Polymeric Proteins, Rheological Properties and BREAD Making Quality of Durum Wheat Flours and Semolina

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***Abstract*:** *Algerian commercial durum wheat flours and semolina from different millers was evaluated for flours/ Semolina mixed properties, dough physical characteristics and baking quality. Variation of protein fractions was studied. Durum flours and semolina exhibited higher glutenin concentration, medium SDS – unextractable polymeric proteins . All samples used in this study had higher starch damage and falling number value Starch damage affects negatively alveograph data (tenacity/extensibility ratio and deformation energy). Farinograph and mixograph indicated both flours and semolina rated best for bread making. Morphological image analysis was applied to characterise each bread crumb type. Bread made with flours characterised by smaller cells, thinner walls and finer crumb*

Keywords: *Durum flour, Durum semolina, Polymeric proteins, Alveograph, Farinograph, Mixograph, Image analysis.*

1. Introduction

Durum wheat is an important crop of Algerian diet used to produce several common foodstuffs such as couscous, pasta, frik and various types of traditional flat bread. Protein quality and quantity are considered primary factors in measuring the potential of flour/semolina in relation to end use. Stored proteins determine dough functional properties. In addition, quality is still heavily dependent on sevral other tests such as alveograph used to predict baking quality. It measures the resistance to biaxial extension obtained from a thin sheet of flour water- salt. The farinograph measures and records resistance of dough to mixing. It is used to evaluate water absorption and to determine stability and other characteristics of doughs during mixing. The mixograph measures the power used to mix the dough or the resistance to the dough. Baking is the final test and indicates the quality of final product. In this paper, proteins quantity and quality of durum wheat flours and semolina were investigated. Rheological and properties of products were assessed. Additionaly, breads were produced using standard method of bread making.

2. Materials and Methods

2.1 Samples

Twelve samples were used. Samples of commercial flour and semolina supplied from three industrial Millers with the same diagram of milling were durum flour (DS), durum first clear flour (DD1), durum first clear flour 4 (DD4), and Durum semolina (DS).

2.2 Physico-chemical properties

Protein content (%N X 5.7) was determined by the Kjeldahl method according to AACC approved method (46-19.01), Wet gluten content (%) is determined by washing the dough obtained from wheat flour/semolina, with 2% NaCl solution to remove the starch and other soluble compounds of the sample. Gluten index were determined using Glutomatic perten instruments (AB type 2200, Huddinge, Sweden) according to AACC standard method (38-12.02). Sodium dodecyl sulfate (SDS) sedimentation test for assessed the gluten strength. The SDS - sedimentation volume of wheat was determined by a modified method as described [1]. Starch Damage was determined using the kit Megazyme Starch Damage (Megazyme Int., Wicklow, Ireland). Falling number was determined according to ICC standard method using Falling Number 1500 (Perten Instruments AB, Sweden).

2.3 Proteins analysis

Determination of polymeric protein, gliadin, albumins + globulins (A+G) and SDS – unextractable polymeric proteins (UPP) carried out using respectively the method [2][3] and [4].

2.4 Rheological analysis

Alveogrpah properties of the flours/semolina were obtained using the method of the Chopin- sa, Villeneuve-la-Garenne – France. The resulting alveograms were used to detrmine the over – pressure (P,mm) as an indicator of dough tenacity or resistance to deformation, the deformation energy (W, 10^{-4}) required to inflate the dough-bubble until it ruptures. The configuration ratio P/L, an indicator of the rheological balance of the dough. Farinograph properties of the flours/semolina were obtaiened using the standard ICC Brabender Farinograph method (115/1). The farinograph was used to determine dough development time (Far DDT), farinograph stability (Far STAB), and mixing tolerance index (MTI). A complementary method of measuring dough mixing properties was applied using a mixographic. Parameters were determined in a 30 g Mixograph according to the AACC method 54-40A .The mixing parameters measured were Peak dough development (MTP, min), peak dough resistance (PDR, %).

2.5 Baking procedure

The Formulation, based BIPEA information, included flour/semolina (100 %), water (farinograph + 9 %), salt (2.2 %), yeast (2.5 %).

2.6 Image analysis

For image analysis leavend breads produced in durum flours and semolina. Easch loaf of bread was sliced in regular slices to characterize cell size with erosion- dilatation method [5].

3. Results and Discussion

3.1 Physico-chemical properties.

Characteristics of Algerian commercial durum flours and Semolina are shown in table I. The highest protein content was observed in DFCF4 which showed also the smallest gluten and , was poorly extensible , with a gluten index value 39 and medium sediment volume in sodium dodecyl sulphate, while Durum semolina was characterised by the lowest values of both proteins content and volume sediment. Results showed all durum flours and semolina had the highest value of falling number 478 to 567 s. The higher damage starch 8.13% and 7.12% were observed in DFCF4 and DF, respectively. In agreement [6], milling treatement had a large effect upon starch damage values.

TABLE I. Flours and semolina physico-chemical properties

Paramètres	DFCF1	DFCF4	DF	DS
Protéins (% dw)	10.83 ± 0.57	13,44 ± 0,40	11,37 ± 0.67	11,34 ± 0.13
Wet Gluten (%)	22.92± 3.07	24.45 ± 3.66	27.33 ± 3.53	26.54 ± 1.31
Gluten index(%ms)	58 ± 8	39 ± 4	48 ± 9	56 ± 7
SDS (ml)	50±4	45 ±6	45±7	31±3
FNS (S)	478±258	511±199	567±261	556±227
Starch damage (AE %)	6.86 ±0.9	8.13±0.94	7.12±0.95	5.93±2.37

3.2 Variation of protein fractions

The proportion of different fractions of protein of flour and semolina is illustrated in table II. Glutenin was the largest fraction ranging between 55,34 and 52,86%, DFCF4 showed the highest and DFCF1 the lowest. Glutenin: Gliadin (Glu: Gli) ranged between 1.49 and 1.80, the highest ratio for DFCF4 and the lowest for DS were observed. A+B were present in the lower proportion ranging between 11,06 and 14,91%. DFCF4 showed the highest proportion of A+ B among the samples studied while DS showed the lowest. UPP showed a wide variation among the flours / semolina with DFCF1 (43,3%) having the lowest and DF (47,90%) the highest proportion. The differences in extractability of the polymeric proteins could be attributed to differences in degree of polymerization (Singh et al, 2011).The difference of amount of UPP between samples can be explained from different quaternary structure [7].

TABLE II: Variation of protein fractions

Parameters	GLU%	GLI%	GLU :GLI	A+B%	UPP%
DFCF1	52,86±3,51	33,26±4,65	1,63±0,29	13,88±2,23	43,3±2,64
DFCF4	55,34±5,23	29,76±3,76	1,80±0,39	14,91±1,48	44,43±4.45
DF	53,58±2,5	32,21±0,8	1,67±0,07	14,21±2,91	47,90±3,03
DS	53,06±3,48.	35,88±0,90.	1,49±0,13	11,06±2,70.	47,83± 3,68

3.3 Rheological properties of flours/semolina

Table III give rheological data for flours and semolina. As for alveograph, P/L varied between flours and semolina. Tenacity was always higher than extensibility. Higher value of P/L was found in DFCF1. The high value of P/L depend both milling process and climate. The stressed milling and high temperature effect tenacity[8]. The work corresponding to the deformation of the dough ranged from 118 X 10^{-4}J in DFCF1 to 197 X 10^{-4}J in DS. The lower W of all samples can be attributed to higher value of P. W values are more influenced by pressure.

Based on farinograph DDT and stability (STAB), durum flour first clear 4 showed a higher dough development time than other fractions. Differences in DDT and STAB can attributed to gluten strength [9] and milling conditions [10]. Differences in peak dough development between flours and semolina estimated by the mixograph can explained with differences in proteins content and the glutenin fraction of protein [11].

TABLE III: Rheological properties of flours and semolina

Paramètres	DFCF1	DFCF4	DF	DS
ALVEOGRAPH				
W (10^{-4}J)	118± 12	114±35	140±31	197±29
P(mm)	97±12	100±29	104±17	132±14
P/L	3.0±0.9	3±0.9	3.0±0.6	4± 0.45
FARINOGRAPH				
DDT(min)	2.4±0.7	3.2 ±0.4	2.2±1.1	2.8±0.4
STAB (min)	3.9±0.1	4.0±0.9	4.5±1.0	4.9±2.1
MTI(BU)	57 ±0	59±6	73±19	63±20
MIXOGRAPH				
MTP(min)	1.91±1.06	1.30±0.15	1.54±0.46	2.66±0.59
PDR(%torque)	44.0±3.0	43.0±8.0	45.0±5.6	48.0±4.7

3.4 Crumb texture evaluation

Crumb morphological for bread of different types are shown in Fig 1. These images reveal differences in the cell size distribution crumb. Erosion- dilation (ERDIL) curves indicates accurate view of these changes (fig 2). The bread made with flours can be clearly distinguished to semolina bread. The crumb structure of bread flours content smaller cells, thinner walls and finer crumb.

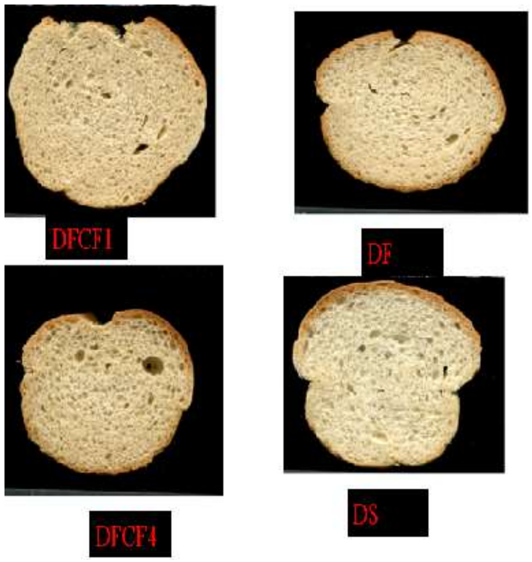

Fig. 1: Photographs of bread slices for different dough.

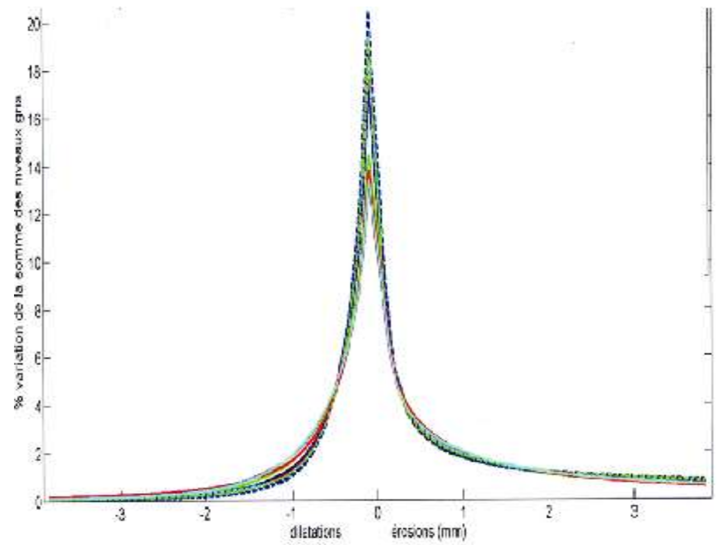

Fig. 2: Erosion- dilatation (ERDIL) curve for different dough.

4. Conclusion

The variations of protein fractions, rheological and bread making quality of Algerian durum wheat fractions (DFCF1, DFCF4, DF and DS) were studied. Breads of good qualities were obtained. The tests showed differences between different fractions. The general profile of alveograph curves of flour and semolina is generally revealed reduced dough extensibility and increased tenacity. The mixograph test and farinograph showed good baking quality of all fractions tested. Image analysis revealed the flours breads are finer crumb, small cells than semolina breads.

5. References

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