Plant Archives Vol. 20 No. 1, 2020 pp. 1448-1452 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

THE INFLUENCE OF FACTORS IN DAMAGE STARCH RATIO OF THE LOCAL WHEAT FLOUR AND BREAD MAKING

N.F. Hassan[1] and M.A. Musa[2]

[1]Agricultural Research Ministry Trade, Iraq.
[2]Department of food Science, College of Agriculture Engineering Science, University of Baghdad, Iraq.

Abstract

The effect of tempering level of wheat grains for local bread wheat varieties (Abu Ghraib, Ibaa 99, Al-Rasheed) was investigated. The results showed that the high tempering level of the grains from 13.5% to 16% resulted in a significant decrease in the average value of the damage starch on the three varieties. It also led to a significant increase in the value of the index of Gluten. The results of farinograph test showed a significant decrease in the water absorption values and a significant increase in the stability values among the moisture varieties at (13.5% and 16%). Therefore, the results showed a significant increase in the rate of sensory evaluation between the moisturized wheat varieties at 13.5% and 16% (83.79% and 88.53% respectively). (20.5) and (22) for the level of tempering (13.5% and 16%) as well as for the rational class (35.8) and (36). The results showed that there were significant differences in the percentage of water absorption of the parent group Ibaa 99 and AL-Rasheed as well as a significant increase in the maturity value of AL-Rasheed variety.

Key words: damage starch, Wheat flour, tempering of wheat

Introduction

Wheat (*Triticum aestivum*) ranks first in terms of area and production in the world. It is considerably a staple food for more than one third of the world population, and is important for its High Gluten content, which is the basic protein to produce good quality and suitable for the bread industry (Jamali *et al.,* 2000). The Global wheat production for 2019 was 2,685 million tonnes, indicating an increase of 1.2% compared to 2018. It is currently projected at approximately 2771 million tonnes, up 5.6% from the year-earlier (FAO, 2019). The past. Global cereal use in 2019/2020 is expected to increase marginally from June, exceeding 2708 million tonnes, 1.0 percent higher than in 2018-2019. Total wheat use is expected to reach 758 million tonnes, 1.5 percent higher than in 2018-2019. There are three main wheat varieties of the genus Triticum: *T. aestivum*, *T. durum* and *T. compactum*. The first type is the source of bread wheat which its flour is relatively high in protein. good quality, as well as its starch content that provides the yeast needs of sugars (Morrison *et al.,* 1994).Wheat is grown as edible grains and many products are made from it into flour with the addition of water and other ingredients to produce bread, biscuits and other confectionery products, pasta and spaghetti. They can also be used or their by-products for animal feed (Saadoun, 2016). Gluten and starch are important functional ingredients in wheat flour, for this reason wheat use in food and non-food products is widely applied to these compounds is related (Frederix *et al.,* 2004). Starch is one of the main carbohydrates stored in most cereals, including the endosperm, where it accounts for 60-75% of the dry weight of the grain and is the most abundant ingredient in wheat flour and plays a nutritional vital role (Lineback and Rasper, 2009). The amount of starch energy is about 1550 kilojoules / 100 grams, the importance of starch comes second after the kidneys in determining the quality of bread and other fermented products during the process of grinding produces quantities of mechanically modified starch, which is called damage starch(DS) and is represented by starch particles cut into pieces not only increase water absorption and affects the rheology dough, it also increases the readiness of the food for the yeast and is more ready for the work of the enzyme Alpha Amylase, that the quality of bread requires certain amounts of this starch as the increase of damaged starch increases the ability of the flour to retain water; resulting in the viscosity of the dough, a strong texture of bread, brown Junk for the crust (Barrera *et al.*, 2012). Mills can adjust

the DS content of flour by choosing wheat, adjusting the grain and adjusting the factors that increase the percentage of DS in the mill. Tempering wheat is an important step for the miller before grinding; it is simply an conditioning process used to enhance grain properties by adding water to soften the endosperm (Steven & John, 2005). The millers conduct the Tempering process of the wheat before grinding to tighten the bran layers until they stick together, to prevent the presence of flour bran powder that can darken its color and easily separate the structures of the kernel (Hourston *et al.*, 2017). The increase of the moisture content during the grinding process benefits the millers by increasing the weight of the flour and the extraction rate, so this work was to study the effecting of tempering level on damage starch which was important factor on bread quality.

Material and Methods

Wheat samples used

Triticum aestivum wheat varieties were used for the marketing season of 2018 (Abu Ghraib, Rasheed, Iba99) From the Bain ALnahreen Company of the Ministry of Agriculture, *Saccharomayces cerevisiae* (yeast), Bakmaya, morning butter, salt and sugar were purchased from local markets.

Grain Purification: Grain purification and isolation from fracture, atrophy grain and impurities based on grain size was using a French origin NSP from CHOPIN.

Wheat moisture content: the raw wheat moisture content was estimated by Measure D 1200 AACC 44-01.01 (2010) for wheat grains.

Grain tempering process: The wheat samples were moisturized with normal tap water at room temperature by adding a quantity of water to in a samples.

$$Q = \frac{W_i(M_f - M_i)}{100 - M_f}$$

where:

Q - amount of water, g

W_i - initial mass of the sample, kg

M_i - initial moisture content of the sample, % d.b.

M_f - final moisture content of sample, % d.b.

The grain was left after moisturizing and stirring several times for 24 hours, and the wheat moisture content was in one go until it reached 16% for the first treatment and 13.5% for the second treatment.

Grain milling: The wheat samples were milled with a laboratory mill Buhler, Switzerland, 202 AACC 26-31.01 (2010).Then the flour was stored in polyethylene bags in the refrigerator at a temperature (4-5)°C till the subsequent tests.

Determination of the chemical components of flour:

Estimation of wet (total) and Gluten index by using Glutomatic 2200 as in AACC (2000) (38-12.02).

Falling number: The fall number was estimated as stated in AACC 56–81.03 (2010).

Farinograph Test

The farinograph test was performed according to the method mentioned in AACC (2000) No.(54-21).The following characteristics were obtained from the diagram of the farinograph test:1-Water absorption % 2-Dough development time 3 – Stability.

Baking tests: Straight dough method was defined (AACC (2000) (10-10) according to the method mentioned in AACC (2000) and numbered (10-10).

Sensible Evaluation of Loof: According to the form in (Zubaidi, 2009).

Determination of the percentage of damaged starch: was used several imported from Earland company and according to the color method as stated in AACC 76-31A and using a spectrophotometer.

Statistical analysis:

Statistical Analysis System: (2012) - SAS (Cave *et al.*, (2012)) was used to analyze the data to study the effect of different coefficients in the studied traits according to a Completely Randomized Design CRD. Significant Difference - LDS.

Results and Discussion

Effect of tempering levels of wheat grains on the percentage of starch damaged in flour

Table 1 shows the effect of tempering levels on the percentage of DS. Increasing the tempering level of wheat grains to 16% gave a lower rate of DS for the three varieties compared with the tempering levels of

Table 1: The Effect of tempering levels of wheat grains on the percentage of starch damaged in local wheat flour.

content of starch damaged% levels of tempering%		Varieties
16%	13.5%	
12.500	12.000	Abu Ghraib
11.690	10.550	Ibaa 99
10.597	9.880	Rashid
0.321*		LDS 5%
11.596	10.810	Average
0.186**		LDS 5%

13.5% 16% at 10.81% and 11.59% respectively. The differences we significant at the level of 0.01. Porai *et al.*, (2012), showed that the tempering time has an effect on the percentage of DS as it decreased from 7.1% and 6.62 when tempering time increased from 24 to36 hours, Baik & Green (2019) founded by assessing the quality of some experimental lines that The affected damage starch ranged between (1.13-6.62)% and the moisture content in flour was (13.6-14%).

The Effect of tempering Levels of Wheat Grain on Specific volume of Bread

Table 2 shows the presence of high significant differences in the specific volume due to the different tempering percentage of the local wheat varieties. The high tempering rates led to decrease the average values of the specific volume as the highest value of the specific volume was (4.66) g / cm3 It is showed that the specific volume (4.64 g / cm3) of Ibaa99 with the 13.5% M.C was reduced with 13.5 M.C by 16% M.C the increasing tempering levels led to higher percentage of DS as shown in Table 1 which is an additional cause of getting sugars in dough and increased yeast activity which Reflect its impact on increasing the specific volume, and the lowest value 3.03 g/cm³ for the class of Abu Ghraib, with 16% M.C.

Table 2: The Effect of tempering Levels of Wheat Grain on Specific volume of Bread of Local Wheat Varieties.

Average	Specific volume g/cm³ levels of tempering%		Varieties
	13.5%	16%	
3.065	3.030	3.100	Abu Ghraib
4.160	3.680	4.640	Ibaa 99
4.630	4.667	4.593	Rashid
0.076**	0.107**		LDS 5%
	3.792	4.111	Average
	0.062**		LDS 5%

Effect of tempering levels of wheat grains on the ratio of wet gluten

Table 3 shows that there are no significant differences in the ratio of wet gluten to local wheat varieties. There was no significant increase in the average percentage of wet gluten for tempered varieties at 13.5 and 16%, since the amount of gluten is a constant characteristic for each variety but is affected by genetic factors and environmental conditions.

Effect of tempering levels of Grains on the Gluten Index

It is noted from Table 4 that the increase of the tempering levels to 16% gave the highest average 66.0% of G index ,compared with the tempering levels of 13.5% ,which gave the lowest value of 53.93%. The increase in the percentage of tempering increased from 13.5% to 16%. You should at least The gluten index of flour used for bread production is 55%, while Curic *et al.*, (2001) stated that the gluten index should be at least 75% for the production of good bread. The Gluten index is a quick test to measure the quality of wheat flour. A successful alternative to conventional tests such as Farinograph and Mixograph, represent a standard tests that determine the quality of gluten, the strength of the gluten network and the suitability of flour for the bread industry, for this reason, it has gained wide acceptance in international trade standards (Oikonomou *et al.*, 2015).

Table 3: The Effect of tempering levels of Wheat Grain on Wet Gluten Ratio of Flour.

wet gluten%levels of tempering%		Varieties
13.5%	16%	
22.000	20.500	Abu Ghraib
19.667	28.100	Ibaa 99
36.000	35.800	Rashid
NS		LDS 5%
25.889	28.133	Average
NS		LDS 5%

Table 4: Effect of tempering levels in G Index% of Local Wheat Flour.

% Gluten Index levels of tempering		Varieties
13.5%	16%	
50.000	7.900	Abu Ghraib
65.000	77.900	Ibaa 99
83.000	76.000	Rashid
2.773**		LDS 5%
66.000	53.933	Average
1.601**		LDS 5%

Effect of tempering levels on F.N values of local wheat varieties

It is noted from Table 5 that the increase in the tempering levels led to a decrease in the values of the fall number and the values of the fall number of the varieties (Abu Ghraib, Ibaa 99 & Rashid) were (476,

Table 5: Effect of tempering Levels on Falling Number Values of Local Wheat Flour.

F.N. sec. levels of tempering %		Varieties
13.5%	16%	
469.00	476.00	Abu Ghraib
404.00	371.00	Ibaa 99
638.00	674.33	Rashid
34.58*		LDS 5%
503.67	507.11	Average
NS		LDS 5%

674, 371) sec. respectively at 13.5% tempering level,(469, 404, 638) sec at 16% tempering level. Increasing the tempering levels led to decrease content of the DS which led to a decrease the speed of attacking the amylase enzymes. Liu *et al.*, (2014) indicated that Amylase enzymes attack the damaged starch granules faster than healthy starch granule.

Effect of tempering levels of wheat grains on the parameters of Farenograph flour test

Table 6 shows that the increase of tempering Levels of wheat grains resulted in a significant decrease in the rate of water absorption values% of the three wheat varieties. This is self-evident as moisturizing the grain increases the percentage of tempering In the flour product thus reduced its need for water to reach the line 500 units Brabender which is the line of appropriate textures. Hussein. (2003) showed that the lower the moisture content of the flour, the higher its absorption of water to form a paste of homogeneous strength.

Table 6: The Effect of tempering Levels on Percentage Water Absorption of Local Wheat Flour.

absorption % levels of tempering %		
13.5%	**16%**	**Varieties**
68.30	68.10	Abu Ghraib
63.77	66.20	Ibaa 99
63.90	66.30	Rashid
0.911**		LDS 5%
65.32	66.87	Average
0.526**		LDS 5%

Effect of Tempering levels on development time

Table 7 shows the effect of increasing the tempering levels from 13.5% to 16% on the development time in minutes of the dough. Alfen (2013) showed that there is a perfect correlation between the development time and wet gluten. The development time should not be less than 5 minutes for good bread quality (Edwards, 2007), while (lons, 2009) suggested that The optimal value of Farinograph for the acceptable dough development time for baking products ranges from (2-6) min.

Table 7: The Effect of tempering levels on development time of Local Wheat Flour.

Development time min. levels of tempering%		Varieties
16%	**13.5%**	
1.900	2.200	Abu Ghraib
5.500	5.500	Ibaa 99
6.300	5.000	Rashid
0.689**		LDS 5%
4.567	4.233	Average
NS		LDS 5%

Effect of Tempering levels on the stability period

It is noted from Table 8 that there was a significant increase in the average stability values of the dough when the Tempering level increased to 16% and that the highest stability period was (6.9) minutes for Rasheed variety at the level of tempering 16%. The duration of dough stability is defined as the time difference between the point of contact of the line diagram 500 units Brabender and the point of departure of the scheme 500 units Brabender This is one of the most important readings Farinograph because it determines the quality of flour and the pressure endures during the stages of baking (Almosafir, 2016), and explained Edwards, (2007) Soft wheat flour ranges from 3 to 5 minutes.

Table 8: The Effect of tempering levels on Stability of Local Wheat Flour.

Stability time min. levels of tempering %		
13.5%	**16%**	**Varieties**
2.400	2.000	Abu Ghraib
4.500	5.700	Ibaa 99
6.900	4.500	Rashid
0.586**		LDS 5%
4.600	4.067	Average
0.338**		LDS 5%

Table 9: Effect of tempering levels on sensible evaluation of bread produced from local wheat varieties.

Stability time min. levels of tempering %		
13.5%	**16%**	**Varieties**
80.680	66.600	Abu Ghraib
87.580	92.530	Ibaa 99
97.340	92.243	Rashid
1.183**		LDS 5%
88.533	83.791	Average
0.683**		LDS 5%

It is noted from table 9 the degree of sensory evaluation of bread produced from the three wheat

varieties tempered at the level of 13.5 and 16%. Sensory evaluation of the bread produced from the three varieties, as the increase of the tempering levels to 16% gave the highest average of the sensory calendar 88.53% compared to the tempering of 13.5% which gave a lower value 83.79%.

References

AACC (2000). Approved Methods of the American Association of Cereal Chemists, 10th ed. AACC, St. Paul, MN, USA.

AACC (2010). Approved Methods of the American Association of Cereal Chemists. 11th ed.

Alfeen, Farhan Ahmed (2013). Grain milling technology. Theoretical Department, College of Chemical and

Petroleum Engineering, Al-Baath University Publications, 49-33.

Almosafir, Alaa Mohammed Saleh (2016). Microwave-assisted antioxidant recovery Eliron wheat grain and embryo and bran and study its effect on the rheological characteristics of the dough. Doctoral dissertation. College University of Basra.

Barrera, G.N., A.E. Leo´n and P.D. Ribotta (2012). Effect of damaged on starch starch thermal behavior. *J. Int. Starch Sta¨rke.*, **64:** 786–793. doi:10.1002/star.201200022.

Byung-Kee Baik and Dave Green (2019). Milling and Baking Test Results for Eastern Soft Wheats Harvested in 2018. USDA-ARS-CSWQRU Soft Wheat Quality Laboratory OARDC-OSU 1680 Madison Avenue Wooster, Ohio 44691 byungkee.baik@ars.usda.gov.

Curic, D., D. Karlovic, D. Tušak, B. Petrovic and J. Đugum (2001). Gluten as a standard of wheat flour quality. *Food Technology and Biotechnology,* **4(39):** 353-361.

Edward, P.W. (2007). Flour Testing in: Science of Baking Products. First ed. The Royal Society of chemistry. P. 139-153.

El-Porai, E.S., A.E. Salama, A.M. Sharaf, A.I. Hegazy and M.G.E. Gadallah (2013). Effect of different milling processes on Egyptian wheat flour properties and pan bread quality. *Ann. Agric. Sci.,* **58:** 51–59. doi:10.1016/j.aoas.2013.01.008.

FAO (2019). Food and Agriculture Organization of the United Nations.

Frederix, S.A., C.M. Courtin and J.A. Delcour (2004). Influence of process parameters on yield and composition of gluten fractions obtained in a laboratory scale dough batter procedure. *Journal of Cereal Science,* **39:** 29-36.

Hourston, J.E., M. Ignatz, M. Reith, G. Leubner-Metzger and T. Steinbrecher (2017). Biomechanical Properties of Wheat Grains: The Implications on Milling. *Journal of The Royal Society Interface,* **14(126):** pp. 1-12.

Hussein, Kamal Roshdy Fouad (2003). Chemistry of cereals and its products. Ain-Shams University. faculty of Agriculture.

Jamali, K.D., M.A. Arain and M. Mhamd (2000). Comparative performance of semi-dwarf wheat (*Triticum aestivum*) genotypes. *Wheat Information Service,* **90:** 45-46.

Lineback, D.R. and V.F. Rasper (2009). Wheat Carbohydrates. In: Y. Pomeranz (Ed) Wheat: Chemistry and Technology. American Association of Cereal Chemists: St. Paul, Minn, USA.

Liu, C., L. Li, J. Hong, X. Zheng, K. Bian, Y. Sun and J. Zhang (2014). Effect of mechanically damaged starch on wheat flour, noodle and steamed bread making quality. *Int. J. Food Sci. Technol.,* **49:** 253-260.

Lons, M. (2009). Standards and methods Brabender GmbH and Co. KG Duisbury. Germany. 25p.

Morrison, W.R., R.F. Tester and M.J. Gidley (1994). Properties of damaged starch granules. II. Crystallinity, molecular order and gelatinisation of ball milled starches. *J. Cereal. Sci.,* **19:** 209–17. Crossref CASWeb of Science®Google Scholar.

Oikonomou, N.A., S. Bakalis, M.S. Rahman and M.K. Krokida (2015). Gluten index for wheat products: Main variables in affecting the value and nonlinear regression model. *International journal of food properties,* **18(1):** 1-11.

Saadoun, Abdullah Amin Abdul Aziz (2012). Study of the functional properties and nutritional value of some proteins isolated from some varieties of wheat. Master Thesis. Tikrit University College of Agriculture, Food Science Department.

Steven, J.L. and G.R. John (2005). Process for Tempering and Milling Grain. General Mills, Inc.US6887509B2.

Zubaidi, Abbas Hassan Hussein (2009). Practical book in grain processing. Ministry of Higher Education and Scientific Research - University of Baghdad - College of Agriculture. University House for Printing and Publishing.