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Farinograph as a Rheological Tool to Predict the Quality Characteristics for Blend of Wheat with Pulse Flour

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ABSTRACT

Wheat is one of the most widely grown food grain crop in the world. Durum and bread wheat (Triticum durum and T. aestivum) constitute the base for human food. The Durum wheat (Triticum turgidum L. var durum) has the high grain quality and it is the main source of semolina for the production of pasta, couscous, and grain for burgher. Although production of wheat has not been sufficient to meet the increasing demand to satisfy human needs. Recently, new efforts have been systematically undertaken to replace part of the wheat flour by other sources. Legumes are a rich source of protein and contain approximately three times more proteins than cereals and high in lysine. The grain quality is important for processing of these end products, particularly the protein content and the gluten strength. For this reason, the rheological characterization of wheat flour dough is essential in bakery industry. Traditional dough testing instruments such as Farinograph, Mixograph, Alveograph, Extensograph,Mixograph, Amylograph, Maturograph, etc., have become important tests to asses and predict the quality of the finished bakery products. The Farinograph test is the importance of requirements of the industry and export markets. It measures the dough properties by measuring the resistance of dough against the mixing action of paddles (blades).It is generally used to determine water absorption required to make dough, to evaluate the effects of ingredients on mixing properties and to check blending requirement for dough development, tolerance to over mixing and dough consistency during production. In addition farinograph used to predict product texture characteristics. Therefore the present investigation was carried out to prepared the pulse flour blend [pea flour and lentil flour were mixed at 1:1ratio] and this blend was replaced with durum semolina for 15%, 30% and 45% to assess the pasta quality by farinograph. The result showed that 15% of pulse flour blend had dough water absorption (60.3%) and stability time (2.6min) were high and tolerance index was lower (62.6FU) than 30% and 45% of pulse flour blend replaced with wheat flour. These finding suggested that 15% of pulse flour blend had relative to dough properties of durum semolina (control) which was suitable for good quality of pasta and other bakery products.

Keywords: Durum semolina– Pulse flour blend – Farinograph – Dough properties

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1. INTRODUCTION

Wheat is one of the most widely grown food grain crop in the world. Durum and bread wheat (*Triticum durum* and *T. aestivum*) constitute the base for human food. The annual world durum wheat production was estimated at 33 million tons (CWB2001). Durum wheat (*Triticum turgidum* L. var *durum*) is a tetraploid constituted of A and B genomes (AABB) and is the main source of semolina for the production of pasta, couscous, and grain for burgher. Pasta is one of the primary extruded foods made from durum wheat. Pasta products largely consumed all over the world and are traditionally manufactured from durum wheat semolina, which was the best raw material suitable for pasta production (Feillet and Dexter, 1996). Pasta products are high in starch, but low in proteins and dietary fibers and are mainly made up of hard wheat flour which is deficient in lysine, an essential amino acid. Legumes are a rich source of protein and contain approximately three times more proteins than cereals and high in lysine. Grain legume enhances the protein content of cereal-based diets and may improve the nutritional status of the cereal-based diets. Even if production of wheat has not been sufficient to meet the increasing demand to satisfy the human needs. Recently, new efforts have been systematically undertaken to replace part of the wheat flour by other sources and it has became important to improve the quality of pasta by the addition of other ingredients. Hence the legume such as dry peas (Pisum sativums sp. arvense), lentil (Lens culinaris) were good source of protein, high in dietary fiber, folate, manganese, phosphorous, thiamin and phytochemicals. So these legume flours as peas (dry) and lentil were mixed at equal quantity and it's substituted with durum wheat semolina for multigrain blends helps to mix different whole grains to maximize their nutritional, functional and sensory properties. The grain quality is important for processing of these end products, particularly the protein content and the gluten strength. For this reason, the rheological characterization of wheat flour dough is essential in bakery industry. Traditional dough testing instruments such as Farinograph, Mixograph, Alveograph, Extensograph, Mixograph, Amylograph, Maturograph, etc., have become important tests to asses and predict the quality of the finished bakery products. With the special instruments, such as Farinograph, assess the dough rheological parameters can be performed (Liu *et al*., 2005). The Farinograph test is the importance of requirements for the industry and export markets. The resistance of dough is evaluated by the Farinograph test, which

means the evaluation of behaviour of dough against mixing at a specified constant speed with specified water addition (ISO 5530-1:2013). Farinograph measures the dough properties by measuring the resistance of dough against the mixing action of paddles (blades).It is generally used to determine water absorption required to make dough, to evaluate the effects of ingredients on mixing properties and to check blending requirement for dough development, tolerance to over mixing and dough consistency during production. In addition farinograph used to predict product texture characteristics. For example strong dough properties are related to firm product texture. Weak flour has lower water absorption and short stability time than strong flour reported by Sewa Ram and Mishra (2010).The dough parameters determined by farinograph test are consistency, farinograph unit (FU), water absorption capacity, dough development time, stability, mixing tolerance index, time to breakdown and farinograph quality number (FQN) (D'Appolonia &Kunerth,1984). The different baking products require wheat with different quality. Therefore the present investigation was carried out to prepared the pulse flour blend [pea flour and lentil flour were mixed at 1:1ratio] and this blend was replaced with durum wheat semolina for 15%, 30% and 45% to assess the pasta quality by farinograph technique.

2. MATERIALS AND METHODS

2.1. Samples:

Durum wheat semolina *Triticum turgidum* L. var *durum*, peas (dry) (*Pisum sativums sp. arvense*) and lentil *(Lens culinaris)* were purchased from loyal world departmental store, Mysore, Karnataka, India.

2.2. Pre preparation of samples:

Durum wheat semolina, peas (dry) and lentil were cleaned by winnowed and milled into flour separately.

2.3. Preparations of pulse flour blend:

Peas (dry) flour and lentil flour were mixed equal quantity at 1:1 ratio

2.4. Preparations of composite flour:

Pulse flour blend was replaced with durum wheat semolina at 15% level for formulae 1, 30% level for formulae 2 and 45% level for formulae 3 respectively. Durum semolina was used as control.

2.5. Rheological properties of composite flour –Farinograph test:

Farinograph is one of the most widely used physical dough testing instruments in the world. It measures plasticity and mobility of dough that is subjected to prolonged relatively gentle mixing at constant temperature. Farinograph curves (C.W. Brabender Instruments, Inc., South Hackensack, NJ, USA) were generated according to AACC method 54-21 (AACC, 2000). The 50 g mixing bowl was used, in conjunction with the standard operating speed of 63 rpm. Resistance offered by the dough to mixing blades is transmitted trough a dynamometer to a pen that traces a curve on a kymograph chart (Brabender 1965). The resistance to mixing could also be measured with mixograph or resistogram. The farinograph used in this study is a Brabender OHG Duisburg/Germany with two mixing arms(Brabender 1965).The flour humidity is determined by weight before and after incubation for one hour at 130°C. Depending on the flour humidity, forty five to fifty grams of flour (14.0% mb) is used for farinograph test. The farinograph test indicates basically two important physical dough characteristics: 1) the absorption or amount of water (ml) required for a dough to have definite consistency (FAB); and 2) the behavior of the dough during mixing in graphical form.The curves were read manually and several parameters were recorded: farinograph water absorption (FAB, 14.0% mb), the amount of water required to centre the curve on the 500 BU line; Farinograph Stability Time (FST),the difference in time from when the top of the curve first reaches the 500 BU line (arrival time) to when it first leaves the 500 BU line (departure time); Farinograph dough Development Time (FDT), the time required to reach peak dough development; mixing tolerance index (MTI), the drop in the curve five minutes after peak development, measured in Brabender Units (BU) the highest BU values are related with weak dough strength, whereas small values are associated with strong dough.; and time to breakdown (TTB), the time from the start of mixing to the time at which the consistency decreases 30 BU from the peak. Farinograph index (FQN) of flour is a

measure index of flour quality and is measured on to farinogram horizontally (in minutes) from consistency vertical axis of dough to the point where the midline of the curve meets the horizontal line lowered by 30 UF from the point of maximum consistency, multiplies by 10. The higher this number the flour is even stronger (Gheorghe Constantin 2011).

2.6. Statistical Analysis:

A rheological property of samples was expressed at 14 per cent moisture and experiments were conducted in triplicates and the mean values and standard deviations were reported. Analysis of variance (ANOVA) was performed and the means were compared using Multiple Ranges Duncan's test ($p < 0.05$) using statistical software of INSTAT (Graphpad), USA.

3. RESULTS AND DISCUSSION

The rheological properties of samples were shown in Table.1.

Table 1: Rheological properties of samples dough analysis by farinograph test

Dough properties of samples	Control (100%)	Durum wheat flour substituted with Pea & lentil flour blends*			F value
		Formulae 1 (15%)	Formulae 2 (30%)	Formulae 3 (45%)	
Moisture (%)	9.1±0.1	8.3±0.1**	8.2±0.1**	7.8±0.1**	62.75
Consistency (FU)	504.6±1.1	495.6±1.7 ^{ns}	495.6±1.4 ^{ns}	487.6±1 ^{ns}	0.65
Water absorption (14% m.b)	61.9±0.4	60.3±0.2**	57±0.2**	53.1±0.2**	492.87
Development time (min)	2.3±0.15	2.6±0.1*	3.5±0.2**	4.2±0.05**	230.41
Stability (min)	2.7±0.3	2.6±0.04 ^{ns}	2.3±0.1**	2.3±0 **	9.78
Tolerance index (FU)	53.3±8.5	62.6±2.4*	91±3**	82.6±4.7**	91.08
Time to breakdown (min)	4.5±0.3	4.2±0.04 ^{ns}	5.1±0.2*	5.8±0.1**	74.58
Farinograph Quality Number	45.3±3.2	42.6±0.4 ^{ns}	51±2*	58.3±1.1**	36.05

Note: Control denotes 0% flour substitution; ***** For preparing pulses flour blends, all the flours were mixed at 1:1 ratio. The values are expressed as the mean of three replicate sampels ± standard deviation. *** = 0.1% Significance Level; ** = 1% Significance Level;* = 5% Significance level; NS = Not Significant

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The result showed that moisture content of control had 9.1%, formulae 1 had 8.3%, formulae 1 had 8.2% and formulae 3 had 7.8%.The dough consistency of the samples ranges from 487 FU to 504.6FU. The quantity of water required to flour to obtain dough with standard consistency 500-F.U ±20 for farinograph. The quantity of water is the percentage of water absorption capacity of flour. The water absorption capacity of control had 61.9%, formulae 1 had 60.3%, formulae 2 had 57% and formulae 3 had 53.1% from this result observed that water absorption capacity gradually decreased when increased in the quantity of pulse flour blend and also which was significant ($P<0.05$) to control. Further the dough development time of control had 2.3min, formulae 1 had 2.6min, formulae 2 had 3.5min and formulae 3 had 4.2min the outcome of this result expressed that pulse flour blend increased consequently increased in the dough development time and also which was significant ($P<0.05$) to control. In addition to that stability time of samples ranges from 2.3min to 2.7min from this result exposed that increased pulse flour blend concentration decreased dough stability time which was not significant to control ($P>0.05$).Furthermore the mixing tolerance index of control had 53.3FU and pulse flour blend had 62.6FU, 82.6FU and 91 FU for formulae 1, formulae 3 and formulae 2 respectively from this result showed that pulse flour blend substitution of durum wheat increased the tolerance index of dough and significant to control ($P<0.05$). While wheat flour replaced with pulse flour was an end result as weakened to wheat dough due to dilution of the gluten structure by present in pulse flour protein (Hefnawy *et al*. 2012). Moreover the time to breakdown of dough ranges from 4.2min to 5.8min and farinograph quality number of dough ranges from 42.6 to 58.3 from this result observed that high dough break down time and farinograph quantity number indicated that strong dough and also pulse flour blend at 15% was no significant ($P>0.05$) to control. From this result revealed that reported that water absorption capacity of formulae 1 and control indicated that strong flour and formulae 2 and formulae 3 were medium strength flour. The dough development time of all samples indicated that medium strength flour except formulae 3 which was strong flour. Further the mixing tolerance index of all samples indicated that medium strength flour according to Saldivar (2012).

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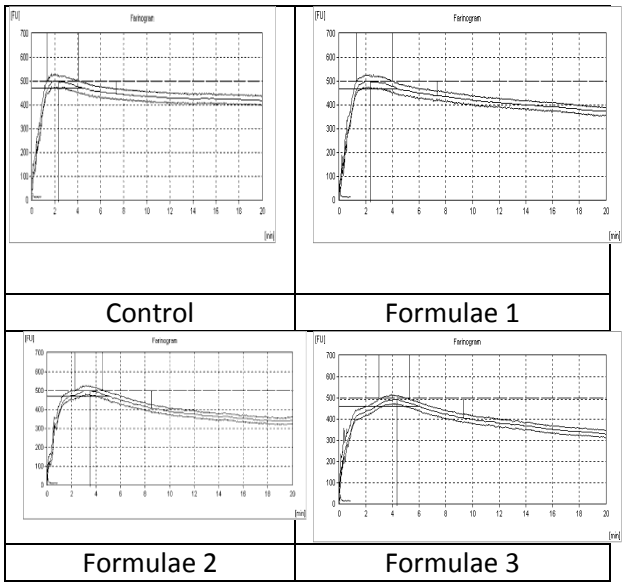

Figure1. Farinogram of control and composite flour

4. CONCLUSION

The present study of this result exposed that 15% of pulse flour blend substitution with durum wheat semolina (formulae 1) dough properties such as water absorption, dough development time ,dough stability time and tolerance index had relative to dough characteristics of control which was suitable for good quality of pasta and other pulse flour blend such as 30% and 45% for formulae 2 and formulae 3 were suitable for bakery products and also all the samples (Formulae1 to 3) were multigrain which help to fulfill the nutritional, functional and sensory properties. Hence the multigrain blend of dough properties are water absorption, dough development time, dough stability time, mixing tolerance index assessed by farinograph technique are significant and offer a high level of predictability. For this reason we believe that Farinograph rheological parameters can be used in evaluating the quality of flour.

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A Brief Author Biography

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