EFFECT OF PREHARVEST RAINS ON QUALITY CHARACTERISTICS OF SOME PAKISTANI COMMERCIAL WHEAT VARIETIES

Muhammad Khalid, R. Nasim, I. Ullah & M.A. Khan
Food Technology Research Laboratory,
National Agricultural Research Centre, Islamabad

Eight commercial wheat varieties were harvested in two sets, i.e. pre-rain and post-rain. All the varieties were grown in field of National Agricultural Research Centre, Islamabad. Pre-rain harvested samples were without any sign of visible sprouting while post-rain harvested samples showed 6.0 to 21.5% sprouting depending upon variety. There was a decrease in thousand kernel weight and flour yield in sprouted samples of four varieties. Test weight was lower in sprouted samples than unsprouted samples of all the varieties except Faisalabad 83. Protein and gluten contents showed a considerable decrease in sprouted samples. Falling number values decreased considerably ranging from 290 to 367 seconds and from 164 to 288 seconds for sound and sprouted samples, respectively. Dough characteristics such as water absorption, dough development time, stability and time to break down as derived from farinograms were lower in sprouted samples.

INTRODUCTION

Untimely continuous heavy rainfalls and wet conditions during harvesting and threshing cause considerable preharvest sprouting. Even high moisture content of grain during storage has the same implications. Such visible or incipient sprouting causes deterioration of quality and consequently, down grading of grain qualitatively. According to Lukow and Bushuk (1984) germination leads to detrimental effects resulting from cumulative loss of grain yield, grain quality, flour yield and flour quality. During sprouting an induced synthesis of α-amylases and proteases occur in grain (Shorina *et al.*, 1967). Flour recovery, diastatic activity and total ranges increased significantly in laboratory sprouted samples whereas damaged starch and gluten decreased (Singh *et al.*, 1987). Poor rheological and baking quality were exhibited by sprouted wheats (Derera *et al.*, 1977; Kulp *et al.*, 1983; Lorenz *et al.*, 1983 and Reddy *et al.*, 1984). Widespread rain during May, 1987 seriously affected wheat grains quality in different parts of the country. The objective of this study was to determine quality changes caused by pre-harvest heavy rains in some Pakistani commercial wheat varieties grown in fields at National Agricultural Research Centre, Islamabad.

MATERIALS AND METHODS

Collection of samples: Eight Pakistani commercial wheat varieties (Barani 83, Blue Silver; Koh-i-Noor 83, Faisalabad 83, Pirsabak 85, Faisalabad 85, Punjab 85, Sarsabz) were provided by Wheat Programme, National Agricultural Research Centre, Islamabad. All these varieties were grown in the same field at Islamabad. One set of samples was harvested pre-rain on 6th May, 1987 and 2nd set of samples was harvested post-rain on 20th May, 1987. Average rainfall during this period was above 10 mm.

The frequency of sprouting was assessed visually. Seeds were counted using Numigral Electric Seed Counter. Standard test weight balance (kilogram per hectolitre) was used for weight per unit volume.

Samples were conditioned for 14% moisture level. Flour yield was calculated on 14% moisture basis and on the basis of wheat sample used, according to American Association of Cereal Chemists approved methods (AACC, 1983). Quadrumat Senior Mill was used for milling.

Flour samples were analysed for moisture and falling number using AACC approved methods (AACC, 1983). Nitrogen determination was carried out for whole wheat flour using Kjeltec Auto Analyzer No. 1030 according to AACC (1983) with slight modification i.e. Kjeltab was used as catalyst containing 1.5 g potassium sulphate and 0.0075 g Selenium, Nitrogen concentration was converted to protein by using conversion factor, i.e. N x 5.7. Gluten was washed from white flour in Glutomatic 2200 according to International Association for Cereal Chemistry Method No. 137. Farinographic determinations were based on 14% moisture level (AACC, 1983).

RESULTS AND DISCUSSION

Pre-rain harvested samples (Table 1) showed no visible sign of sprouting while post-rain harvested samples showed a sprouting frequency ranging from 6.0% for Blue Silver to 21.5% for Pirsabak 85.

Thousand kernel weight from 28.0 to 44.0 g and from 30.0 to 42.0 g for pre-rain and post-rain harvested samples, respectively. Except for a few varieties, it was decreased in sprouted grains. Test weight ranged from 70.5 to 78.5 kg per hectolitre and from 68.2 to 76.4 kg per hectolitre in pre-rain and post-rain harvested samples,

Table 1. Physical and chemical characteristics of pre-rain and post-rain harvest samples of wheat varieties

Variety	Sprouted kernels (%)		Thousand kernel weight (g)		Test weight (kg HL)		Flour yield (%, 14% moisture basis)		Protein (%, dry matter basis)		Dry gluten (%, dry matter basis)	
	PR	AR	PR	AR	PR	AR	PR	AR	PR	AR	PR	AR
Barani 83	0	17.0	35.8	36.3	74.6	68.8	73.0	70.9	14.1	11.7	10.2	7.1
Blue silver	0	6.0	43.0	42.0	77.2	71.2	67.1	69.6	12.7	10.4	9.8	8.0
Kohinoor 83	0	12.0	31.4	33.0	70.5	68.2	73.1	70.7	12.9	10.0	9.8	6.6
Faisalabad 83	0	15.5	33.8	37.2	72.2	72.2	70.7	74.4	10.2	10.0	7.7	7.5
Pirsabak 85	0	21.5	38.9	38.5	77.1	76.5	76.1	69.9	14.3	9.9	9.7	6.4
Faisalabad 85	0	10.0	44.0	40.1	78.5	75.0	70.1	69.8	15.9	11.5	11.6	7.6
Punjab 85	0	12.0	40.1	37.2	75.3	71.4	72.1	69.9	13.2	11.1	9.3	7.7
Sarsabz	0	9.0	28.0	30.0	75.5	71.4	68.2	69.6	11.8	9.3	8.8	7.0
Average	0	12.9	36.9	36.8	75.1	71.8	71.3	70.6	13.1	10.6	9.6	7.3
C.V.	0	38.3	15.3	10.4	3.6	3.9	4.1	2.3	13.1	7.3	11.7	7.7

PR = Pre-rain; AR = Post-rain.

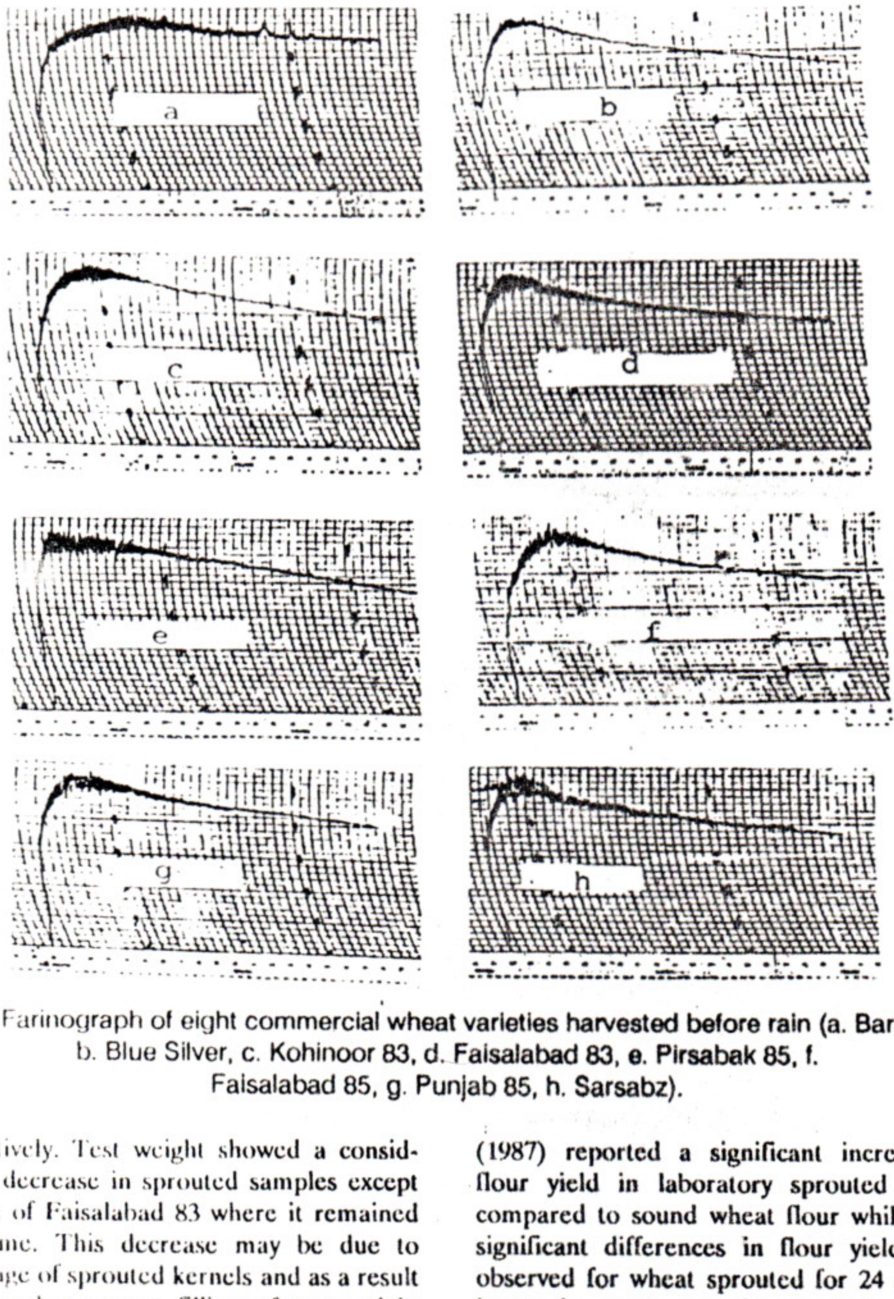

Fig. 1. Farinograph of eight commercial wheat varieties harvested before rain (a. Barani 83, b. Blue Silver, c. Kohinoor 83, d. Faisalabad 83, e. Pirsabak 85, f. Faisalabad 85, g. Punjab 85, h. Sarsabz).

respectively. Test weight showed a considerable decrease in sprouted samples except in case of Faisalabad 83 where it remained the same. This decrease may be due to shrinkage of sprouted kernels and as a result in somewhat poorer filling of test weight container (Pomeranz *et al.*, 1971).

Flour yield showed a decrease in sprouted samples except in Blue Silver, Faisalabad 83 and Sarsabz. Singh *et al.* (1987) reported a significant increase in flour yield in laboratory sprouted wheat compared to sound wheat flour while non-significant differences in flour yield were observed for wheat sprouted for 24 and 48 hours in same experiment. Lukow and Bushuk (1984) have reported that sprouting did not affect flour yield data. Our results are not supported exclusively by either report because in our study floor yield has

decreased in some cases. This decreases may be partially attributed to suspected shrinkage of grains which hinders the efficient separation of endosperm and bran.

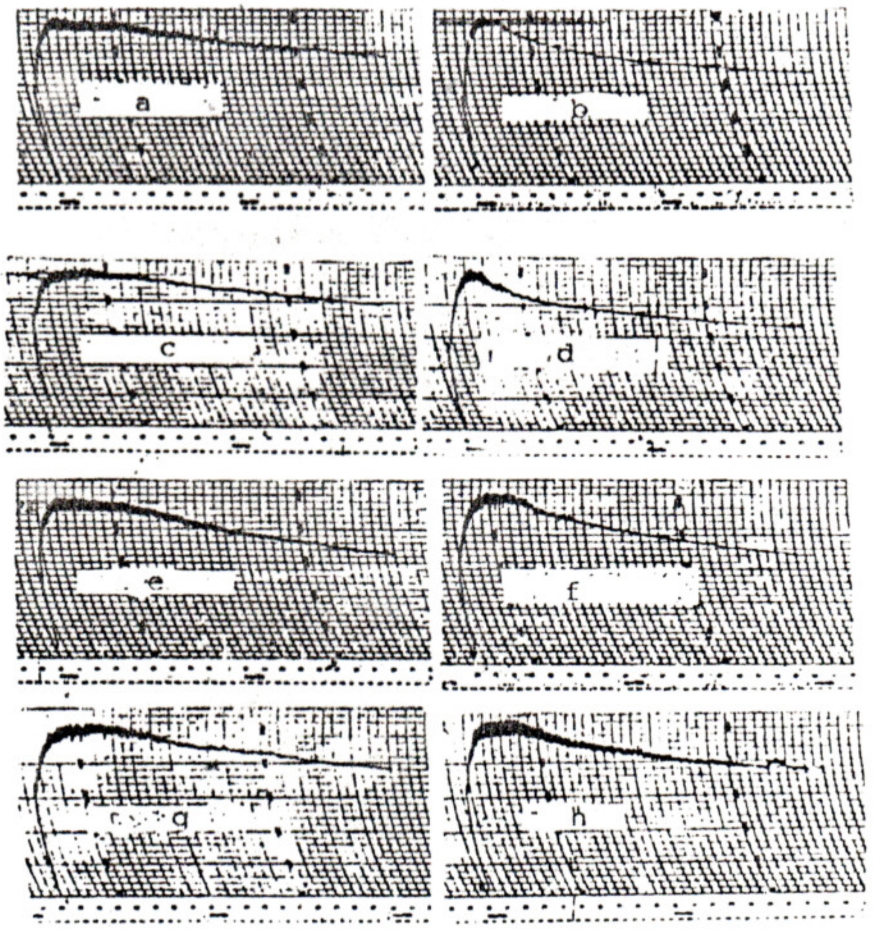

Fig. 2. Farinograph of eight commercial wheat varieties harvested before rain (a. Barani 83, b. Blue Silver, c. Kohinoor 83, d. Faisalabad 83, e. Pirsabak 85, f. Faisalabad 85, g. Punjab 85, h. Sarsabz).

Protein contents ranged from 10.2 to 15.9% in pre-rain harvested and from 9.8 to 11.7% in post-rain harvested samples. Similarly, dry gluten content varied between 7.7 to 11.6% and 6.4 to 8.0% in pre-rain and post-rain harvested samples, respectively. In post-rain harvested samples the protein and gluten contents were decreased in our study. These results are supported by findings of Lukow and Bushuk (1984). They described translocation of free amino acids in developing embryo as the responsible factor for reduction of proteins in sprouted samples. Singh *et al.* (1987) reported an increase in protein content and a decrease in gluten content in laboratory sprouted samples but they did not suggest any reason for increase in protein.

Falling number values (Table 2) ranged from 290 to 367 and 164 to 288 seconds for the pre-rain and post-rain harvested samples, respectively. In most of the varieties, the falling number values decreased considerably in post-rain harvested samples. The drop in falling number was different in different varieties. Low falling number values seem to be an indication of increased α-amylase activity in sprouted samples. The extent to which residual enzyme degrade starch upon wetting of mature kernels, depends on enzyme content which is specific to the cultivar (Derera *et al.*, 1977) and also on enzyme activity which is related to degree and length of wetting (Reddy *et al.*, 1984). Due to hydrolysis of starch, dough becomes sticky and poor in handling which produces poor quality bakery products. Keeping such standards of Perten (1984) in view, only two varieties (Barani 83 and Pirsabak 85) after sprouting fall in unsuitable category of flours because of high amylase activity.

Water absorption for pre-rain harvested samples ranged from 61.0 to 64.4% depending upon the varieties (Table 2; Fig. 1 & 2). Water absorption in post-rain harvested samples ranged from 58.0 to 61.0%. Similar decrease in water absorption was reported by a number of researchers (Kulp *et al.*, 1983; Lorenz *et al.*, 1983; Lukow and Bushuk, 1984; Singh *et al.*, 1987). Lukow and Bushuk (1984) suggested that loss of water binding capacity of gluten was responsible for this decrease in water absorption while Singh *et al.*, (1987) attributed it to lower contents of damaged starch. Considering these reports, decrease in water absorption can be best explained on the basis of lower values of falling number and gluten content in our results.

Stability and dough development times ranged fro, 3.0 to 6.3 and 2.8 to 6.8 minutes, respectively for pre-rain harvested samples while same characteristics ranged from 1.2 to 4.8 and 2.2 to 4.0 minutes, respectively for

Table 2. **Falling number and farinographic values (14% moisture level basis) of pre-rain and post-rain harvested samples of wheat varieties**

	Falling number (seconds)		Water absorption (%)		Dough development time (minutes)		Stability time (minutes)		Time to breakdown (minutes)	
	PR	AR	PR	AR	PR	AR	PR	AR	PR	AR
Barani 83	367	164	63.8	59.4	6.8	2.2	5.8	4.5	13.0	8.0
Blue silver	290	285	62.6	60.2	3.5	2.8	3.5	1.5	6.5	4.0
Kohinoor 83	342	278	61.8	58.0	4.5	4.0	6.3	4.8	8.5	8.0
Faisalabad 83	305	274	62.5	61.0	2.8	2.5	3.5	1.2	6.5	3.5
Pirsabak 85	294	170	64.4	59.0	3.0	2.5	6.2	4.3	9.5	7.5
Faisalabad 85	335	233	62.6	59.6	4.2	4.0	3.0	3.0	7.5	5.5
Punjab 85	338	288	61.0	58.4	4.5	4.0	4.3	4.0	8.0	7.5
Sarsabz	346	203	61.9	59.4	3.8	3.0	4.0	3.0	6.5	6.0
Average	327.1	236.9	62.6	59.4	4.1	3.1	4.6	3.3	8.3	6.3
C.V.	8.4	22.0	1.8	1.6	30.2	24.4	29.0	41.5	20.7	28.7

PR = Pre-rain; AR = Post-rain.

post-rain harvested samples. Dough development was decreased slightly in sprouted samples of all the varieties. In Barani 83 it was much decreased. Stability was decreased considerably in sprouted samples of most of the varieties. Time to breakdown was also decreased in sprouted samples. According to Mita and Matsumoto (1984) rheological properties of dough were primarily considered to be dependent on gluten quality. Lowering of rheological values in our study is an index of damage to gluten quality which is also evident from decrease in gluten contents. Farinographic data in our studies showed that rains affected different wheat cultivars to different degrees.

It may be concluded that rain caused a change in different quality parameters of all the commercial wheat varieties used in this study. Degree of sprouting was different under same environmental conditions in different varieties.

Sprouting caused a damage to starch in different varieties to different extent. Different varieties could stand to a varied degree of farinographic mixing after sprouting which showed that field sprouting also caused considerable adverse changes in rheological quality of wheat flour.

REFERENCES

American Association of Cereal Chemists (AACC). 1983. Approved method of AACC. 8th Ed. The Association. St. Paul. MN.

Derera, N.F., G.M. Bhatt and G.J. McMaster. 1977. On the problem of pre-harvest sprouting of wheat. Euphytica, 26: 299-308.

Kulp, K., P. Roewe-Smith and K. Lorenz. 1983. Pre-harvest sprouting of winter wheat. I. Rheological properties of flour and physico-chemical characteristics of starches. Cereal Chem. 60: 355-359.

Lorenz, K., P. Roewe-Smith, K. Kulp and L. Bates. 1983. Pre-harvest sprouting of winter wheat. II. Amino acid composition and functionality of flour and flour fractions. Cereal Chem. 60: 360-366.

Lukow, O.M. and W. Bushuk. 1984. Influence of germination on wheat quality. I. Functional (breadmaking) and biochemical properties. Cereal Chem. 61: 336-339.

Mita, T. and H. Matsumoto. 1984. Dynamic viscoelastic properties of concentrated dispersion of gluten and gluten methyl ester: contribution of glutamine side chain. Cereal Chem. 61: 169-173.

Perten, H. 1964. Application of the falling number method for evaluating α-amylase activity. Cereal Chem. 41: 127-140.

Pomeranz, Y., N.N. Standridge and H.L. Shands. 1971. Functional and biochemical changes in maturing barley. I. Changes in malting and brewing characteristics. Crop Sci. 11: 85-88.

Reddy, L.V., T.M. Ching and R.J. Metzger. 1984. Alpha-amylase activity in wheat kernels matured and germinated under different temperature conditions. Cereal Chem. 61: 228-231.

Shorina, O.S., A.B. Vakar and V.L. Kratovich. 1967. Physio-chemical changes during sprouting of wheat. III. Disulphide bonds and sulphydryl groups. Pril I Biokem Mikorbiol. 3: 379-382.

Singh, N., K.S. Sekhon and H.P.S. Nagi. 1987. Laboratory sprout damage and effect of heat treatment on milling and baking properties of Indian wheats. J. Food Sci. 52: 176-179.