in their bread making quality, dough characteristics and milling properties. Keeping in view all above facts, following study have been designed.

Materials and methods

Collection of wheat samples

Eight wheat varieties (Anmool, Abadgar, Imdad, SKD-1, Moomal, TD-1, TJ-83 and Kiran) were procured from Agricultural Research Centre, Tandojam and three (Shafaq, Sahar and Auqab) from Wheat Research Institute Ayub Agriculture Research Institute, Faisalabad, Pakistan.

Tempering and milling of wheat grains

The grains of each wheat variety were tempered and milled through Quadrumate Senior Mill by following the method given in AACC (2000) Method No. 26–95.

Physical attributes

A representative grain sample of wheat varieties was tested for thousand kernel weight and test weight (kgh^{-1} L^{-1}) by the procedure described in AACC (2000).

Physico-chemical properties of flour

Flour of each wheat variety was analyzed for moisture content (Method No. 44-15A), ash (08–01), crude protein (46–12), wet and dry gluten content (38–10) and pelshenke value (56–50) by following the methods described in AACC (2000) and SDS sedimentation value was determined according to the method mentioned by Williams et al. (1986a).

Mineral estimation

Mineral content (Na, K, Cu and Mn) in flour were determined by using atomic absorption spectrophotometer (Varian AA-240) according to the method described in AOAC (2000).

Farinographic studies and Mixographic studies

Straight grade flour samples of each wheat variety were run through Brabender Farinograph and Mixograph (National Mfg. Co. Lincoln, Nebraska) to determine various dough characteristics with the method described in AACC (2000).

Preparation of pizza

Pizza was prepared from different wheat varieties in the Baking Hall of National Institute of Food Science and Technology, University of Agriculture, Faisalabad, Pakistan by the recipe provided by MCR (Pvt.) Ltd. Pizza Hut International. The flat bread prepared for pizza was evaluated for gas retention capacity and fermentation tolerance during proofing and retarding period. The recipe used for preparation of pizza is given below:

Ingredients	Quantity
Flour	1 kg
Dough blend	45 g (Supplied by Pizza Hut)
Oil	10 g
Water	550–600 ml

Procedure

The bowl of mixer was washed and rinsed with water having a temperature of 32 °C. The correct amount of water

(at a temperature of 32 °C) was added to mixing bowl to activate the yeast present in dough blend. The weighed amount of dough blend was added into mixing bowl and mixed with spatula for one minute, then allowed to rest for two minutes. Thereafter the oil was added, mixed and finally wheat flour was added. The dough was mixed for 10 min at slow speed (speed 1). After that the dough was taken out of the mixing bowl and divided into pieces of 250 g and molded into round balls. The dough balls were flattened and put into pizza pans which were already greased. These pans were put into a proofer by maintaining a temperature of 32–33 °C for 60–90 min or till the dough attained the desired height marked in the pizza pans. The pizza pans were taken out of the proofer and placed in a refrigerator in which 1–2 °C temperature was maintained for proper retarding for at least one hour.

Topping

The topping used for pizza consist of tomato sauce, mozzarella cheese, chicken, green pepper and onion etc.

Baking

The pizza shells after topping were baked for 6–7 min at a temperature of 240–250 °C in a baking oven.

Type of pizza

The pizza was of pan type which was similar to deep-dish style, and baked in a similar deep-sided pan, but its crust was quite thick. Toppings and cheese frequently go on the top of a pan pizza, rather than under the sauce. The placement of cheese and toppings made pan pizza variety similar to a thin crust pizza with a thicker and larger crust.

Sensory evaluation of baked pizza

Pizzas were evaluated by a trained panel of judges for various sensory characteristics such as color, taste, texture, and flavor and over all acceptability, using nine point hedonic scales as described by Larmond (Larmond 1987). Pizza prepared with different spring wheats was subjected to sensory evaluation by a trained taste panel of 10 judges (Meilgaard et al. 2007). Evaluation was carried out by the panelists using 15 cm unstructured line for parameters of crumb color, aroma, taste and overall quality. All evaluations were conducted at room temperature on the same day in the National Institute of Food Science and Technology (NIFSAT), University of Agriculture, Faisalabad, Pakistan. The data thus obtained was converted to numerical scores using hedonic scale and statistically analyzed to check the degree of significance and variance analysis using Co-Stat 2003 software.

Statistical analysis

Data obtained for each parameter were subjected to statistical analysis to determine the level of significance using analysis of variance in completely randomized design and means were further compared through Duncan's multiple range test (DMRt) described by Steel et al. (1997).

Results and discussion

Physical characteristics of wheat varieties

Thousand kernel weight measures the mass of wheat kernel. It is used as a complement to test weight to better describe wheat kernel composition and potential flour extraction. Generally speaking, wheat with a higher thousand kernel weight can be expected to have a greater potential flour extraction.

The test weight and thousand kernel weight significantly varied among different wheat varieties (Table 1). Test weight and thousand kernel weight ranged from 72.66 to 78.67 kgh^{-1} L^{-1} and 30.53 to 51.87 g respectively. Highest thousand kernel weight was found in TD-1 and lowest in TJ-83. In the same way the maximum test weight was observed in Shafaq and minimum in TJ-83. Test weight and thousand kernel weight were highly significant and similar to the earlier findings of Anjum et al. (2002) and Dholakia et al. (2003).

Physico-chemical analysis of wheat varieties

Results for moisture, ash and protein content were differing considerably for different wheat varieties. The results showed that the difference in moisture content among the whole flours of different wheat varieties was significant. Moisture content ranged from 10.48 to 12.84%. Moisture content is an indication of grain storability. Maximum ash content was found in Moomal (1.81%) and minimum in SKD-1 (1.34%). Milling performance indicated by the ash content which indirectly revealing the amount of bran in the flour, so it determines the yield. Ash content affects the color of finished product. Protein content considerably differ from 9.43 (Kiran) to 13.96% (Anmool) (Table 1). The results for moisture, ash and protein content in the entire wheat varieties are in line with the data reported by Asghar et al. (2007), Yadav et al. (2011) and Saeed et al. (2011).

Protein content has key specification for wheat flour which related to many processing properties such as water

Table 1 Physical and chemical quality characteristics of different wheat flour

Varieties	Test wt (kg/hL)	Thousand kernel wt (g)	Moisture (%)	Ash (%)	Protein (%)	Wet gluten (%)	Dry gluten (%)	Pelshenke value (min.)	SDS sedimentation value (mL)
Anmool	73.0f	39.9cd	11.5c	1.7b	13.9a	35.8b	11.5bc	273.0e	29.0c
Abadgar	75.0e	41.4bc	10.7e	1.5g	12.8c	29.8e	11.7ab	311.6c	31.2b
Imdad	73.0f	36.4de	12.2b	1.6cd	11.9e	35.2bc	12.4a	273.0e	31.8b
SKD-1	76.0de	40.9bc	11.4cd	1.3h	13.7b	38.0a	11.6ab	287.0d	22.6e
Shafaq	78.6a	40.6c	10.4f	1.7b	12.6d	31.9d	10.4d	360.6b	38.0a
Moomal	76.3cd	42.9bc	11.3d	1.8a	11.5g	27.2f	9.1e	389.2a	24.6d
Sahar	77.6ab	44.7b	10.7e	1.6c	11.2i	31.3de	11.2bc	274.0e	28.3c
Auqab	78.3ab	35.8e	12.8a	1.5f	11.2h	33.9c	11.0bcd	307.6c	23.1e
TD-1	77.3bc	51.8a	11.4c	1.6cd	10.9j	30.8de	9.3e	157.6g	15.0g
TJ-83	72.6f	30.5f	10.8e	1.5e	11.7f	34.9bc	10.9cd	306.0c	23.4e
Kiran	73.0f	43.5bc	12.1b	1.6d	9.4k	26.6f	8.8e	197.0f	18.4f

$n=3$

Values carrying same letters in each column are not significantly different from each other.

content and gluten strength. It also related to finished product attributes like texture and appearance.

The wet and dry gluten contents ranged from 26.64 to 38.04% and 8.85 to 12.44%, respectively. Results match with the results of Yadav et al. (2010), Asghar et al. (2007) and Curic (2001). Gluten plays vital role in structure of pizza crust because it providing an elastic matrix, springiness to dough and firmness to the baked products (Lopez et al. 2003). The properties of wheat flour reside by the gluten proteins such as glutenins and gliadins. Strong gluten flour has higher water absorption and longer stability time than weak gluten flour. Pelshenke and SDS sedimentation values were found to be significantly affected by the wheat varieties. Pelshenke value ranged from 157.0 to 289.21 min. Highest sedimentation value was observed in wheat variety Shafaq and lowest in TD-1. SDS sedimentation value ranged from 15.0 to 38.0 mL (Table 1). The values for SDS sedimentation test for all the wheat varieties were notably significant ($P<0.05$). These results are in range with the results of Anjum et al. (2002) and Farooq et al. (2001).

Mineral estimation

Minerals such as sodium, potassium, copper and manganese examined (Table 2) and their values ranged from 745.61 mg kg^{-1} to 790.33, 297.93 to 411.96, 7.07 to 14.63 and 3.23 to 5.06 mg kg^{-1}, respectively. These minerals varied significantly due to variations in different wheat varieties. The results for mineral content are in line with the results of Lopez et al. (2003) and Davis et al. (1994).

Wheat milling

With respect to the milling fractions, TD-1 gave maximum straight grade flour followed by Shafaq and Auqab. Milling yield of straight grade flour, reduction flour and break flour were ranged from 60.30 to 75.50%, 45.20 to 54.0% and 11.86 to 19.0%, respectively. Shorts and bran ranged from 3.4 to 8.8% and 26 to 33%, respectively (Table 3). These findings are in close agreement with conclusion of Butt et al. (1997) and Posner and Hibbs (1999) as flour yield is the most important technical and economic factor of milling.

Table 2 Mineral content of different wheat varieties (mg/100 g)

Varieties	Sodium	Potassium	Copper	Manganese
Anmool	787.4ab	411.9a	14.6a	3.8d
Abadgar	760.0bcde	401.6b	8.3d	3.7e
Imdad	761.4bcde	411.0a	7.5fg	3.7f
SKD-1	755.7de	297. 9g	10.0b	5.0a
Shafaq	749.9de	367.2e	7.2i	3.4g
Moomal	755.7de	393.5c	8.4c	3.2i
Sahar	786.0abc	345.1f	7.9e	4.0b
Auqab	774.4abcd	385.9d	7.6f	3.9c
TD-1	758.6cde	380.8d	7.0j	3.2i
TJ-83	745.6e	385.9d	7.4h	3.3h
Kiran	790.3a	411.9a	7.5gh	3.2i

$n=3$

Mean values carrying same letters in each column are not significantly different from each other.

Table 3 Milling fractions of different wheat varieties

Varieties	RF (%)	BF (%)	SGF (%)	Shorts (%)	Bran (%)
Anmool	53.0	15.6	68.6	3.4	30.4
Abadgar	47.8	12.5	60.3	8.8	33.0
Imdad	49.5	17.0	66.5	4.3	31.7
SKD-1	50.0	11.8	61.8	7.0	31.5
Shafaq	54.0	18.5	72.5	4.2	26.0
Moomal	45.2	16.7	61.9	4.1	31.7
Sahar	54.0	17.2	71.2	5.0	29.5
Auqab	51.0	19.0	70.0	4.2	28.5
TD-1	58.0	17.5	75.5	4.8	29.0
TJ-83	48.8	16.6	65.5	4.8	32.2
Kiran	49.0	15.2	64.2	5.5	31.7

RF Reduction flour; *BF* Break flour; *SGF* Straight grade flour

Rheological properties

Farinograph widely used to determine the quality of end product. The parameters of Farinograph have significant role in formulation to estimate the amount of water for dough making, to evaluate the effects of ingredients during mixing, to assess flour blending requirements and to ensure flour uniformity. Weak doughs have greater elastic characteristics due to high proportion of starch as compared to strong doughs (Khatkar and Schofield 2002). Farinographic characteristics of wheat varieties such as SKD-1, Shafaq and Kiran gave higher percentage of water absorption while wheat varieties TD-1 and TJ-83 contributed lower percentage of water absorption. Parameters for instance; dough development time, dough stability, mixing tolerance index and softening of the dough were ranged from 2.3 to 6.5 min, 3.9 to 18.5 min, 20 to 80 BU, and 40 to 120 BU, respectively (Table 4). In general flours that have lower tolerance index value have more strength. Anmool, Abadgar, Sahar and Auqab fell in the category of medium strong gluten on the basis of dough development time which ranged from 5.5 to 6.5 among these wheat varieties (Amjad et al. 2010). Stronger wheat flours have the ability to absorb and retain more water as compared to weak flours (Williams et al. 1986b). On the basis of dough stability the wheat varieties Shafaq, Anmool, Auqab and TJ-83 can be categorized as strong gluten group because their stability falls above 11 min.

Small quantity of flour for dough gluten strength promptly explores by the mixograph test. Water absorption in mixograph serves as bake absorption in pizza baking. Mixographic characteristics of selected wheat varieties showed there is a significant disparity for development time and peak height percentage which ranged from 2.1 to 5.6 min and 47 to 73%, respectively (Table 5). Highest development time was observed in Kiran (5.6 min.) and lowest in TD-1 (2.1 min). In the same way the highest value for peak height was observed in SKD-1 and lowest in TD-1 (Amjad et al. 2010).

Evaluation of pre-baked pizza

a. Clean-up stage

Clean-up stage is an indicator which determines dough behaviour during mixing. It is well known fact that stronger wheats generally take more time for reaching clean-up stage as compared to wheats possessing weaker gluten.

The results pertaining to the analysis of variance for clean-up stage of pizza dough prepared from flours of different wheat varieties have been depicted in Table 6. The results

Table 4 Farinographic characteristics of different wheat varieties

Varieties	W.A (%)	D.D.T (min.)	D.S (min.)	A.T (min.)	D.T (min.)	M.T.I (BU)	S.O.D (BU)
Anmool	56.6bc	6.5a	16ab	2.0bc	18.0a	39bc	60d
Abadgar	57.6bc	5.5b	6.8cde	2.5b	9.3de	40bc	120a
Imdad	56.8bc	4.0cd	12.2bc	1.4cd	13.6b	20e	42f
SKD-1	63.6a	4.4bc	6.8e	1.8c	8.6d	58b	100b
Shafaq	61.3a	2.3cde	18.5a	1.4cd	19.9a	20e	40
Moomal	55.0c	3.5de	6.1de	0.9d	8.7d	22de	62d
Sahar	57.8bcd	6.0ab	12.8bc	1.8bc	14.6bc	21de	58e
Auqab	58.3bc	5.5b	13.23b	1.57cd	14.8bc	35bc	50ef
TD-1	54.4bcd	4.0cd	3.9f	2.9a	6.8e	80a	120a
TJ-83	56.3bc	5.0bc	13bcd	2.5	15.5b	20de	35efg
Kiran	59.4b	3.5cd	7.9cd	1.5	9.4de	30xc	75bc

W.A Water absorption; *D.D.T* Dough development time; *D.S* Dough stability; *A.T* Arrival time; *D.T* Departure time; *M.T.I* Mixing tolerance index; *S.O.D* Softening of the dough

Table 5 Mixographic characteristics of different wheat varieties

Varieties	Development time (min.)	Maximum peak (%)
Anmool	3.2bcd	57cd
Abadgar	2.3cd	59bc
Imdad	5.1ab	69ab
SKD-1	4.0bc	73a
Shafaq	3.7c	68b
Moomal	4.3bc	49cde
Sahar	4.9ab	60bc
Auqab	4.1bc	60bc
TD-1	2.1cd	47de
TJ-83	4.8b	60bc
Kiran	5.6a	62bcd

showed that clean-up stage differed significantly among different wheat varieties. The clean-up stage time varied from 2.17 to 3.52 min. The highest time for clean-up stage was taken by the flour of Shafaq followed by Auqab. The wheat variety TD-1 took significantly the lowest time to reach clean-up stage. It is indicated from the table that the wheat varieties Shafaq, Auqab, Anmool, Abadgar, TJ-83 and Kiran showed non significant difference among each other. The results are identical to the findings reported by Randhawa et al. (2002).

b. Proofing time of pizza dough base

The analysis of variance pertaining to the proofing time of pizza dough base prepared from flour of different wheat varieties have been shown in Table 6. It is obvious from results that the proofing time varied from 61.17 to 85.67 min among different wheat varieties. Significantly the highest proofing time was observed in the dough prepared from the flour of SKD-1. The lowest proofing time was observed in TJ-83 and Kiran.

c. Shelf life of pizza dough during retarding

Shelf life of the pizza dough base is a very important parameter which determines the suitability of particular wheat flour for the production of pizza (Table 6). Wheat variety possessing good shelf life is more desirable for pizza production. Shelf life of the dough base is determined in terms of time in hours taken by proofed dough to retain gas in the form of aerated dough during its time in refrigerator where a temperature of 1 to 2 °C is maintained. Retardation of pizza is carried out in order to slow down or retard the activity of yeast.

Evaluation of baked pizza

Results pertaining to the color of the baked pizzas prepared from flours for different wheat varieties showed significant effect (Table 7). Values of color ranged from 6.75 to 7.63% and it was highest for TD-1 and lowest for Kiran. With respect to aroma of pizza it was observed that this character showed non significant differences among each other. The values for aroma of pizzas prepared from different wheat varieties ranged from 6.63 to 7.75 have been given in Table 7. The highest score for aroma was assigned by the judges to the pizza prepared from flour of TD-1 followed by

Table 6 Evaluation of pre-baked pizza

Varieties	Clean-up stage (min.)	Proofing time (min.)	Retarding time (hrs.)
Anmool	2.9b	70.6e	7.04a
Abadgar	3.1b	75.3d	7.0a
Imdad	2.4c	80.6b	6.5b
SKD-1	2.3de	85.6a	7.0a
Shafaq	3.5a	71.6e	7.1a
Moomal	2.9b	65.3g	5.0c
Sahar	2.5c	68.6f	4.0d
Auqab	3.3a	77.3c	3.1e
TD-1	2.1e	64.6g	3.0e
TJ-83	2.4cd	61.1h	4.0d
Kiran	2.4cd	61.6h	1.1f

$n=3$

Mean values carrying same letters in each column are not significantly different from each other.

Table 7 Sensory characteristics of baked pizza

Varieties	Color	Texture	Aroma	Flavor	Taste	Overall acceptability
Anmool	7.2abc	7.3ab	7.1abc	7.3b	7.6a	7.7a
Abadgar	7.5ab	7.2ab	7.1abc	7.7ab	7.5ab	7.3abc
Imdad	7.2abc	7.3ab	7.3ab	7.5ab	7.5ab	7.5abc
SKD-1	6.8bc	7.5ab	7.6a	7.5ab	7.3ab	7.5abc
Shafaq	7.5ab	7.1ab	7.1abc	7.6ab	7.5ab	7.1bcd
Moomal	7.5ab	7.5ab	7.3ab	7.7ab	7.7a	7.6ab
Sahar	7.5ab	7.3ab	7.6a	7.3b	7.6a	7.5abc
Auqab	7.5ab	7.2ab	7.3ab	7.3b	7.5ab	7.7a
TD-1	7.6a	7.7a	7.7a	8.0a	7.7a	7.8a
TJ-83	7.0abc	6.8bc	6.7bc	6.7c	6.8bc	7.0cd
Kiran	6.7c	6.3c	6.6c	6.6c	6.5c	6.7d

$n=3$

Mean values carrying same letters in each column are not significantly different from each other.

Sahar and SKD-1. Similarly, the lowest score for aroma was observed from flour of Kiran.

Results indicated that texture of baked pizza not differ significantly among different wheat varieties. Significantly the highest scores were assigned to the pizza of TD-1 which ranged from 6.38 to 7.75 (Table 7). The pizza of Kiran got significantly the lowest scores for texture. The score for taste ranged from 6.50 to 7.75 among pizzas prepared from different wheat varieties. Significantly the highest scores for taste were assigned to Moomal and TD-1 (7.75). The lowest scores were assigned by the judges to Kiran. The highest scores were assigned to TD-1 followed by Anmool and Auqab. All the wheat varieties exhibited non significant differences with respect to scores obtained for overall acceptability. The statistical data regarding different sensory parameters of baked pizza showed that pizza prepared from Anmool, TD-I, Imdad, Abadgar, Shafaq, SKD-1, Auqab, Sahar and Moomal are suitable for the production of pizza and should be tested on commercial scale.

Conclusion

Wheat is the most broadly grown crop in the world and its economical significance for human kind is matched only by rice. Rheological and end-use attributes of different spring wheats is very imperative to understand mechanical properties of the dough and also for determining the quality of final product. Nevertheless, physico-chemical properties of spring wheats have been assessed for various parameters and these were found in significant range. Wheat varieties e.g. Anmool, Abadgar, Imdad, SKD-1, Shafaq and Moomal were considered better than other wheat varieties. Protein content appeared to play a significant role on rheological and sensory characteristics of wheat. Regarding the quality and shelf life of pizza; it may be recommended that three wheat varieties of Sindh province for instance; Anmool, Abadgar and SKD-1 and one variety of Punjab such as Shafaq are relatable for the production of good quality pizza in Pakistan and can substitute the existing wheat variety being used for the production of pizza.

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References

AACC (2000) Approved Methods of the American Association of Cereal Chemists. The American Association of the Cereal Chemists, Inc, St Paul Minnesota

Ahmed J, Ramaswamy HS, Raghavanm VJS (2008) Dynamic viscoelastic, calorimetric and dielectric characteristics of wheat protein isolates. J Cereal Sci 47:417–428

Amjad M, Safdar MN, Mumtaz A, Naseem K, Raza S, Khalil S (2010) Comparison of different wheat varieties grown in punjab for leavened flat bread (Naan) production. Pak J Nutr 9(2):146–150

Andrea F, Aniello C (2003) Numerical stimulation of the rheological behavior of pizza dough Agricultural Engineering Department. University of Naples Debrecen, Hungary

Anjum FM, Niaz M, Butt MS (2002) Suitability of different wheat flours for the commercial production of crackers. Pak J Food Sci 12(3–4):1–6

AOAC (2000) Official Methods of Analysis. The Association of Official Analytical Chemists. 17th edn., Arlington Virginia, USA

Asghar A, Anjum FM, Butt MS, Tariq MW, Hussain S (2007) Rheological and storage effect of hydrophilic gums on the quality of frozen dough pizza. Food Sci Tech Res 13(2):96–102

Atwell WA (2001) Wheat Flour Eagan Press Handbook Series St Paul, Minnesota, USA

Butt MS, Anjum FM, Rehman A, Ali A (1997) Physiochemical characteristics of spring wheats. J Agric Res 35(6):413–422

Curic D (2001) Gluten as a standard of wheat flour quality. Food Tech Biotechnol 39(4):353–361

Davis KR, Peters LJ, Cain RF, Letourneau D, Mc-Ginnis J (1994) Evaluation of the nutrient composition of wheat. Cereal Foods World 29:246–248

Dholakia BB, Ammiraju JSS, Singh H, Lagu MD, Roder MS, Rao VS, Dhaliwal HS, Ranjekar PK, Gupta VS (2003) Molecular marker analysis of kernel size and shape in bread wheat. Plant Breed 122:392–395

Dubois M, Juhue B (2000) The importance of experimental milling for determining rheological parameters as measured by the alveograph. Cereal Foods World 45:385–388

Esminger AH, Ensminger ME, Konlande JE, Robson JRK (1995) The concise encyclopedia of food and nutrition. CRC press, Boca Raton

Farooq Z, Rehman S, Butt MS, Bilal MQ (2001) Suitability of wheat varieties/lines for the production of leavened flat bread (naan). J Res Sci 12(2):171–179

Frant M, Bujak K (2004) Influence of simplication in soil culture and level of mineral fertilization on weeding of winter wheat (in polish). Fragmenta Agronom 3:31–39

GOP (2010) Government of Pakistan. Agricultural Statistics of Pakistan 2009–10. Ministry of Food, Agriculture and Livestock (Economics Wing), Islamabad, Pakistan

Hibbs AN (1999) Wheat flour milling. American Association of Cereal Chemists, Inc, St Paul Minnesota

Hruskova M, Smejda P (2003) Wheat flour dough alveograph characteristics predicted by NIRSystems 6500. Czech J Food Sci 21 (1):28–33

Khatkar BS, Schofield JD (2002) Dynamic rheology of wheat flour dough. II. Assessment of dough strength and bread-making quality. J Sci Food Agric 82:823–826

Larmond E (1987) Laboratory methods for sensory evaluation of food. Canadian Government Publishing Center, Ottowa

Lehman T (1997) Guide to pizza crust production. AIB Technical Bulletin 1(2)

Lopez HW, Duclos V, Coudray C et al (2003) Making bread with sourdough improves mineral bioavailability from reconstituted whole-wheat flour in rats. Nutr 19(6):524–530

Meilgaard MC, Civille GV, Carr BT (2007) Sensory evaluation techniques, 4th edn. CRC Press LLC, New York

MissouriSteel RGD, Torrie JH, Dickey DA (1997) Principles and procedures of statistics. A biometrical approach, 3rd edn. McGraw Hills Book Co. Inc, New York

Ohm JB, Ross AS, Peterson CJ, Ong YL (2008) Relationships of high molecular weight glutenin subunit composition and molecular weight distribution of wheat flour protein with water absorption and color characteristics of noodle dough. Cereal Chem 85 (2):123–131

Randhawa MA, Anjum FM, Butt MS (2002) Physico-chemical and milling properties of new spring wheats grown in Punjab and Sind for the production of pizza. Int J Agr Biol 4 (4):482–483

Redl A, Guilbert S, Morel MH (2003) Heat and shear mediated polymerization of plasticized wheat gluten protein upon mixing. J Cereal Sci 38:105–114

Saeed F, Pasha I, Anjum FM, Sultan JI (2011) Water-extractable arabinoxylan content in milling fractions of spring wheats. CyTA - J Food 9:43–48

Shuaib M, Zeb A, Ali Z et al (2007) Characterization of wheat varieties by seed storage protein electrophoresis. Afr J Biotechnol 6 (5):497–500

Sobering DC, Klassen B, Salazar D, Pawlinsky T, Williams PC (2000) Determination of wet and dry gluten content and gluten index on whole meals and whole meal sieved flours from Canadian bread wheat types, using the perfect instruments glutomatic Canadian Grain Commission, Grain Research Lab Kansas City

Syers JK, Mackay AD, Brown MW, Currie LD (1986) Chemical and physical characteristics of phosphate rock materials of varying reactivity. J Sci Food Agric 37:1057–1064

Wang YG, Khan K, Hareland GA, Nygard G (2007) Distribtuion of protein composition in bread wheat flour mill streams and relationship to bread making quality. Cereal Chem 84:271–275

Wieser H (2007) Chemistry of gluten proteins. Food Microbiol 24:115–119

Williams PC, El-Haramein FJ, Sayegh A (1986a) Relationship of sodium dodecyl sulphate (SDS) sedimentation volume and wheat meal in bread and durum wheats. Rachis 2:3–5

Williams R, El-Haramein FJ, Nakkoul H, Rihawi S (1986b) Crop quality evaluation methods and guidelines. Technical manual 16 Int Cent Agric Res Dry Areas, P.O. Box 5466, Aleppo, Syria

Yadav DN, Rajan A, Sharma GK, Bawa AS (2010) Effect of fiber incorporation on rheological and chapatti making quality of wheat flour. J Food Sci Tech 47(2):166–173

Yadav DN, Singh KK, Rehal J (2011) Studies on fortification of wheat flour with defatted rice bran for chapati making. J Food Sci Tech (January–February 2012) 49(1):96–102

Yang Y, Song Y, Zheng Q (2011) Rheological behaviors of doughs reconstituted from wheat gluten and starch. J Food Sci Tech 48 (4):489–493