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Effect of Diastatic Malt Powder on Dough Rheology and Chemical Properties of Fortified White Wheat Flour

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ABSTRACT

In this research, composition of flours was prepared from White wheat flour (WWE) with supplementation of diastatic malt powder (DMP) in level of 0, 1, 2 and 3 percent. The effects of these treatments were measured on chemical, rheological and color. The result indicated that by increasing of the level of malt powder, water absorption and degree of softness decreased. The Highest level of moisture, crude ash, and protein was obtained in 3% of DMP whereas the lowest level of wet gluten was found in 3% of DMP. Highest score for Farinograph quality number (FQN) of composition of flours was record at 1% level of substitution. Hence it can be concluded that supplementation of DMP 1% is more suitable for fortification of WWE.

Keywords: *Diastatic, Dough, Farinograph, Flour, Malt powder, Rheology*

Introduction

Rheology is the study of deformation and flow properties of solids, semisolids and liquids. Rheological principles and theory can be used as an aid in process control and design, and as a tool in the simulation and prediction of the materials response to the complex flows and deformation conditions often in practical processing situations, which can be inaccessible to normal rheological measurement [1]. The viscoelastic properties of dough have a profound Effect on dough machinability of confectionary and baked product. A number of empirical tests have been developed it characterize dough rheology [2]. One such empirical test is the Farinograph. The Farinograph is a standard tool for generating information concerning the water absorption and mixing characteristics of flour. Water absorption is important to the generation of a farinogram. It is define as the amount of water required to center the peak area of a Farinograph curve on the 500 Brabender line for flour- water dough [2]. Other values obtained from the farinogram include development time, stability, Degree of softness and Farinograph quality number [3].

Malted barley is the source of the sugars (principally maltose). The purpose of malting is to create enzymes, break down the matrix surrounding the starch granules, prepare the starches for conversion, and then stop this action until the brewer is ready to utilize the grain. There are two basic varieties of barley, two rows, and six rows - referring to the arrangement of the kernels around the shaft. Two-row barley is the generally preferred variety, having a bit higher yield per pound, lower protein levels, and claiming a more refined flavor than six rows. However, six rows have a little lighter diastatic power than two rows [4] [5]. There are two types of malt. The two types are diastatic malt and non-diastatic malt. The two forms are powder and syrup. Diastatic Malt powder

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(DMP) made by sprouting a grain like wheat or barley, stopping the growing process after a few days. The sprouted grain is then carefully dried, the small roots rubbed off and the cleaned seeds ground (milled) into a powder. DMP contains a collection of enzymes that help the yeast to grow [4].

Table 1. Ingredients of MP for Fortification of WWF

Ingredient	Amount	Unit
Energy	361	Kcal
PH	6	-
Moisture	3.5	%
Ash	3	%
Fat	1.84	g/100 gr
Protein	10.3	%
Carbohydrate	78	g/100 gr
Crude Fiber	7.1	g/100 gr
Sodium(Na)	11	mg/100 gr
Calcium(Ca)	37	mg/100 gr
Iron(Fe)	4.71	mg/100 gr
Magnesium(Mg)	97	mg/100 gr
Phosphorus(p)	312	mg/100 gr
Zinc(Zn)	3.1	mg/100 gr
copper(Cu)	0.3	mg/100 gr
Manganese (Mn)	1.2	mg/100 gr
Selenium(se)	37.7	mg/100 gr
Thiamine(B_1)	0.72	mg/100 gr
Riboflavin(B_2)	0.31	mg/100 gr
Niacin(B_3)	5.6	mg/100 gr
Pyridoxine(B_6)	0.52	mg/100 gr
Folate(B_9)	38	µgr/100gr
α-amylase	44	ASBC
Diastatic power	433	WK
Particle size(mesh 180µ)	82	%

Materials And Methods

White wheat flour (WWF) was purchased from NC macaroon company, Karaj, Iran and Diastatic malt powder (DMP) was purchased from shahd gostare jahanbin company, shahrekord, ran. In table l. some important ingredients of DMP that were bought from shahd gostare jahanbin co. were shown. Admixed flour were prepared in order to replace 0 (T_0), 1(T_1), 2(T_2) and 3(T_3) % of WWF with DMP (Table 2).

The moisture content (Oven method, D-63450-UT-6, Heraeus, Germany), curde protein (Micro kjeldahl method, Gerhardt, Germany), curde Fat (Soxhlet method, extractor Duran 50 m lit) and curd ash (FR570-SN-FU-10, Galenhump, England) of composition of WWF and malt powder, was determined respectively according to AACC approved methods 44-16, 46-12, 30-10 and 08-01, (AACC,1990)[6]. The quantity of wet gluten, falling number (Perten-FN-14-109, Sweden) and pH (pH meter, CH- 1 Herisau 744, Metrohm, Switzerland) was measured according to AACC approved standards 38-10, 56-81b, (1995)[7]. A Hunter Lab Colorimeter (Model Color Flex EZ Hunter lab, CX 1, USA) was used to measure the L*, a* and b* according to AACC (1990) method 50-10. The color volumes were recorded as "L" (0 black; 100 white), "a" (-a greenness; +a redness) and "b" (-b blueness; +b yellowness). The effect of different levels of malt powder on the rheological behavior of dough was determined by Brabender Farinograph (E810112, Germany). The mixer bowl with three hundred grams capacity was used in the experiment, that it is, mixing speed was 63.1 rpm and according to AACC method 54-21 (1995) operated at 30℃. The parameters measured by software included Consistency (CO), water absorption (WA), development time (DT), stability (S), degree of softness (DOS) and Farinograph quality number (FQN).

Table 2. Treatments used in the study Treatments

Treatments	White Wheat Flour (%)	Diastatic Malt Powder (%)
T_0	100	0
T_1	99	1
T_2	98	2
T_3	97	3

Means sharing the same letters in a column are not significantly different ($P<0.05$)

Statistical Analysis

All experiments conducted in triplicate and analyzed by one-way analysis of variance ANOVA. (SPSS software version 19.0 2010 IBM) LSD and Duncan tests were used to compare the mean squares at difference level of $p< 0.05$.

Results And Discussion

Table.3 indicates the average of pH, wet gluten, Moisture, crude protein, crude fat, crude ash and falling number of the DM and wheat flours. The content of moisture, crude protein, crude fat and crude ash by increasing the level of DMP. This is 'probably due to the highest levels of DMP in T_1, T_2, T_3, in comparison with T_0 (control). The same results obtained by Yarmand and et al (2005)[8].

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Table 3. Effect of DMP on chemical properties of WWF

Treatments	pH	Wet gluten	Moisture	Crude Protein	Crude Fat	Curd Ash	Falling number
T_0	6.3 [a]	30.86 [a]	10.58 [a]	11.60 [a]	0.95 [a]	0.55 [a]	622[d]
T_1	6.3 [a]	32.95 [a]	9.72 [a]	11.62 [a]	1.35[b]	0.45 [a]	279 [C]
T_2	6.3 [a]	30.73 [a]	10.19 [a]	11.59 [a]	1.85[c]	0.56 [a]	220.5[b]
T_3	6.3 [a]	22.25 [a]	11.90[b]	11.76 [a]	2.00[C]	0.85 [a]	174.5 [a]

Means sharing the same letters in a column are not significantly different (P<0.05)

On the other hand, by increasing of DMP level content of wet gluten and falling number decreased. Adding DMP destroyed texture of dough, in that manner, the least content of wet gluten obtained in T_3. Adding DMP on WWF, increased enzymatic activity in T_1, T_2 and T_3, consequently, rate of falling number decreased. Treatment of T_0 had the lowest enzymatic activity (the highest rate of Falling number) so, all of treatments had significant difference. The results were same with Yarmand and et al,.(2005). Increasing of DMP had no effect on pH parameter in those treatments (Table. 3, fig.1). Adding DMP, resulted loss of WWF brightness (L*) and decrease in yellowness (b*) that probably is due to DMP color and particles in the flour whereas redness Index (a*) had increased with significant difference on treatments (Table 4).

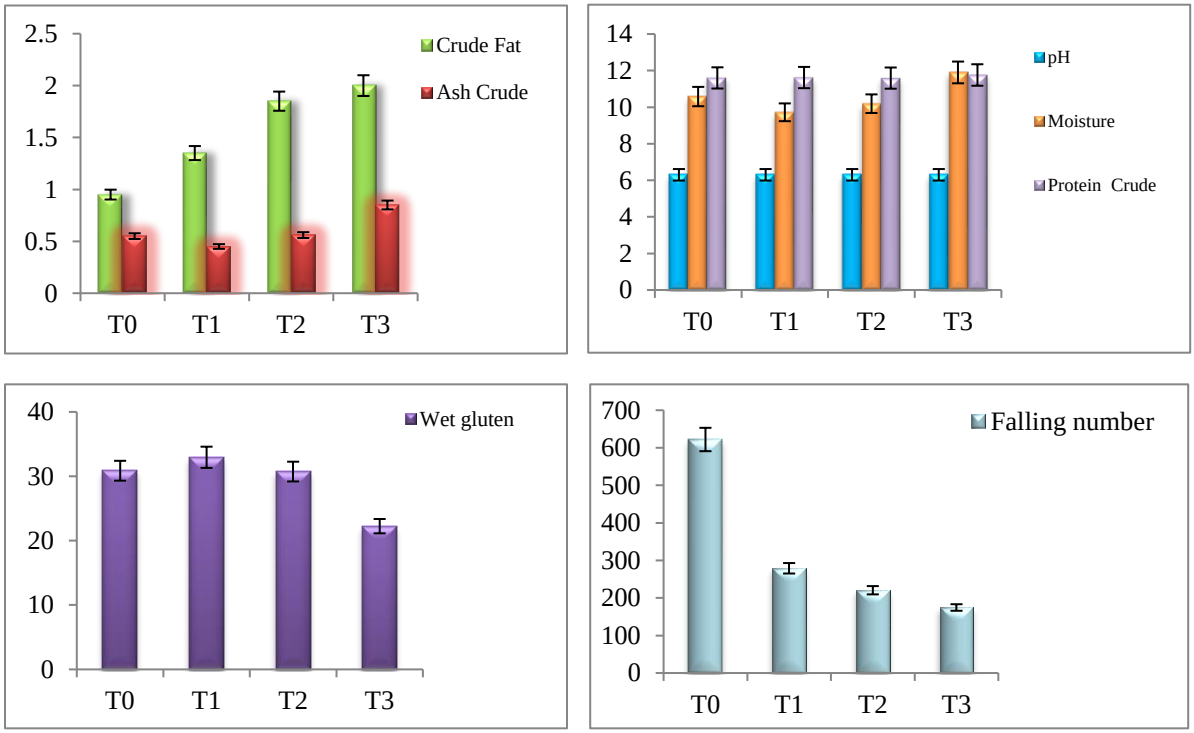


Fig. 1. Effect of DMP on chemical properties of WWF

Table 4. Effect of DMP on WWF brightness

Treatments	L*	a*	b*
T_0	91.32 [b]	0.51 [a]	12.17[a]
T_1	90.92 [ab]	0.5 [a]	12.03[a]
T_2	90.60 [a]	0.62[b]	12 [a]
T_3	91.455[b]	0.58 [ab]	12.005[a]

Means sharing the same letters in a column are not significantly different (P<0.05)

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The results were not the same with Yarmands and et al,.(2005) Parameter in those treatments (Table 3). The particle size of DMP was larger than wheat flour and it was also due to using whole DMP and presence of bran particle in the flour. Comparison of average for consistency (FU) and water absorption of dough, showed a decreasing trend that by the caused proportionate increase of DMP supplementation, although there was no significant difference between treatments (Table 5). DMP had obvious effects on dough rheology properties. Farinograph characteristic had many changes, so water absorption decreased by increasing of DMP, The same results obtained by Khalil (2000)[9].

Table 5. Effect of DMP on rheological properties of WWF

Treatments	CO	WA	DT	S	DOS 10 min after start	DOS 20 min after start	FQN
T_0	548 ^{a}	53.9 ^{a}	1.45 ^{a}	2.1 ^{a}	79.5 ^{a}	100.5 ^{a}	23.5 ^{a}
T_1	547 ^{a}	53.9 ^{a}	1.85 ^{a}	3.2 ^{a}	98.5 ^{ab}	130 ^{ab}	26.5 ^{a}
T_2	530 ^{a}	52.7 ^{a}	1.35 ^{a}	2.45 ^{a}	106.5 ^{ab}	136 ^{ab}	20.5 ^{a}
T_3	526 ^{a}	52.0 ^{a}	1.2 ^{a}	2.0 ^{a}	128.5 ^{b}	156.5 ^{b}	18.5 ^{a}

Means sharing the same letters in a column are not significantly different (P<0.05)

Generally, high moisture and enzymatic activity in DMP caused decreasing of water absorption. Maximum of Development time (DT) and stability (S) obtained in T_1 treatment. Adding DMP on 2 and 3 level decreased DT and S parameters. The quantity of dough softness increased by increasing DMP level 10 minutes after addition and 20 minutes before maximum. The same results were obtained by Yarmand and et al,. (2005). As shown in table 5, and fig.2 maximum of Farinograph quality number (FQN) obtained in T_1, so T_1 was the best treatment, and T_3 was the worst. T_0 and T_2 were moderate. As seen, there is no significant difference because there is no significant among the scores of FQN (fig.2 and 3).

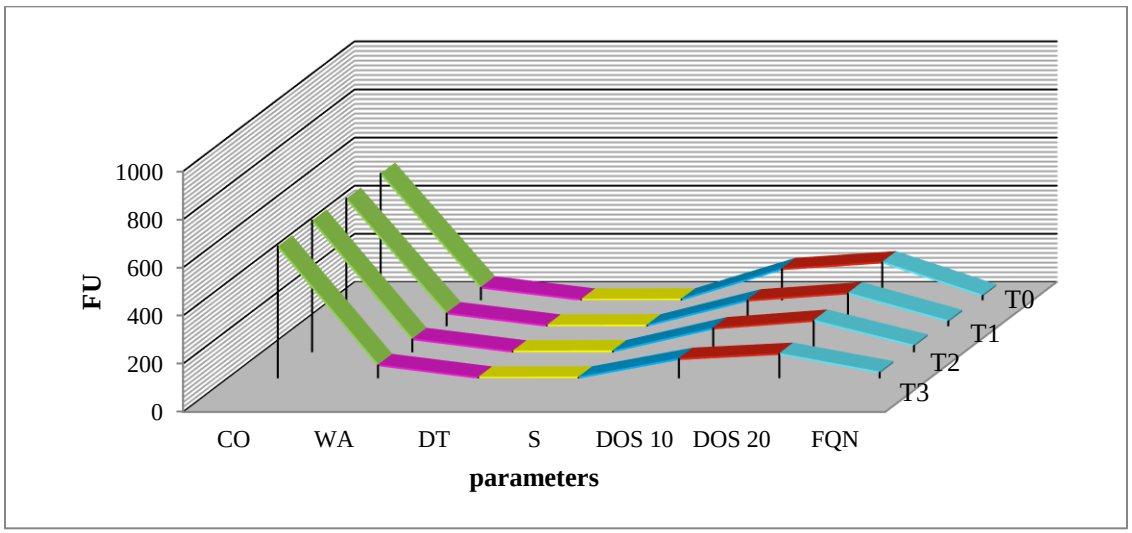


Fig. 2. Effect of 0(T_0), 1(T_1), 2(T_2), 3(T_3) % DMP on the parameters of Farinograph

Conclusion

Adding DMP on WWF, generally was affected decrease of water absorption capacity, stability, and development time. The proteins in DMP caused nutrient value improvement in wheat flour but the lack of gluten had a negative impact on the dough. The characteristic of WWF and dough were modified to different extents by addition of DMP.

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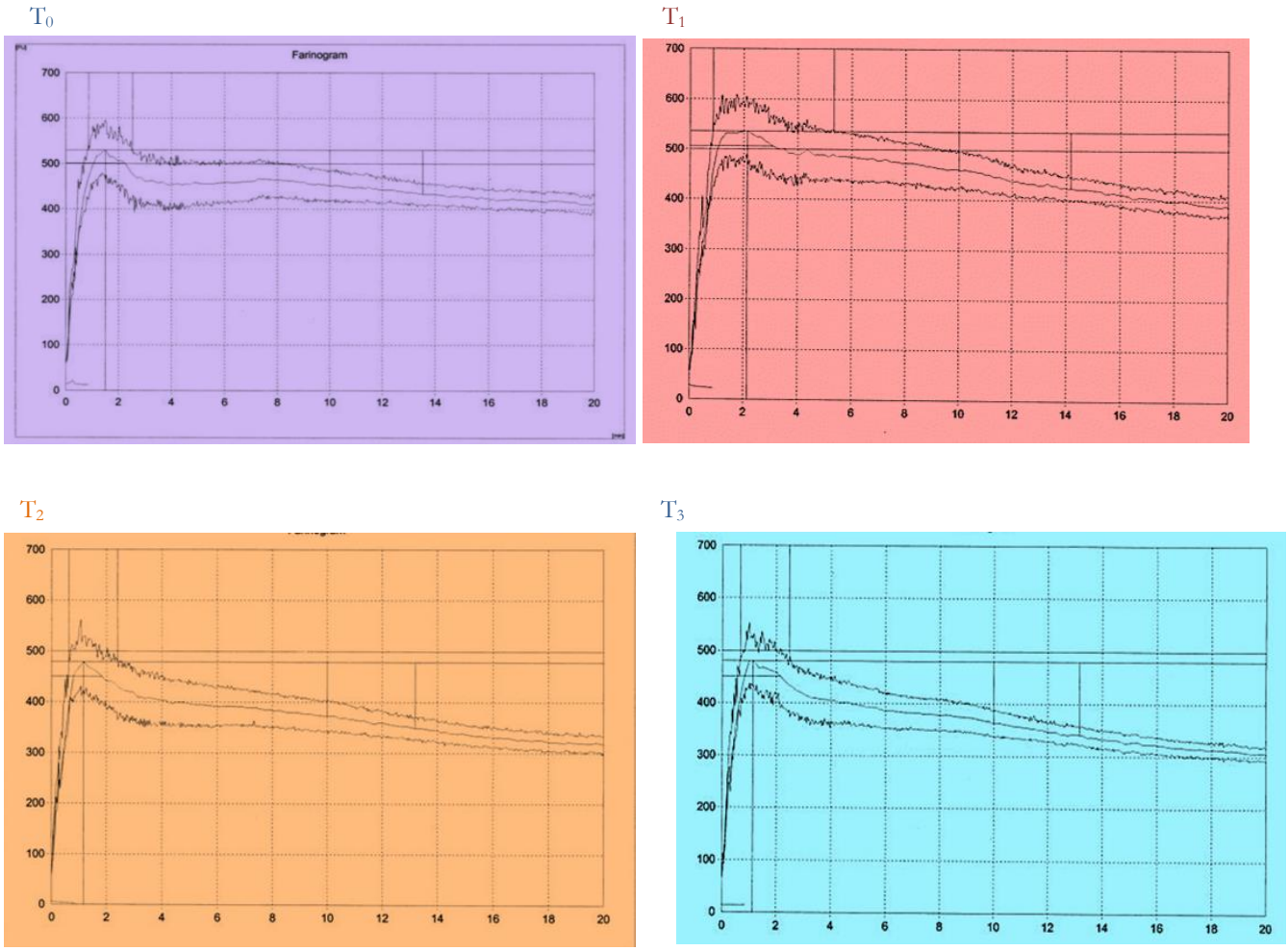


Fig. 3. Differences of farinogram 0(T_0), 1(T_1), 2(T_2), 3(T_3) % DMP on Farinograph properties of WWF

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