EVALUATION OF DURUM CLEAR FLOUR

A PROJECT REPORT FOR MASTER'S DEGREE

in

Food Engineering
University of Gaziantep

by
Gülben KILIÇ

February, 1999

Approval of the Graduate School of Natural and Applied Sciences.

Assoc.Prof. Dr. Ali Rıza Tekin
Director

I certify that this project satisfies all the requirements as a project for the degree of Master of Science.

Prof. Dr. Sami Eren
Chairman of the Department

I certify that I have read this project and in my opinion it is fully adequate in scope and quality, as a project for the degree of Master of Science.

Supervisor

Prof.Dr. Sami Eren

Examining Comittee in Charge

Assoc. Prof. Dr. A.Rıza Tekin ....

Prof. Dr. Sami Eren ....

Assoc. Prof. Dr. Fahrettin Göğüş ....

ABSTRACT

Evaluation of durum clear flour

Kılıç, Gülben

M.Sc. In Food Engineering

Supervisor: Prof. Dr. Sami Eren

February 1999, 65 pages

In this project, some investigations about on physical chemical and technological characteristics of triticum durum clear flour were presented. At these investigations, durum clear flour alone and blended with using some additives had been searched. The properties of clear flour blends with weak and strong wheat flour with the ratio of 100:0, 80:20, 60:40, 50:50 and 0:100 and the properties of the blends with the incorporation of ascorbic acid, sodium stearoyl lactylate (SSL), diacetyl tartaric acid esters of monoglyceride (DATAEM) and wheat gluten had been studied.

The results showed that bread with acceptable characteristics can be obtained with blends containing 25% durum first clear flour and 75% bread wheat flour by adding a combination of SSL (0.5%) and ascorbic acid (75 ppm). The sample with 15% durum clear flour was preferable for pizza making. Although the samples which contained durum clear flour was preferable for tasting, the sample which had more than %15 durum clear flour leads to undesirable texture and taste properties at pizza. According to the calculations, use of %15 durum clear flour instead of bread flour decreased the production cost by 7%.

Keywords: Clear flour, bread, flour blend, flour additives, damaged starch.

ÖZET

İrmik altı unlarının değerlendirilmesi

Kılıç, Gülben
Yüksek Lisans Projesi, Gıda Mühendisliği Bölümü
Proje Yöneticisi: Prof. Dr. Sami Eren

Şubat 1999, 65 sayfa

Bu projede triticum durum buğdayının irmik altı ununun fiziksel, kimyasal ve teknolojik özellikleri üzerine yapılmış araştırmalar sunulmuştur. Bu araştırmalarda irmik altı unu yalnız olarak, paçal yapılarak ve katkı maddeleri kullanılarak araştırılmıştır. İrmik altı ununun, zayıf ve kuvvetli ekmeklik unlarla 100:0, 80:20, 60:40, 50:50 ve 0:100 oranlarında karıştırılmasıyla paçallar hazırlanmış olup, bu paçalların özellikleri ve bu paçallara askorbik asit, sodyum stearoyl lactylate (SSL), monogliseridlerin diasetil tartarik asid esterleri (DATAEM) ve gluten katımının etkileri gözlenmiştir.

Sonuçlar uygun özelikte ekmeğin %25'lik irmik altı un %75'lik ekmeklik un paçalına %0.5 SSL ve 75 ppm askorbik asid katılımıyla elde edilebileceğini göstermiştir. Pizza yapımı için %15 lik irmik altı unu içeren örnek tercih edilmiştir. Pizza için irmik altı unu içeren örneklerin tercih edilmesine rağmen %15 den fazla irmik altı unu içeren örneklerin, istenmeyen yapısal ve tatsal özelliklere sebep olduğu gözlenmiştir. Hesaplamalara göre ekmeklik un yerine %15 lik irmik altı unu kullanımı, üretim maliyetini %7 düşürmüştür.

Anahtar Sözcükler: İrmik altı un, ekmek, paçal, un katkı maddeleri, zedelenmiş nişasta.

ACKNOWLEDGEMENT

The author wishes to express her sincere appreciation to the following:

My advisor Prof.Dr.Sami Eren, for his friendship, advice help and valuable suggestions throughout this investigation and preparation of this project.

Assoc. Prof. Dr. Fahrettin Gögüş, for his frendship and valuable help.

Çağla Özer who is a food engineer, for her friendship and valuble help to reach some investigations which are related with my project.

I also thanks to my family, for their love, encouragement and support throughout my education.

TABLE OF CONTENTS

LIST OF TABLES

ABBREVIATIONS

BU	Brabender unit
DATAEM	Diacetyl tartaric acid esters of monoglyceride
DCF	Durum clear flour
DF	Durum flour
S	Semolina
SSL	Sodium stearoyl lactylate
UBF	Untreated bread flour
VWG	Vital wheat gluten

1. INTRODUCTION

Real pasta is produced exclusively with semolina, yellow-colored and with a good appearance, without any white spots or hints of the presence of other substance, with a minimum number of black spots and bran parts for each square decimetre, with a specific taste and smell. The quality of durum wheat semolina pasta is better from the gastronomic and culinary points of view (taste, cooking, resistance, etc.) than pasta made with flour. Chemical analysis show a slight superiority of semolina pasta even as to the nutritional value.

During the production of semolina from durum wheat an undesirable by-product which is called as durum clear flour is obtained.

In Turkey the wheat production was 18.000.000 tons and yield 1985 at 1996. Semolina production was about 70500 tons while macaroni was about 312 400 tons (DIE, 1997).If the yield of durum clear flour is between %13-16 is considered it is understood that there is a need to study the utilization of durum clear flour from an economical perspective. Utilization of durum clear flour in breadmaking or another purposes may increase its commercial value and off-set the semolina cost.

At fist quarter of 1997, the semolina production was reached to about 14 000 tons when macaroni was 83 672 tons. By the effect of GAP. This indicates the importance of studies on the evaluation of durum clear flour.

2. LITERATURE REVIEW

Durum first clear flour is "a flour made during the milling of durum semolina. Durum first clear flour is often blended back into durum flour or durum granulars for use in generic noodles or, first line products. It is defined as the throughs of the No. 100 US sieve (0.14 mm)"

Durum second clear flour is "a flour made during the milling of semolina. Durum second clear flour is of high ash, specks, and of dull color."

Kowalczuk and Krasnowska (1978) studied the potential use of durum clear flour. They reported that durum clear flour had high ash content, low gas forming and moisture-binding ability, and could be used to substitute for only or part of type "850" wheat flour.

Pattakou (1981) reported that, durum flour is made from the by products during semolina production by collecting the line fractions of certain streams and the flour which is extracted during grinding. She also noted that durum flour is extensively used in regional bakeries for bread production and that preparation of bread from this flour is not different from the other breads, except that it required a reduced fermentation time. Furthermore, she mentioned that the characteristics of this bread, which are the most positive, are its strong flavour and ability to stay fresh for several days.

Özen (1986) reported that durum clear flours below 5% concentration did not have apparent deleterious effects on dough properties and bread quality.

The investigations on the durum wheat milling products showed that particle size range, damaged starch and pentosan amount affect the physical, chemical properties of those goods.

2.1. Effects of Some Factors

2.1.1. Size Range:

It was observed that smaller granules increased the α-amylase enzyme activity, ash and protein amount, black point number and the absorption of water on dough (Wickser *et al.*, 1947; Harris *et al.*, 1950; Matsuo and Dexter, 1980; Mousa *et al.*, 1983; Krimato and Shelton, 1988; Özer, 1994)

2.1.2. Damaged Starch

Dexter *et al.* (1994) stated that when the protein amount was high at durum wheat the percent of damaged starch decreases and at low protein content flour with increasing damaged starch, developing time and stabilisation value decrease.

For obtaining a fine quality bread, certain amount of damaged starch is necessary (Mc Dermott, 1985). If the amount of that is so low, low volume and low crumb quality bread is obtained, if it is so high, dough show high viscosity and crumb is wet and grey in color. (Tripless, 1969)

2.1.3. Pentosan Amount

The Effects of Pentosans During Cooking:

- Due to the holding water property, better water distribution at dough.
- To balance the crumb structure by adjusting the rheological properties

The cereals have water soluble and insoluble pentosans. Jelaca and Hlynka (1971) stated that water soluble pentosans hold the water 6.3 times their weights, insolubles hold 6.7 times their weight (dry solid) and observed that addition of pentosans to dough, increases the developing time, viscosity and decreases the necessary energy.

2.2. Function of Bread Additives

Additives are used to help stabilize and bring uniformity to the dough properties that translate into production variables (Stauffer 1990). These are categorized under the following headings emulsifiers, oxidizing agents, vitamin C, reducing agents, acidulants and buffers and fermantation accelerators (Cole 1973).

2.2.1. Ascorbic Acid (Vitamin C)

For obtaining fine quality bread, the milling fresh flours should be waited about 3-4 weeks. So that reacting with oxygen in air strengthen the flours. The effect of the vitamin C is the same as with that strengthening.

It is necessary to convert (oxidize) ascorbic acid to dehydroascorbic acid first. This rection requires a supply of oxygen which can be provided as molecular oxygen(air) or the oxygen can be derived from another oxidant, e.g. bromate. Dehydroascorbic acid oxidizes sulfhydryl groups to disulfides which connect adjacent chains of gluten protein molecules and, thus, strengthen the gluten structure so that gas retention is improved and increase the resistance to the water vapour and pressure which are produced during the baking. This leads to greater loaf volume, improve internal characteristics, such as grain texture and enhance the symmetry of bread.

Vitamin C which strengthen the flour by stabilizing the gluten and increasing the elasticity of the dough (reduce the extensibility), has no nutrional effect due to the deterioration during baking.

Unal (1980) stated that optimum amount of vitamin C is around 2-4 g for 100 kg flour.

Since ascorbic acid is a "self-buffering" oxidant, the dough is not subject to over oxidation by an excess, as is the case with other oxidants. Finley (1984) reported that even 600 ppm ascorbic acid did not give adverse effects.

Collins (1966) observed that for bread made by the Chorleywood process:

-A weak flour required more ascorbic acid than a strong flour to reach its best potential as judged by extensigraph measurements

-Ascorbic acid in excess of the amount required for the best result did not cause a deterioration in strength, in contrast to the behavior of other oxidants such as bromate.

The addition of ascorbic acid has little effect on the mixing properties of a dough. Mixograph or farinograph studies indicated that it lowered the peak slightly, but it did not change the development time or the shape of the curve upon overmixing. (Zentner 1968 and Weak *et al.* 1977) .

Zentner (1968), stated that addition of vitamin C as dry or as water soluble during the dough making did not change the effect of vitamin C.

2.2.2. Emulsifiers

Generally, emulsifiers which are used for the bread making are mono and diglycerides, diacetyl tartaric acid esters of monoglyceride (DATAEM), calcium stearoyl lactylate (CSL), lactylic stearate, sodium stearoyl lactylate (SSL). The emulsifiers should improve the dough stability and fermantation tolerance, increase the volume, soften the crumb and retard the staling. (Pomeranz, 1987)

Sodium stearoyl lactylate is used extensively as a dough strengthener in bread products, it is also very effective as a crumb softener. SSL will complex with the protein during mixing to produce the dough strengthening characteristics and, during baking, will complex with the starch and thus, function as a crumb softener to retard staling (Dubois 1979). As a dough strengthener, SSL provides a number of benefits when added to a dough system. At the dough mixing and fermentation stages, the effects of the SSL are improved mixing tolerance, gas retention and resistance of the dough to collapse on rough handling (shock resistance). It may also increase the water absorption of the flour. In the finished product, SSL improves loaf volume and gives a resiliant texture and fine grain, together with improved slicing properties. The SSL also provides some crumb softening effect in bakery products, but generally it is not to the same extent as distilled monoglycerides (Tanstorf *et al.* 1986)

Surfactants modify the gelatinization behavior of starch the change in amylograph gelatinization curves for wheat starch caused by the inclusion of 0.5% of various emulsifiers was examined by Krog (1973). Diacetyl tartaric acid esters of fatty acids was the least interactive, glycerol mono stearate (GMS) was the most effective, sodium stearoyl lactylate was less effective, with regards to inhibiting swelling. Furthermore, Eliasson (1983) reported that SSL decreased the rate of recrystallization of starch.

Tenney and Schmidt (1968) reported that SSL imparted tolerance to a rich-formula yeast dough, giving improved volume and crumb grain (as compared with the control) with oven-or undermixing, as well as with excess or inadequate absorption or in the presence of high levels of sugar, powdered whole egg, or soy flour.

Tsen and Hoover (1971) attributed the improving and shortening-spaning effects of SSL to the relatively high melting point of its stearic acid group. The presence of the lactylic group in this surfactant aids its dispersion and solubilization in the dough system and, thereby, renders it more effective than shortening in forming complexes with gluten that strengthen dough structure and with starch that retard the staling rate.

De Stefanis *et al.* (1977) examined the binding of SSL, succinylated monoglyceride, and monoglycerides during the various stages of breadmaking. They found that surfactants form strong bonds with the flour protein during gluten development in the dough stage. Sodium stearoyl lactylate produced the strongest bonds and was, therefore, the most effective dough strengthener. At baking temperatures, however protein denaturation began to weaken the bonds between the gluten proteins and the surfactants, and this enabled the latter to translocate to the starch.

Table 1. The Performance of Emulsifiers at Breadbaking
(Mooner and Kirsch, 1995)

	MONO	DATAEM	SSL	LECITHIN
Dough making tolerence with machine	XXXX	XX	XX	X
Fermentation tolerence	X	XXX	X	
Shape	XX	XXX	XX	X
Volume	X	XXXX	XX	X
Softening	XX		XXXX	
Structure	X		XX	X

Mooner and Kirsh (1995) examined the performance of emulsifiers at breadbaking and Table 1 shows the results of that investigation. They stated that DATAEM is generally most effective emulsifier, function of it depends on the amount of tartaric acid, fat, and size.

A more meaningful test of the dough strengthening capabilities of a surfactant, besides measurement of loaf volume increment due to the inclusion of the surfactant, is to subject the proofed loaf to mechanical abuse before putting it in the oven.

Junge and Hoseney (1981) showed that a dough which contains %3 shortening, gave a final volume greater than the volume of control which contains no shortening because it expanded for a longer time in the bake cycle. The presence of shortening delayed the swelling of starch granules (and perhaps the denaturation of the gluten protein) and this delay translated into a larger loaf volume. The addition of a surfactant, such as SSL or DATAEM, to the no-shortening dough also produced this delay in the setting mechanism and thus increased the loaf volume.

2.2. 3. Vital Wheat Gluten

The unique functional properties of wheat gluten are high water absorption (two to three times its own weight) and the ability to form viscoelastic films which contribute to dough handling properties and improved loaf characteristics in baking applications. Other interesting and potentially useful functional properties are its thermosetting behavior and its bland or light "wheat" flavor. When heated to about 35°C, hydrated gluten coagulates into a chewy product which is stable under a wide variety of food preparation condition. Wheat gluten alone ranks low on the scale of nutrional quality because of its low lysine content.

Wheat gluten offers many benefits to the food industry. In the baking industry, the major uses of gluten, the following benefits have been clearly demonstrated (IWGA, 1981)

1. To Increase water absorption and thereby improve dough handling properties, bread yield, bread quality and extended shelf life.

2. To improve rheological properties of dough and thereby easier processing and improved bread quality.
3. To improve loaf characteristics and stability due to the film forming and thermosetting properties of gluten.
4. To improve bread flavor.
5. To improve nutrional quality due to increased protein content.
6. To improve quality of specialty products such as high-fiber bread where gluten improves the carrying capacity of flour for "dead weight" ingredients.
7. To decrease flour inventory in bakery; one flour with varying amounts of gluten can meet the requirements of many different baked foods.

Czarnecka *et al.* (1979) reported that a vital wheat gluten addition to flour increased flour hydroscopicity, extended dough development time and stability and may have been a factor in retarding staling.

2.3. Rheological Characteristics of the Flours

2.3.1. Flour Features According to The Farinogram

The following parameters are used for measuring the rheological characteristics of the flours with the farinogram.

a) "C" dough stability

It is qualitative parameter of the product and indicates the time during which the dough resists to a mechanical action without undergoing a change of consistency. (It is marked by the letter "C". This value is measured in minutes, starting from the moment when the graphic (farinogram) rises to the highest point in the curve, until this begins to go down (that is, when the dough starts to soften).

b) "E" degree of softening

This parameter indicates the loss of stability in the dough and its value is represented from the descent of the curve in the farinogram after a certain number (twelve or fifteen) of minutes. It is measured in Brabender's units.

c) "D" dough resistance

It is given by the sum of the values concerning the power of development of the dough (B) and its stabilty (C). Thus D=B+C. It is measured in minutes.

d) "F" and "f" index of elasticity

It indicates the mechanical effort undergone by the dough, which is recorded on the farinogram, and its continual oscillations. The amplitude depends on the elasticity and extensibility of the dough. It is measured in millimeters referring to the width of the farinogram band, immediately after the dough has been formed (F) and in the end, namely, after it has softened (f).

e) "B" development capacity of dough

It refers to the time necessary to reach the consistency of 500 units, necessary to working the flour into dough, which means going up to the maximum point of the farinogram curve. It depends to certain extent on the quality (and quantity) of gluten. It is also measured in minutes.

It is quite a different thing to establish what the quality of gluten depends on, since this question is connected to the different bonds existing, on the one hand between the amino and their complexes and, on the other hand, between the lipids and protein complexes.

f) Power of absorbing water by the flour

This is a qualitative parameter dependent on the granulation of the flour, on the quality (and quantity) of the gluten and on the level of damage undergone by starch. It is established on the ground of the quantity of water added to obtain the right level of consistency in the dough (500 Brabender's units). The dough consistency is given by the maximum ordinate in the farinogram and it is measured by percentage. The thinner the flour (or semolina) granulation is, the quicker and greater water absorption is. Some semolina with a granulation between 630 and 315 microns has absorbed during a test 49.5% of water in twelve minutes (moisture of the semolina: 14%). The same semolina, milled until it reached a granulation between 315 and 125 micron, absorbed during the same time 56.8 % of water. An analogous result sprang from a test carried out on some thick grits of soft wheat. With a granulation between 315 and 630 microns the grits absorbed 50.7% water, whereas it absorbed the 53.5% after being milled up to 125-315 micron. In all the tests performed the initial percentage of moisture in the flours was of 14%.

It is possible to calculate limit values regarding the qualitative factors of soft wheat flour by considering the "E" softening value in the farinogram, which is measured in Brabender's units, as already mentioned. A kind of flour (or semolina) presenting a value higher than 90 B.U. cannot be used for pasta-making.

If such a value is included between 60 and 90 B.U., the flour may be considered good. When the softening value is lower than 60 B.U, the quality of the flour is undoubtedly very good. In order to obtain a correct appraisal of quality, however, it is necessary to keep into account the content of wet gluten, which should never be less than 28% (and at least 9% as regards dry gluten). Moreover, the values pointed out by the extensigram, especially those concerning the maximum resistance to extension (R1), should exceed 400 B.U., while the strength of the flour, or dough energy, should by average be of about 120 square cm (namely, between 110 and 140 square cm).

2.3.2.Flour Features According to The Extensigram

The extensograph is an instrument measuring the physical characteristics of the dough made with water and flour. From the extensigram it is possible to draw the following features concerning the flour (or semolina)

a) Resistance to Extension ("R")

It is measured on the extensigram, that is on the line of the ordinate included between the value of abscissa of 50 mm and and corresponding point in the curve ("R"); or else, in correspondence of the maximum height of the curve ("R1"). The unit measure is consituted by the extensograph unit called E.U.

b) Extensibility ("C")

Extensibility is represented by the length of the extensigram, and it is measured in mm on the line of abscissa.

c) Flour Strength, or Dough Energy ("E")

It is measured in square cm on the planimetry, and it comprises the surface included between the whole curve and the abscissa. It indicates the capacity of pasta-making (and above all that of bread-making) of the flour. The greater the strength (the surface), the greater pasta elasticity (Milatovic, 1991) is.

2.3.3. Flour Features According to The Alveograph

The mills equipped with rheological devices of Brabender are only a few, whereas most of them are only provided with the alveograph of Chopen. Thus, this device has also been utilized to carry out tests and controls on the quality of flour employed for pasta processing. Generally, if a flour is too soft it is not suitable for pasta production. In order to classify the quality of the flour on the ground of the values given by the alveogram, one should proceed as follows: [resistance or elasticity P (in m/m),flour strength W(in sq.cm, erg), extensibility L (in mm), P:L index of value of swelling strength, general value G (in sq. cm)]

- P/L value from 0.8 to 2.0; the flour is quite good both for pasta making and breadmaking;
- P/L value higher than 2.5; the flour is very good and can be used for the production of long-cut pasta or also to improve (by adding it in a percentage

varying from 20 to 40 %) the quality of weak or mediocre flours whose gluten is not elastic;

- P/L value inferior to 0.5; the flour is weak and it cannot be utilized for pasta manufacturing.

2.4. Some Methods for Evaluation of Bread and Durum Wheat Flours

2.4.1.Total Sugars

Total sugar is determined by the phenol sulfuric acid colorimetric method of Dubois *et al.* (1956)

2.4.2. Pentosans

Pentosan content is determined according to the procedure of Dishhe and Borenfreund (1957) as modified by Cracknell and Moye (1970) and outlined by MacArthur and D'Appolonia (1975), by using a lamda 3B UV/VIS

2.4.3. Total and damaged starch

The amount of starch present in flour samples is determined using AACC Approved Method 76-11 (1983) on a D-Glucose is used to establish a standard curve. The starch damage levels of the flour samples is determined according to AACC Approved Method 76-3OA (1983)

Another method is the Mc Dermot (1985) method. The absorption value of the sample is observed at spectrophotometer. Samples are extracted with the 1.67% trichloroacetic acid (TCA) and potassium thiocyanate (KSCN) then precipitated and filtering, after that iodine solution is added to filtrate and finally color intensity is read at 600 nm.

2.5. Some Methods for Evaluation of Physical Dough Properties

2.5.1. Extensigraph

Physical properties of the flour doughs are characterized with the Brabender Extensigraph using the AACC Approved Method 54-10 (1983), with the following modifications. One hundred grams (14.0% moisture basis) of flour are mixed to optimum development in a Standard National Dough Mixer with 20 mL of solution (1.0% sodium chloride, 0.003% potassium bromate) and water to equal farinograph absorption minus 2.0%. After mixing, doughs are scaled to 150 g, rounded and moulded in the extensigraph dough rounder and moulder (roller), respectively, and then placed in the dough holders (cradles). After a 45 min rest at 30°C and 80% relative humidity, the dough piece is stretched on an extensigraph and a curve is obtained. The dough is then placed in a bowl in the humidity cabinet and rested for an additional 90 min, after which it is rounded, moulded, placed on an extensigraph holder, and returned to the cabinet for an additional 45 min. The dough is then stretched on the extensigraph, and a second curve is superimposed over the first curve. The second curve represented the 180 min rest period.

2.5.2. Alveograph

The resistance of the flour doughs to extension and the extent to which they could be blown into a bubble under certain conditions is measured with the alveograph.

2.5.3. Maturograph Oven-Rise Recorder

The maturograph is an instrument that estimates the optimum final proof conditions and fermentation tolerances of a fermented dough by measuring and recording changes in its elasticity (Pyler, 1988). Most methods do not distinguish between the gas that is retained in the dough and the gas that escapes from it; therefore they measure gas production. Exceptions are methods that measure the height of a fermenting dough, such as the maturograph, or the buoyant force on a test piece of dough (oven-rise recorder) (Bloksma and Bushuk 1988). The maturograph measures the net results of gas production and gas loss by recording the changes in height of fermenting dough subjected to periodic punching at 2-minute intervals (Seibel, 1968, Rasper, 1991). Final proof time which shows the time needed to obtain maximum fermentation maturity.

The Maturograph and Oven-Rise Recorder are used to determine the proofing properties and the change in volume of dough during the entire baking process, respectively. Three hundred grams (14.0% moisture basis) of flour are mixed with 2% sodium chloride, 5% yeast, and a quantity of water predetermined by the farinograph. Doughs are mixed to achieve optimum dough development, depending on the stability of the flour, using the Brabender Farinograph in the 300 g bowl. At the end of the mixing time, the consistency of the doughs is on the 500±20 BU line. After mixing, the dough is scaled to 155 and 55 g for the maturograph and oven-rise tests, respectively. Both doughs are placed in the Maturograph fermentation cabinet. After a 20 min rest at 30°C and 80% relative humidity, both dough pieces are reduced in weight, the Maturograph to 150 g and the Oven-Rise Recorder to 50 g, for the particular test, and rounded with the ball homogenizer. For the Maturograph test, the dough is placed into the Maturograph dough container and the periodical loading is applied. The dough for the Oven-Rise test is placed in a metal basket. During the period of the Maturograph test, the oven-rise test dough rested in the center of the proofing cabinet without periodical loading. When the Maturograph curve reached its maximum, which indicated maximum dough maturity, before curve drop the oven-rise test dough is placed into the oil at 30°C and heated up to 100°C with a heating rate of 3°C / min.

The Maturograph records the fermentation behavior of a dough after the proofing time by means of a sensing brode which touches the dough. From the maturograms, the following information is obtained: the "final proofing time" is the time in minutes from the start of the final proof to the first drop of the curve after the maximum; "proofing stability" (min) is evaluated with a gauge in the range of the curve's maximum; "elasticity" (BU) is the band width in the range of the maximum peaks; "dough level" (BU) is the maximum fermentation volume of the dough in the Maturograph.

For the Oven-Rise Recorder, while the volume of the dough increases, the piece ascends in the oil bath and this action is measured by the scale system and recorded in oven rise units on the strip chart recorder. "Dough volume" and "baking volume" are the heights of the curve at the beginning and end of the test, respectively. "Oven-rise" is the difference between final volume and dough volume. All values is expressed in Brabender Units.

3. DISCUSSION

3.1. Some properties of durum clear flour and bread flour.

Physical, chemical, rheological and baking properties of durum clear flour and comparison with bread flour were investigated by different scientists. At this project some studies were presented. Results obtained by Boyacıoğlu (1992) (Tables 2-11 and 19-32), Kemahlıoğlu (1996) (Tables 12-15 and 33-41) and Özer (1994) (Tables 16-18 and 42-43) compared in this study.

Table 2. Protein, Wet and Dry Gluten, and Micro-sedimentation Height Values of Durum and Bread Wheat Flours[a]

Flour Sample	Protein[b] (%)	Wet Gluten[b] (%)	Dry Gluten[b] (%)	Micro Sedimentation Height (mm)
Durum Flour	15.0	42.9	14.5	32
Durum First Clear Flour 1	13.7	38.2	13.3	28
Durum First Clear Flour 2	16.4	41.3	14.5	32
Durum First Clear Flour 3	10.9	28.7	10.0	21
Durum Second Clear Flour	9.6	25.8	8.4	22

[a]Values represent the mean of two replications.

[b]Calculation is based on a 14.0% moisture level.

Table 3. Some Chemical Values of Durum and Bread Wheat Flours[a]

Flour Sample	Ash[b] (%)	Free lutein[c] (ppm)	Total Sugar[b] (%)	Pent-osans[c] (%)	Total Starch[c] (%)	Dam. Starch[d] (%)	Falling Number (sec)	Peak Viscosity (BU)
Durum Flour	0.86	7.16	3.0	1.7	72.4	14.57	501	1250
Durum First Clear Flour 1	1.38	5.47	3.4	2.1	65.7	13.77	402	1000
Durum First Clear Flour 2	1.48	6.54	3.5	2.1	62.6	12.52	570	1550
Durum First Clear Flour 3	1.41	4.22	3.7	2.6	66.7	10.64	511	1560
Durum Second Clear Flour	1.16	3.91	3.5	2.1	60.3	8.52	502	1420
Semolina	0.75	5.68	2.8	1.8	71.9	5.19	524	1170

[a]Calculation is based on a 14.0%moisture level

[b]Values represent the mean of three replications.

[c]Values represent the mean of four replications.

[c]Values represent the mean of two replications calculated on a dry matter basis.

[d]Values represent the mean of four replications calculated on a 14.0% moisture basis.

Table 4. Farinograph Data for Durum and Bread Wheat Flours[a]

Flour Sample	Absorption[b] (%)	Peak Time (min)	MTI[c] (BU)	Stability (min)	Classification[d]
Durum Flour	68.0	4.0	70	3.5	2
Durum First Clear Flour 1	68.4	2.5	60	4.5	2
Durum First Clear Flour 2	65.6	6.0	60	5.5	3
Durum First Clear Flour 3	60.0	2.5	160	3.0	1
Durum Second Clear Flour	56.4	1.5	80	2.0	1
Semolina	55.6	5.5	80	4.5	2

[a]Values represent the mean of two replications.

[b]Calculation is based on a 14.0% moisture level.

[c]Mixing Tolerance Index.

[d]A scale of 1-8 was employed,with the higher number designating a stronger flour.

Table 5. Mixograph Data for Durum and Bread Wheat Flours[a]

Flour Sample	Time to Peak Height (min)	Height of Curve Center at Peak (Mixograph unit)	Classification Number[b]
Durum Flour	2.0	6.2	4
Durum First Clear Flour 1	2.2	4.7	4
Durum First Clear Flour 2	2.2	6.0	4
Durum First Clear Flour 3	2.5	3.8	3
Durum Second Clear Flour	3.3	3.3	2
Semolina	3.2	6.2	5

[a]Values represent the mean of two replications.

[b]A scale of 1-8 was employed,with the higher number designating a strong flour.

Table 6. Extensigraph Data for Durum and Bread Wheat Flours[a]

	Extensibility (cm)		Resistance (cm)		Proportional Number	Area (cm^2)
Flour Sample	45 min	180 min	45 min	180 min	180 min	180 min
Durum Flour	19.3	15.9	1.6	3.1	0.19	35
Durum First Clear Flour 1	13.6	11.8	2.8	4.1	0.35	35
Durum First Clear Flour 2	17.3	15.9	2.7	3.3	0.21	40
Durum First Clear Flour 3	5.5	-b	0.9	-	-.	-
Durum Second Clear Flour	9.2	5.4	1.8	3.3	0.61	18
Semolina	19.0	17.0	2.2	4.1	0.24	49

[a]Values represent the mean of two replications.

[b]Curve unattainable due to extremely weak character of dough.

Table 7. Alveograph Data for Durum and Bread Wheat Flours[a]

Flour Sample	Tenacity P (mm)	Extensibility L (mm)	Deformation Energy,W (10^{-4} Joule)
Durum Flour	118	53	220
Durum First Clear Flour 1	95	42	125
Durum First Clear Flour 2	106	49	190
Durum First Clear Flour 3	37	12	15
Durum Second Clear Flour	57	24	50
Semolina	58	36	75

[a]Values represent the mean of two replications.

Table 8. Maturograph Data for Durum and Bread Wheat Samples[a]

Flour Sample	Final Proof Period (min)	Fermentation Stability (min)	Dough Level (BU)	Elasticity (BU)
Durum Flour	32.0	2.5	395	170
Malted Durum Flour	34.0	6.5	390	160
Durum First Clear Flour 1	32.0	1.0	505	195
Durum First Clear Flour 2	30.0	4.5	470	200
Durum First Clear Flour 3	26.0	1.0	240	135
Durum Second Clear Flour	24.5	0.5	285	150
Semolina	34.0	4.5	480	190

[a]Values represent the mean of two replications.

Table 9. Oven-Rise Recorder Data for Durum and Bread Wheat Flours[a]

Flour Sample	Dough Volume (BU)	End Volume (BU)	OvenRise (BU)	Final Oven Rise (BU)
Durum Flour	290	530	240	+60
Malted Durum Flour	320	515	95	-10
Durum First Clear Flour 1	300	350	50	-110
Durum First Clear Flour 2	280	320	40	-30
Durum First Clear Flour 3	220	210	-10	-65
Durum Second Clear Flour	180	215	35	-35
Semolina	275	500	225	+40

[a]Values represent the mean of two replications.

Table 10. Bread Baking Data for Durum and Bread Wheat Flours[a]

Flour Sample	Loaf Volume (cc)	External Appearance[b]	Crust Color[b]	Grain and Texture[b]	Crumb Color[b]
Durum Flour	640	4.0	10.0	5.0	4.0
Durum First Clear Flour 1	575	2.0	10.0	3.5	2.0
Durum First Clear Flour 2	605	4.0	10.0	4.0	3.0
Durum First Clear Flour 3	445	1.0	8.0	2.0	2.0
Durum Second Clear Flour	420	1.0	7.0	2.0	2.0
Semolina	530	3.0	10.0	4.0	4.0

[a]Values represent the mean of two replications.

[b]Based on a score of 1-10 with a number 10 having the highest score.

Table11. Bread Baking Data for Durum and Bread Wheat Flours[a] (with Potassium Bromate, 10 ppm)

Flour Sample	Loaf Volume (cc)	External Appearance[b]	Crust Color[b]	Grain and Texture[b]	Crumb Color[b]
Durum Flour	660	4.0	10.0	7.0	5.0
Durum First Clear Flour 1	550	2.0	10.0	4.5	4.0
Durum First Clear Flour 2	580	3.0	10.0	5.5	4.5
Durum First Clear Flour 3	440	1.0	8.0	2.0	3.0
Durum Second Clear Flour	435	1.0	7.0	2.0	3.0
Semolina	510	3.0	10.0	4.0	5.0

[a]Values represent the mean of two replications.

[b]Based on a score of 1-10 with a number 10 having the highest score.

Table 12. The % Size Distribution of Durum Clear Flour

Samples	180μm above %	180 150μm %	150 125μm %	125 112μm %	112 63μm %	Undersieve %
A1	44.29	42.48	10.07	2.69	0.96	0.09
A2	22.38	57.74	15.34	3.61	0.93	0.13
A3	30.37	18.56	31.11	13.53	5.56	0.54
A4	16.33	68.00	11.12	3.47	0.94	0.10
A5	95.84	1.72	0.78	0.29	0.05	0.01
A6	95.06	2.82	1.22	0.44	0.06	0.01
A7	3.06	37.97	51.08	6.49	1.43	0.5
A8	3.89	46.65	39.02	8.44	1.73	0.20
A9	68.77	23.06	5.48	2.41	0.66	0.09
A10	90.77	5.65	3.14	0.86	0.08	0.02
B1	16.35	49.54	20.70	10.37	2.19	0.42
B2	6.05	42.22	37.15	10.75	2.83	0.11
B3	2.07	14.17	63.03	16.57	2.99	0.28
B4	5.83	49.81	35.31	6.97	1.69	0.14
B5	93.40	4.00	2.00	0.41	0.02	0.01
B6	91.83	4.73	3.16	0.80	0.06	0.01
B7	4.02	14.67	19.39	32.41	28.53	0.63
Min.	2.07	1.72	0.78	0.29	0.02	0.01
Max.	95.84	68.00	63.03	32.41	28.53	0.63
Mean	40.61	28.46	20.54	7.09	2.98	0.17

A→ means the samples which were grown at 1993

B→ means the samples which were grown at 1994

Table 13. The result of Chemical Analyses of Durum Clear Flour

Samples	Humidity %	Ash %	Protein[a] %	Water Soluble Pentosan %	Total Pentosan %	Damaged Starch %
A1	12.0	2.02	11.7	0.5	3.7	8.87
A2	11.4	2.04	13.7	0.6	3.8	9.18
A3	13.4	1.47	11.7	0.5	2.7	8.46
A4	13.3	1.77	13.3	0.8	3.3	8.49
A5	12.2	1.62	10.6	0.7	2.9	10.00
A6	12.6	1.72	12.5	0.4	3.1	10.41
A7	12.5	1.67	13.4	0.5	3.1	8.25
A8	13.8	1.51	12.2	0.7	2.7	7.74
A9	14.0	1.59	12.4	0.7	2.9	9.28
A10	13.6	1.37	11.5	0.7	2.6	9.49
B1	12.5	1.94	12.5	0.6	3.5	8.87
B2	14.4	1.27	12.7	0.5	2.3	8.77
B3	15.2	0.96	12.3	0.4	1.7	11.03
B4	14.6	1.25	11.5	0.7	2.3	11.13
B5	14.4	1.73	10.8	0.5	3.2	10.72
B6	13.5	1.08	12.8	0.9	2.0	10.52
B7	15.1	1.25	13.1	0.5	2.3	8.35
Min.	11.4	0.96	10.6	0.4	1.7	7.74
Max.	15.2	2.04	13.7	0.9	3.8	11.13
Mean	13.4	1.54	12.3	0.6	2.8	9.44

[a]dry basis

Table 14. Technological Analyses Results of Durum Clear Flour

Samples	Wet Gluten (%)[a]	Dry Gluten (%)[a]	Zeleny Sed (mL)	SDS-Sed (mL)	Falling number (s)
A1	32.0	10.7	21	37	467
A2	36.7	11.5	23	43	480
A3	31.4	9.9	13	29	468
A4	35.4	11.1	24	47	288
A5	27.7	8.9	21	38	429
A6	31.3	9.8	22	41	424
A7	34.8	11.8	24	46	263
A8	32.4	10.7	25	45	261
A9	33.3	11.0	22	39	264
A10	30.6	10.1	17	33	392
B1	32.4	10.9	17	42	472
B2	34.5	10.9	23	50	387
B3	32.2	10.6	18	41	392
B4	31.1	9.2	18	39	388
B5	28.9	9.2	18	388	371
B6	34.7	10.0	24	51	414
B7	34.6	11.1	23	48	401
Min.	27.7	8.9	13	29	261
Max.	36.7	11.8	25	51	480
Mean	32.6	10.4	21	42	386

[a]dry basis

Table 15. The Farinogram Values of Durum Clear Flour at 1994

	Water absorption (%)	Developing time (min)	Stability (min)	Softening degree (BU)
B1	60.5	3	2	220
B2	59.2	3.5	2.5	170
B3	59.6	1.5	2.5	200
B4	64.1	2.5	2.5	130
B5	59.9	2.5	2.5	230
B6	59.2	2.5	2	225
B7	58.9	3	2	200

Table 16. The Physical Chemical and Technological Results of Durum Clear Flour

	SAMPLE					
Analyses	A_1	A_2	A_3	A_4	A_5	A_6
Humidity	14.0	13.9	12.8	13.6	13.4	13.0
Ash(%db)	1.60	1.19	0.95	1.20	2.30	2.29
Protein(%db)	11.70	11.27	12.02	11.60	13.59	13.22
Wet gluten	25.6	30.6	29.3	30.9	20.5	21.3
Dry gluten	8.6	9.7	8.9	9.9	6.6	7.0
Sedimantation (cm^3)	20	22	18	6	19	27
Falling number (sn)	452	387	379	436	495	550
SDS Sedimantation (cm^3)	31	35	32	23	33	38
Size distribution						
180µ	4.12	3.26	2.25	2.76	3.67	2.97
150µ	20.26	16.38	6.01	12.60	18.36	8.49
125µ	60.98	52.63	11.05	52.73	61.72	47.36
112µ	10.86	18.46	32.78	23.25	11.91	31.83
63µ	2.73	6.31	34.48	4.46	2.89	6.59
Undersieve	1.05	2.96	13.41	4.2	1.45	2.76

Table17. The Farinogram Values of Durum Clear Flour

SAMPLES	Absorption of water (%)	Developing time (min)	Stability (min)	Softining degree (BU)
A_1	56.8	2	1	120
A_2	61.8	$2^{1/2}$	1	120
A_3	62.6	$2^{1/2}$	1	140
A_4	59.8	2	1/2	180
A_5	65.8	$1^{1/4}$	1/2	180
A_6	70.6	$1^{3/4}$	3/4	100

Table 18. The Extensogram Values of Durum Clear Flour

SAMPLES	Extensibility (cm)			Resistance to extensibility (BU)			Energy (cm^2)		
	45'	90'	135'	45'	90'	135'	45'	90'	135'
A_1	21.6	21.2	20.5	130	125	100	39.8	29.6	24.2
A_2	26.7	24.0	18.5	90	80	70	49.7	37.3	17.8
A_3	22.6	19.8	17.0	95	80	70	26.5	25.4	21.7
A_4	14.6	*	*	110	*	*	19.7	*	*
A_5	17.1	*	*	60	*	*	11.6	*	*
A_6	11.0	10	*	120	130	*	16.4	17.9	*

*can not drawn

The results of these studies have been summarised as follows:

Generally, protein content of the durum clear flour was slightly higher than those of bread flours.

Durum Clear flour also had a higher wet and dry gluten content than the bread wheat flour.

Micro sedimentation height values, which indicate gluten strength, were also higher for bread wheat flour than durum clear flour. Traditionally, the gluten of durum wheat has been soften, more sticky, more extensible but less elastic then hard wheat glutens (Gilles 1967, Risdal 1971, Matz 1987). According to the zeleny sedimentation, durum clear flour showed low results and weak property.

Dexter *et al.* (1981) stated that the quality of durum wheat is weaker than that of bread wheat. So that it shows short dough making time and weak baking property.

Although the falling number of some samples had optimal value (250s±253), durum clear flour had generally low amylase enzyme activity (420s and above) it was stated by some scientist that those samples which showed high falling numbers, grown under hot and dry climate conditions.

The durum samples were higher in ash content than the bread wheat flours. Since clear flour represent primarily the outer parts of the kernel, there was a large difference between the clear flour and bread flour. Total sugar of durum samples was higher than that of bread flours. Clear flour contains a greater amount of the outer layers of the kernel which is higher in sugar content, than the endosperm portion (Mac Arthur and D'appolonia, 1976). This also was confirmed by the higher ash content in the flour. The difference between durum and bread wheat flours in total sugar content might also be due to the higher levels of damaged starch. Pentosans content of clear flour was also higher than that of bread flour. Since pentosans are major endosperm cell-wall polysaccharides of wheat and found in grade flour fractions (Ciacco and D' Appolonia 1982, Pyler 1988).

Durum clear flours showed low starch content. With the exception of semolina and durum second clear flour, durum wheat flours showed higher amounts of damaged starch than the bread wheat flours. The bread wheat flour contained higher starch damage values than the semolina which was probably due to the use of smooth rolls during the milling process for producing bread flour. Likewise, durum flour had a higher starch demage value than the remaining samples, indicating gerater milling severity (Boyacıoğlu 1992).

In general, the optimal damage starch level is 7.0±1.5% (Schiller 1981). From results, the damaged starch content of durum clear flour was similar with that of bread flour. About % 9.69-10.31 durum clear flour had high absorption at farinograph. This may be due to the higher starch damage content of durum clear flour.

Despite the higher absorption values for the durum samples, they showed a short to medium peak time compared to a medium of long peak time for the bread wheat flour. The dough development time or peak time is an indication of protein quality, with stronger flours normally requiring a longer development time, than weaker flours. According to the farinogram results developing time of durum clear flour was short, stability was low and softening property was high.

A distinct difference was found in mixing tolerance index (MTI) between the durum and bread wheat flours. For bread wheat flours, the MTI values were lower than for the durum flour. The MTI value is represented by the difference in Brabender Units at the peak of the curve to the peak of the curve measured five minutes after the initial peak.

For bread wheat flours, the stability values were higher than for the durum clear flour.

The stability or MTI values indicate how much additional mixing can be done to the dough before it begins to break down. All doughs even Itally break down on sustained mixing and this phase is indicated in the farinogram by the descending slope of the curve.

From extensogram values, it was seen that as the time increase, durum clear flour showed weaker results than the other samples.

From oven-rise recorder durum clear flour showed collapse, on indicated by the negative oven rise figure during baking.

3.2. Bread Blending Study Incorporating Various Additives

Table 19. Some Chemical Properties of Durum First Clear Flour and Untreated Bread Four Blends[a]

Durum First Clear Flour: Untreated Bread Flour	Protein[b] (%)	Wet Gluten[b] (%)	Dry Gluten[b] (%)	Micro-Sedimentation Height (mm)	Ash (%)	Falling Number (sec)
0:100	14,5	36.1	12.8	80	0.41	444
25:75	15.0	36.4	13.0	70	0.69	557
50:50	15.4	36.6	13.2	54	0.94	583
75:25	15.8	36.9	13.6	43	1.20	655
100:0	16.4	41.3	14.5	32	1.48	674

[a] Values represent the mean of two replications.
[b] Calculation is based on a 14.0% moisture level.

The addition of the durum first clear flour to bread wheat flour had a similar effect to the durum flour: an increase in protein and wet and dry gluten contents but a decrease in micro-sedimentation height value.

Table 20. The Effect of Ascorbic Acid, Sodium Stearoyl Lactylate, and Vital Wheat Gluten on Farinograph Properties of Durum First Clear Flour and Untreated Bread Flour Blends[a]

Durum First Clear Flour: Untreated Bread Flour	Absorption[b]	Peak Time (min)	MTI[c] (BU)	Stability (min)
Control				
0 :100	64.9	20.0	10	22.5
25 :75	64.5	23.0	10	24.5
50 :50	64.7	8.5	20	20.0
75 :25	65.0	6.0	30	10.0
100 :0	65.4	4.5	40	7.5
Ascorbic Acid				
0 :100	64.4	21.0	5	25.0
25 :75	64.0	23.0	10	21.0
50 :50	64.4	7.0	20	19.0
75 :25	65.3	4.5	25	8.0
100 :0	65.9	4.0	40	5.5
Sodium Stearoyl Lactylate				
0 :100	64.0	22.5	5	45.0
25 :75	63.0	16.5	5	36.5
50 :50	63.2	8.0	20	20.5
75 :25	63.5	6.0	30	10.0
100 :0	64.3	4.0	40	7.5
Vital Wheat Gluten				
0 :100	67.2	32.5	30	7.0
25 :75	68.0	27.5	30	30.5
50 :50	69.0	9.0	20	25.5
75 :25	69.9	8.5	20	22.5
100 :0	70.3	4.5	20	16.5

[a]Values represent the mean of two replications.

[b] Calculation is based on a 14.0% moisture level.

[c]Mixing Tolerance Index.

Table 21. Comparison of Mean Values for the Effects of Additives on Farinograph Properties of Durum First Clear Flour and Untreated Bread Flour Blends[a]

Additive	Absorption[b] (%)	Peak Time (min)	MTI[c] (BU)	Stability (min)
Control	64.9 b	12.7 b	22 a	16.9 ab
Ascorbic Acid	64.8 b	11.9 b	20 a	15.7 b
Sodium Stearoyl Lactylate	63.6 c	11.4 b	20 a	23.9 a
Vital Wheat Gluten	68.9 a	16.4 a	24 a	20.4 ab

[a]Means followed by the same letter in columns are not significantly different at P=0.05 according to Duncan's New Multiple Range Test (n=10).

[b]Calculation is based on a 14.0% moisture basis.

[c]Mixing Tolerance Index.

3.2.1. Durum First Clear Flour: Bread Flour Blends

Table 20 shows the farinograph data for durum first clear flour and untreated bread flour blends. The addition of durum first clear flour to untreated bread flour an increase in water absorption and MTI, but a decrease in farinograph peak time and stability. However, the 25 and 50 % blends resulted in a decrease water absorption. Due to its higher water absorption, the durum first clear flour blends had greater absorption than the durum flour blends. The 25 % addition of durum first clear flour increased the farinograph peak time which may have been due to this higher absorption. This particular blend also had higher stability than the untreated bread flour. The incorporation of SSL and VWG had a significant decreasing and increasing effect on water absorption of the blends, respectively (Table 21). Only VWG addition showed a significant effect on peak time while all additives had no significant effect on MTI value. Addition of VWG to untreated bread flour resulted in a double peak on farinogram. The dough strengthening effect of SSL was observed with the higher stability values. Vital wheat gluten addition also had a significant improving effect on the stability of the dough.

Table 22. The Effect of Ascorbic Acid, Sodium Stearoyl Lactylate, and Vital Wheat Gluten on Extensigraph Properties of Durum First Clear Flour and Untreated Bread Flour Blends[a]

DFCF:UBF	Extensibility (cm)	Resistance (cm)	Proportional Number	Area (cm^2)
Control				
0 :100	26.8	10.4	0.39	195
25 :75	28.9	7.9	0.27	168
50 :50	27.2	6.8	0.25	144
75 :25	25.2	5.1	0.20	109
100 :0	22.1	4.1	0.19	75
Ascorbic Acid				
0 :100	25.5	13.2	0.52	227
25 :75	22.9	14.3	0.63	219
50 :50	22.0	11.5	0.52	181
75 :25	19.1	8.7	0.46	124
100 :0	18.6	5.9	0.32	89
Sodium Stearoyl Lactylate				
0 :100	25.0	12.6	0.50	222
25 :75	24.5	9.6	0.39	163
50 :50	23.5	7.5	0.32	134
75 :25	22.2	4.9	0.22	91
100 :0	21.3	3.9	0.18	69
Vital Wheat Gluten				
0 :100	26.5	11.9	0.45	222
25 :75	25.4	9.2	0.34	164
50 :50	24.1	6.9	0.26	123
75 :25	23.3	5.0	0.23	94
100 :0	21.3	3.6	0.17	63

[b]Measurements are for the 45 min curve and values represent the mean of two replications.

The extensigraph properties of durum first clear flour and untreated bread flour blends are summarized in Table 22. As the percentage of durum first clear flour was increased, the resistance to extension and area values decreased. With the 25 and 50% addition of durum first clear flour, extensibility increased, but decreased with the 75% blend and 100% durum clear flour.

Table 23.Comparison of Mean Values for the Effects of Additives on Extensigraph Properties of Durum First Clear Flour and Untreated Bread Flour Blends[a]

Additive	Extensibility (cm)	Resistance (cm)	Proportional Number	Area (cm^2)
Control	26.0 a	6.9 b	0.26 c	138 b
Ascorbic Acid	21.6 c	10.7 a	0.49 a	168 a
Sodium Stearoyl Lactylate	23.3 b	7.7 b	0.33 b	136 b
Vital Wheat Gluten	23.1 bc	7.3 b	0.30 bc	133 b

[b]Measurements are for the 45 min curve and means followed by the same letter in columns are not significantly different at P=0.05 according to Duncan's New Multiple range Test (n=10).

Among the additives, ascorbic acid had a renounced effect on extensigraph properties. Overall, incorporation of SSL showed a significant decrease in extensibility and an increase both in resistance to tension and area values (Table 23). The addition of SSL to the 25% durum first clear flour 75% untreated bread flour blend resulted in a higher resistance to extension value than of the 100 % untreated bread flour with SSL. The dough improving effect of ascorbic acid on durum first clear flour and untreated bread flour blends was more pronounced than for the durum and control bread flours. This may in part be due to the greater effect of oxidants on low grade flours than patent flours, since the former contain high amounts of fatty acids which respond to the effect of oxidizers (D'Appolonia 1984b, Galliard 1986).

Table 24. The Effect of Ascorbic Acid, Sodium Stearoyl Lactylate, and Vital Wheat Gluten on Bread Properties of Durum First Clear Flour and Untreated Bread Flour Blends[a]

DFCF:UBF	Loaf Volume (cc)	External Appearance[b]	Crust Color[b]	Grain and Texture[b]	Crumb Color[b]
Control					
0 :100	765	9.0	10.0	8.5	9.0
25 :75	735	9.0	10.0	8.0	8.0
50 :50	695	8.0	10.0	7.5	6.5
75 :25	650	7.0	9.0	6.0	5.0
100 :0	585	5.0	7.5	4.0	3.0
Ascorbic Acid					
0 :100	745	9.0	10.0	9.0	10.0
25 :75	820	10.0	10.0	9.0	8.5
50 :50	745	9.0	10.0	8.5	7.5
75 :25	665	8.0	9.0	7.5	6.0
100 :0	605	6.0	7.5	6.5	4.0
Sodium Stearoyl Lactylate					
0 :100	840	10.0	10.0	9.5	9.5
25 :75	800	10.0	10.0	8.5	8.0
50 :50	740	9.0	10.0	7.5	7.0
75 :25	705	8.0	9.0	7.0	5.0
100 :0	600	6.0	7.5	5.0	4.5
Vital Wheat Gluten					
0 :100	825	10.0	10.0	9.0	9.5
25 :75	805	10.0	10.0	8.5	8.0
50 :50	795	10.0	10.0	7.5	6.5
75 :25	755	9.0	9.0	7.0	5.0
100 :0	665	7.0	7.5	5.0	4.0

[a]Values represent the mean of two replications.

[b]Based on a score of 1-10 with a number 10 having the highest score.

Table 25. Comparison of Mean Values for the Effects of Additives on Bread Properties of Durum First Clear Flour and Untreated Bread Flour Blends[a]

Additive	Loaf Volume (cc)	External Appearance[b]	Crust Color[b]	Grain and Texture[b]	Crust Color[b]
Control	684.5c	7.6c	9.3a	6.8c	6.3c
Ascorbic Acid	714.5bc	8.4b	9.3a	8.1a	7.2a
Sodium Stearoyl Lactylate	737.0b	8.6ab	9.3a	7.5b	6.8b
Vital Wheat Gluten	768.5a	9.2a	9.3a	7.4b	6.6b

[a]Means followed by the same letter in columns are not significantly different at P=0.05 according to Duncan's New Multiple Range Test (n=10).

[b]Based on a score of 1-10 with a number 10 having the highest score.

Baking results and external characteristics of bread baked from durum first clear flour and untreated bread flour with incorporation of additives are given in Tables 23 and 24. As the percentage of durum first clear flour was increased, the loaf volume and bread scores decreased, except for crust Color, which was only affected after the addition of 75% durum flour. Durum wheat is higher in gliadin, but lower in glutenin content compared to bread wheat. Also, Abacuses *et al.* (1987) demonstrated that, within the durum wheat milling streams, the semolina fraction contained more gliadin and less glutenin than the flour fractions. It has been shown also that the amount of sulfhydryl groups in the endosperm increases from the centre to the outer portion of the kernel (Pomeranz and Shellenberger 1961). Thus, durum clear flour would contain more sulfhydryl groups than durum flour. Since the quality of the flour protein for bread making purposes increases with an increase in the number of possible disulphide linkages (Wostmann 1950, Sokol and Mecham 1960), the low disulphide content of durum first clear flour could have negative effect on its bread making quality.

The addition of VWG significantly affected the loaf volume of the blends (Table 25). To produce acceptable bread from high-extraction flours, wheat gluten is often added to increase the protein content and consequently improve bread volume and texture (Galliard 1986). The effect of gluten on high-extraction flours could be similar to durum first clear flour. Within the blends, the highest bread volume was obtained with the 25% durum first clear flour and 75% untreated bread flour blend containing ascorbic acid. These loaves of bread were slightly lower in volume than the bread from the control flour containing SSL or VWG. These results can be explained, in part, by the greater response of low-grade flours to oxidising agents. In addition, the speculated change in the gluten structure of the blends could result in a higher loaf volume. Ascorbic acid addition resulted in significantly higher scores for grain and texture and crumb Color, whereas none of the additives showed any effect on the crust.

Table 26. The Effect of Potassium Bromate (10ppm) and Potassium Bromate (10 ppm)+ Ascorbic Acid (100 ppm) on Bread Properties of Durum First Clear Flour and Untreated Bread Flour Blends[a]

DFCF:UBF	Loaf Volume (cc)	External Appearance[b]	Crust Color[b]	Grain and Texture[b]	Crumb Color[b]
Control					
0 :100	855	9.0	10.0	8.5	9.0
25 :75	830	9.0	10.0	8.0	8.0
50 :50	845	9.0	10.0	8.0	6.5
75 :25	775	7.5	9.0	6.5	5.0
100 :0	650	6.0	8.0	4.0	3.0
Potassium Bromate					
0 :100	890	10.0	10.0	9.5	9.5
25 :75	965	10.0	10.0	9.0	8.5
50 :50	930	10.0	10.0	8.5	7.0
75 :25	770	8.0	8.5	7.5	5.5
100 :0	675	6.5	7.5	6.0	4.0
Potassium Bromate + Ascorbic Acid					
0 :100	810	9.0	10.0	8.5	9.0
25 :75	870	9.0	10.0	8.5	8.5
50 :50	845	9.0	10.0	8.0	7.0
75 :25	760	8.0	8.5	7.5	5.5
100 :0	655	6.5	7.5	6.0	4.0

[a]Values represent the mean of two replications.

[b]Based on a score of 1-10 with a number 10 having the highest score.

Table 27. Comparison of Mean Values for the Effects of Potassium Bromate (10ppm) and Potassium Bromate (10 ppm)+ Ascorbic Acid (100 ppm) on Bread Properties of Durum First Clear Flour and Untreated Bread Flour Blends[a]

Additive	Loaf Volume (cc)	External Appearance[b]	Crust Color[b]	Grain and Texture[b]	Crust Color[b]
Control	790.5 b	8.1 b	9.4 a	7.0 b	6.3 b
Potassium Bromate	846.0 a	8.9 a	9.2 a	8.1 a	6.9 a
Potassium Bromate + Ascorbic acid	788.0 b	8.3 b	9.2 a	7.7 a	6.8 a

[a]Means followed by the same letter in columns are not significantly different at P=0.05 according to Duncan's New Multiple Range Test (n=10).

[b]Based on a score of 1-10 with a number 10 having the highest score.

Baking evaluation results for durum first clear flour and untreated bread flour blends with incorporation of potassium bromate and a combination of potassium bromate and ascorbic acid are given in Table 26. The blend consisting 25% durum first clear flour and 75% untreated bread flour containing potassium bromate gave higher bread volume than any of the other blends or the control bread wheat flour. However, the bread had a coarse grain and texture as a result of over-oxidation. This could be explained, partly, by the greater response of low-grade flours to oxidising agents. The use of a combination of these two oxidising agents had no significant effect on the bread loaf volume made from the blends. (Table 27.)

Table 28. The Effect of Sodium Stearoly Lactylate (0.5%)+ Ascorbic Acid (100 ppm) on Bread Properties of Durum First Clear Flour and Untreated Bread Flour Blends[a]

DFCF:UBF	Loaf Volume (cc)	External Appearance[b]	Crust Color[b]	Grain and Texture[b]	Crumb Color[b]
Control					
0 :100	855	9.0	10.0	8.5	9.0
25 :75	830	9.0	10.0	8.0	8.0
50 :50	845	9.0	10.0	8.0	6.5
75 :25	775	7.5	9.0	6.5	5.0
100 :0	650	6.0	8.0	4.0	3.0
Sodium Stearoly Lactylate + Ascorbic Acid					
0 :100	885	10.0	10.0	9.5	9.5
25 :75	925	10.0	10.0	9.5	8.5
50 :50	890	10.0	10.0	8.0	7.0
75 :25	765	8.5	8.5	7.5	5.5
100 :0	720	7.5	7.5	7.0	4.5

[a]Values represent the mean of two replications.

[b]Based on a score of 1-10 with a number 10 having the highest score.

Table 29. Comparison of Mean Values for the Effects of Sodium Stearoyl Lactylate (0.5%)+Ascorbic Acid (100 ppm) on Bread Properties of Durum First Clear Flour and Untreated Bread Flour Blends[a]

Additive	Loaf Volume (cc)	External Appearance[b]	Crust Color[b]	Grain and Texture[b]	Crust Color[b]
Control	790.5 b	8.1 b	9.4 a	7.0 b	6.3 b
sodium stearoyl lactylate +Ascorbic acid	837.0 a	9.2 a	9.2 a	8.3 a	7.0a

[a]Values followed by the same letter in columns are not significantly different at P=0.05 according to Duncan's New Multiple Range Test (n=10).

[b]Based on a score of 1-10 with a number 10 having the highest score.

Table 28 shows the effect of an SSL and ascorbic acid combination on bread properties of durum first clear flour and untreated bread flour blends. The blend, containing 25% durum first clear flour and 75% untreated bread flour with incorporation of SSL and ascorbic acid, resulted in higher loaf volume than with the remaining blends or the bread flour by itself. The 50% durum first clear flour containing blend gave a loaf volume comparable to the control. A combination of SSL and ascorbic acid showed a significant effect on loaf volume and external and internal bread characteristics (Table 29).

Table 30. The Effect of Potassium Bromate (5 ppm) +Ascorbic Acid (50 ppm) and Sodium Stearoyl Lactylate (0.5%) + Ascorbic acid (75 ppm) on Bread Properties of Durum First Clear Flour (DFCF), Semolina (S), and Untreated Bread Flour (UBF) Blends[a]

Treatment	Loaf Volume (cc)	External Appearance[b]	Crust Color[b]	Grain and Texture[b]	Crumb Color[b]
Control					
100 % UBF	850	10.0	10.0	8.5	9.0
25 % DF	850	10.0	10.0	8.5	8.0
25 % DFCF	805	9.0	10.0	7.5	8.0
25 % S	760	9.0	10.0	7.5	8.0
Potassium Bromate + Ascorbic Acid					
100 % UBF	890	10.0	10.0	9.0	8.5
25 % DF	920	10.0	10.0	8.5	8.5
25 % DFCF	880	10.0	10.0	8.0	8.5
25 % S	760	9.0	10.0	8.0	8.0
Sodium Stearoyl Lactylate + Ascorbic Acid					
100 % UBF	910	10.0	10.0	9.5	9.5
25 % DF	945	10.0	10.0	9.0	8.5
25 % DFCF	945	10.0	10.0	9.0	9.0
25 % S	830	10.0	10.0	8.5	8.0

[a]Values represent the mean of two replications.
[b]Based on a score of 1-10 with a number 10 having the highest score.

Table 31. Comparison of Mean Values for the Effects of Additives a Bread Properties of 25% of Durum Flour, or Durum First Clear Flour or Semolina and Untreated Sread Flour Blends[a]

Additive	Loaf Volume (cc)	External Appearance[b]	Crust Color[b]	Grain and Texture[b]	Crust Color[b]
Control	816.3 c	9.5 b	10.0 a	8.0 c	8.3 b
Potassium Bromate+ Ascorbic acid	862.5 b	9.8 ab	10.0 a	8.4 b	8.4 b
Sodium Stearoly Lactylate + Ascorbic acid	907.5 a	10.0 a	10.0 a	9.0 a	8.8 a

[a]Means followed by the same letter in columns are not significantly different at P=0.05 according to Duncan's New Multiple Range Test (n=8).

[b]Based on a score of 1-10 with a number 10 having the highest score.

Bread from the 25% blend of durum flour or durum first clear flour resulted in higher loaf volume. Bread from these blends also gave high grain and texture scores. Crumb color was not appreciatively affected with the addition of 25% durum flour or durum first clear flour to the bread. SSL and ascorbic acid combination showed more of a significant positive effect on loaf volume and internal bread characteristics compared to the addition of the potassium bromate and ascorbic acid combination. (Table 30 and 31)

Based on the results it can be concluded that with the introduction of durum wheat cultivatars with strong gluten properties, it is no longer valid to state that durum wheat is not suitable for bread. Bread with acceptable characteristics can be obtained with blends containing 25% of durum flour, or durum first clear flour, and 75% of bread wheat flour by the addition of SSL (0.58%) and ascorbic acid (75 ppm).

3.3. Sensory Evaluation

The results of the sensory evaluation are presented in Table 32. Analysis of variance (ANOVA) showed no significant difference for all characteristics among the breads made with 100% untreated bread flour and 25% durum flour, or durum first clear flour, or semolina, and 75% untreated bread flour and with the incorporation of ascorbic acid and SSL.

Table 32. Sensory Evaluation Data of Bread Baked From Bread and Durum Wheats[a]

	Score (1-9)				
Flour Used To Prepare Bread[b]	Color	Flavour	Mouthfeel	Freshness	Overall
100 % UBF[c]	6.8	6.4	6.4	6.7	6.5
25 % DF[d] + 75 % UBF	6.8	6.2	6.2	6.7	6.2
25% DFCF[e] + 75 % UBF	6.7	6.1	6.3	6.6	6.3
25 % S[f] + 75 % UBF	6.7	6.1	6.2	6.5	6.3

[a] No significant difference was found between the samples (n=75)

[b]All samples contained Ascorbic acid (75 ppm) and Sodium Stearoyl Lactylate (0.5%).

[c]Untreated Bread Flour

[d]Durum Flour.

[e]Durum First Clear Flour.

[f]Semolina.

Table 33. The Chemical Properties of Flour Blendings at Bread Baking

DCF Bread Flour	Humidily (%)	Ash (%)[a]	Protein (%,Nx5.7)[a]
I	13.2	1.42	11.7
I80 + Z20	13.4	1.24	11.2
I60 + Z40	13.5	1.11	10.8
I50 + Z50	13.6	0.99	10.5
Z100	14.0	0.65	9.6
I80 + K20	13.4	1.29	11.8
I60 + K40	13.4	1.10	11.9
I50 + K50	13.6	1.03	11.9
K 100	13.8	0.63	12.1

[a]dry basis

(I means DCF, Z means weak flour and K means strong flour)

Table 34. The Technological Properties of Flour Blending at Bread Baking

DCF Bread Flour	Wet Gluten (%)[a]	Dry Gluten (%)[a]	SDS-sed. (ml)	Zeleny sed. (ml)	(S)
I	29.8	9.7	37	20	452
I80 + Z20	28.9	9.6	41	20	384
I60 + Z40	28.1	9.2	46	21	354
I50 + Z50	27.7	9.1	47	22	339
Z100	25.3	8.3	56	24	273
I80 + K20	30.1	9.8	41	23	406
I60 + K40	30.5	9.9	49	27	367
I50 + K50	30.7	9.9	51	30	343
K 100	31.5	10.2	67	40	307

[a]dry basis

Table 35.The Farinogram values of Flour Blending in Bread Bakings

DCF Bread Flour	Water Absoption (%)	Proofing Time (min)	Stability (min)	Softening Degree (BU)
I 100	56.8	1.5	3	200
I80 + Z20	56.8	4	5.5	180
I60 + Z40	56.7	4	5.5	180
I50 + Z50	56.6	4	6	180
Z100	56.5	4	4.5	190
I80 + K20	57.2	5	6	170
I60 + K40	57.8	5.5	6.5	170
I50 + K50	58.4	5.5	7	170
K 100	59.9	7.5	8.5	150

Depending on the blending ratio of weak bread flour to durum clear flour; the result of tables 33-35 have been summarised as follows:

- humidity increased
- ash and protein content decreased
- SDS and zeleny sedimentation values increased
- dry and wet gluten content and falling number decreased
- water absorption content increased
- developing time, stability and softening degree values were similar with weak bread flour values. It can be said that addition of weak bread flour improved the durum clear properties.

Depending on the blending ratio of strong bread flour to durum clear flour:

- humidity content increased
- ash content decreased
- there was no significant change on protein content
- SDS and zeleny sedimentation values increased
- dry and wet gluten contents increased, falling number was decrease.
- water absorption decreased

- developing time, stability and softening degree values decreased but the ratio of blending had no significant effect on the softening degree value.

Table 36. The Extensogram Values of Flour Blending

DCF Bread Flour	Time (min)	R_5 (BU)	R_m (BU)	Extensibility (mm)	Ratio Number	Energy (cm^2)
I 100	45	470	510	77		42.8
	90	320	500	62		35.6
	135	420	450	66	6.36	35.6
I80 + Z20	45	360	420	103		50.8
	90	420	320	81		42.3
	135	320	320	74	4.32	28.5
I60 + Z40	45	300	380	115		48.7
	90	380	350	78		32.7
	135	350	260	84	4.16	35.8
I50 + Z50	45	250	300	124		44.2
	90	300	300	97		38.7
	135	300	280	96	3.13	35.5
Z100	45	240	350	127		49.3
	90	320	330	112		52.3
	135	320	380	100	3.20	42.6
I80 + K20	45	350	440	117		59.3
	90	440	400	75		43.9
	135	400	370	77	5.19	37.6
I60 + K40	45	330	570	124		59.7
	90	560	410	78		45.7
	135	400	370	74	5.41	38.7
I50 + K50	45	340	370	125		61.5
	90	430	440	99		56.5
	135	410	410	90	4.56	41.9
K 100	45	350	430	146		84.1
	90	460	510	126		79.1
	135	420	460	116	3.62	65.5

The best result for extensogram which gives on idea about on the bread baking, was about 60:40 ratio (durum clear flour: strong bread flour) (Table 36)

Table 37. The Results of Sensory Evaluation of Breads from the Durum Clear Flour with Additives

	Taste	Preference
Control	61	59
SSL	73	70
DATAEM	39	50
VWG	51	56
SSL+C	65	62
DATAEM+C	47	45
SSL+C+VWG	50	50
DATAEM+C+VWG	46	40

*Limits 41-67 (p=0.05).

Table 38. The Sensory Evalvation of Breads frow Flour Blendings

	Taste	Prefenence
I 100	51	58
I80 + Z20	58	66
I60 + Z40	49	56
I50 + Z50	43	41
I80 + K20	41	44
I60 + K40	40	37
I50 + K50	54	34

* limits 37-59 (p = 0.05)

For additives, the incorporation of SSL had negative effect on the taste, whereas that of DATAEM had positive effect and the sample which contained DATAEM+C+VWG was the most prefable one. (Table 37)

For sensory evaluation, there was no significant difference at taste results, but for preference, I80+Z20 was worst, I50+K50 was the best. (Table 38)

General results showed that the property of the durum clear flour is similar with the weak flour so that using high amount of durum clear flour with weak flour was not acceptable for bread making (especially DCF 80 + W20) and using strong flour with durum clear flour improved the bread baking guality. Especially DCF 50:S50 blend showed the similar results with the % 100 strong flour.

3.4. Utilization of Durum Clear Flour in Biscuit and in Pizza Making

Özer (1994), studied the usability of durum clear flour in bakery products such as biscuits and pizza. She mixed different amounts of durum clear flour with flour which is used in the production of biscuit and pizza.

She studied on the two type crackers and one type biscuits (Balık Cracker, Can Kraker and Petit Beurre)

She expected that durum clear flour may be used in high amounts for cracker making. Since the weak structure is desired at gluten and technological dough properties for cracker production. Whereas for biscuit making; the dough should be strong and soft structure should be obtained for the end product. So that before analysing the samples it was expected that the durum clear flour can be used in lower amount at biscuit making than the cracker making

For pizza making, the strong gluten structure is desired. Addition of durum clear flour decrease the gluten quality, this leads to undesired texture at the end product. For that reason, it was considered that using low amount of durum clear flour instead of high amount might more suitable for obtaining the fine quality end product for pizza making.

The results of analyses had showed the similarity with the considerations.

Table 39. The Physical and Chemical Analyses Results of Biscuits Samples

	Balık Cracker						Can Cracker				Petit Beurre			
Analyses	Cont.	%10	%20	%30	%40	%50	Cont.	%15	%30	%45	Cont.	%5	%10	%20
Size (cm)	1.59	1.65	1.6	1.6	1.69	1.78	4.1	4.4	4.5	4.5	5	5.2	5.6	5.8
Width	3.05	3.1	3.12	3.23	2.96	3.03	6.4	6.4	6.5	6.4	7	7	7.2	7.1
Length	0.4	0.4	0.36	0.3	0.3	0.25	0.5	0.4	0.4	0.38	0.3	0.35	0.3	0.3
Weight (g)	6.4	6.2	6.8	6.2	6.2	6.2	7.6	7.5	7.6	7.5	9.1	9.1	9.2	9.2
Humidity (%)	4.1	3.14	3.88	3.76	2.91	3.92	3.42	2.63	3.88	4.47	5.19	5.54	5.64	5.85
Salt (%)	0.86	1.18	1.16	1.19	1.1	1.11	0.81	0.76	0.78	0.82	0.2	0.19	0.15	0.18
Ash (%db)	0.18	0.28	0.23	0.49	0.51	0.61	0.17	0.21	0.36	0.55	0.69	0.65	0.7	0.81
Protein (%db)	13.38	13.14	13.48	13.63	13.96	14.03	7.7	8.05	8.54	9.16	7.61	7.54	7.77	7.9

It was difficult to dough making and shaping at all three type product depending on the added amount of durum clear flour and the dark yellow color which was expected at Petit Beurre, was not seen.

The chemical and physical analyses results of samples which contain different amount of durum clear flour was given at Table 39.

Balık cracker showed short length and high height with increasing durum clear flour amount.

At can cracker and petit beurre, there was no change at length but increase in width with increasing durum clear flour.

The humidity of samples were around 2.63-5.58 %, the weight of balık cracker was around 6.3g, can cracker was around 7.6g and petit beurre was around 9.2g. The ash and protein content increased with increasing durum clear flour.

For pizza, durum clear flour was incorporated to three different pizza's flour with different ratio. The results of these samples was given at Table 40. The increasing of durum clear flour result in the increase the ash and protein content.

Çağla observed that for balık cracker the sample which contained 40% clear flour, for can cracker the sample which had no clear flour and for petit beurre the sample with 5% clear flour was the most preferable.

Table 40. The Chemical Analyses Result of Pizza Samples

	C_1 Pizza Flour / DCF					C_2 Pizza Flour / DCF					C_3 Pizza Flour / DCF				
Analyses	Cont.	%15	%30	%45	%60	Cont.	%15	%30	%45	%60	Cont.	%15	%30	%45	%60
Humidity (%)	40.51	41.86	37.83	39.66	42.44	36.61	42.36	42.92	40.63	39.85	41.30	38.43	42.54	44.02	40.09
Ash (%db)	1.71	1.69	1.78	1.82	2.14	1.52	1.44	1.69	1.84	1.90	1.65	1.77	1.98	2.11	2..27
Protein (%db)	11.75	12.03	12.50	12.97	13.64	1126	1.60	10.78	11.26	12.73	11.62	11.83	11.91	12.36	12.82

According to the study of Çağla:

15% durum clear flour was preferable for pizza making, but there is no significant change among the samples for texture and all other properties. With increasing durum clear flour, increase the attractiveness of the appearance. Although the samples which contained durum clear flour was preferable for tasting, the sample which had more than 15% durum clear flour leads to undesirable texture and taste properties at pizza. According to the calculations, use of 15% durum clear flour decreased, the production cost by 7%.

4. CONCLUSION

Bread made from the blend consisting of 25% durum flour and 75% untreated bread flour, with the addition of ascorbic acid to the baking formula, showed higher loaf volume than for bread made from all other blends, including the control bread. Bread from this blend also had better external and internal scores. Similar results were obtained with the 25% durum first clear flour and 75% untreated bread flour blend containing ascorbic acid. These loaves of bread were slightly lower in volume than the bread from the control flour containing SSL or VWG.

Since the results with the blends of durum wheat flours, in particular with the 25 % durum addition, were positive, additional studies were conducted in which bread was made with the addition of either 10 ppm potassium bromate, 10 ppm potassium bromate plus 100 ppm ascorbic acid or 0.5 % sodium stearoyl lactylate, and 100 ppm ascorbic acid. A combination of 0.5 % sodium stearoyl lactylate and 75 ppm ascorbic acid was used with the 25 % blends, including the durum flour, durum first clear flour, and semolina.

Compared to the other samples, bread from the 25% blend of durum flour or durum first clear flour resulted in higher loaf volume. Bread from these blends also gave high grain and texture scores. Crumb color was not noticeably affected with the addition of 25% durum flour or durum first clear flour to the bread.

It can be concluded that bread with acceptable characteristics can be obtained with blends containing 25% of durum flour, or durum first clear flour, and 75% bread wheat flour by the addition of SSL (0.5%) and ascorbic acid (75 ppm).

The bread containing 25% durum flour, or durum first clear flour, or semolina, and 75% untreated bread flour, with or without ascorbic acid and SSL, were less firm compared to bread made from 100% untreated bread flour, with or without additives.

The result of the analyses about the using of additives have been summarized as follows:

1. Elasticity of the dough was high when using SSL, DATAEM, VWG and DATAEM + vitamin C, while using of SSL + vitamin C + VWG together increased sharply the elasticity and the stickiness of the dough decreased with additives (separately or together).
2. The bread at which DATAEM was added had higher loaf volume than the bread at which SSL was added. Using vitamin C with emulsifiers increased the loaf volume and using DATAEM with other additives showed significant increase in loaf volume.
3. The weight of the bread at which DATAEM was added, was heavier than the bread at which SSL was added. The yield of the breads showed similar results with the weight results.
4. The loss of baking was lower for DATAEM added bread than SSL added bread and least result was obtained for the bread at which DATAEM+vitamin C were used together.

5. Use of additives increased the quality of breads using 3 % of VWG was enough for obtaining fine quality bread. The effect of Vitamin C could not be seen significantly. It was observed that DATAEM was more effective than the SSL.
6. For sensory evaluation, results showed that the sample with DATAEM for taste and the sample with DATAEM+C+VWG were accepted as the most preferable.

15% durum clear flour was preferable for pizza making. Furthermore, there is no significant change among the samples for texture and all other properties.

Increasing durum clear flour, increase the attractiveness of the apprearance. Although the samples which contained durum clear flour was preferable for tasting, the sample which had more than 15% durum clear flour leads to undesirable texture and taste properties at pizza. According to the calculations using of 15 % durum clearflour decrease 7% the production cost.

REFERENCES

1. Abecassis, J., Autran, J.C and Kabrehel, K. 1987. Composition and quality of durum wheat mill streams. In "Cereals in European Conference on food Science and Technology". Bournemounth, UK., 1-3 July, 1986.
2. American Association of Cereal Chemists. 1983. Approved Methods of the AACC. The Association: St. Paul, MN.
3. Bloksma, A.H. and Bushuk, W. 1988. Rheology and chemistry of dough. In:Wheat Chemistry and Technology. 3rd ed., Y. Pomeranz, ed. Am. Assoc. Cereal Chem.: St. Paul, M.N.
4. Boyacıoğlu H.M. 1992 Evaluation and characterization of durum wheat for bread Ph.D. in the Uni. of North Dakota State Agriculture and Applied Science Dept.
5. Ciacco, C.F and D'Appolonia, B.L. 1982 Characterization and gelling capacity of water-soluble pentosans isolated from different mill streams.. Cereal Chem. 59.163.
6. Cole, M.S. 1973. An overview of modern dough conditioners. Bakers Digest 47:21.
7. Collins, T.H. 1966. Flour properties and the Charleywood bread process. Milling 146:296.

8. Cracknell, R.L. and Moye, C.J. 1970. A colorimetric method for the determination of pentosans in cereal products. Presented at the 20 th Annual Conference, Royal Australian.

9. Czarnecka, L., Bartnik, M. and Szweryn, K. 1979. Effect of protein preparations on the baking quality of wheat and rye flours and on keepling characteristics of the bread. Przeglad Piekarski Cukierniczy 27:225. Cited in: Berglund, P.T. 1988. Examination of ultrastructure, water distribution, gluten supplementation and hard red spring wheat varietal response in frrozen bread dough. Ph.D. Thesis. North Dakota State University: Fargo, ND:

10.D'Appolonia, B.L. 1984b. Types of farinograph curves and factors affecting them. In: The Farinograph Handbook. B.L. D'Appolonia, and W.H. Kunerth, eds. Am. Assoc. Cereal Chem.: St. Paul, MN.

11.D'Appolonia, B.L.Gilles, K.A., Osman, E.M. and Pomeranz, Y. 1971. Carbohydrates. In: Wheat Chemistry and Technology. 2nd ed., Y. Pomeranz, ed. Am. Assoc. Cereal Chem.: St. Paul, MN.

12.De stefanis, V.A., Ponte, Jr. J.g., Chung, F.H. and Ruzza, N.A. 1977. Binding of crumb softeners and dough strengtheners during bread making. Cereal. Chem. 54:18.

13.Dexter, J.E., Matsuo, R.R., Preoton, K.R and Kılbarn, R.H. 1981 Comparıson of gluten strength, mixing properties, baking quality and sphaghetti quality of some Canadian durum and common wheats. Can. Inst. Food Sci. Technol. J.14:108

14.Dexter, J.E., Prenton, K.R., Martin, B.G. and Günder, E.J., 1994, The effects of protein content and starch damage on the physical dough properties and bread making quality of Canadian durum wheat, Journal of Cereal Science, 20:(2) 139-151.

15.Dische, Z. and Borenfreund, E.A. 1957. A new color reaction for determination of aldopentose in the presence of other saccharides. Biochim. Biophy. Acta 28:639.

16.Dubois, D.K. 1979. Dough Strengtheners & Crumb Softeners: I. Definition & Classification. AIB Technical Bulletin Vol.I:4. Am. Inst. of Baking: Manhattan, KS.

17.Dubois, M., Gilles, K.A., Hamilton, J.K., Rebers, P.A. and Smith, F. 1956. Colorimetric method for determination of sugars and related substances. Anal. Chem. 28:350.

18.Eliasson, A.C. 1983. Differential scanning calorimetry studies on wheat starch-qluten mixtures. II. Effect of gluten and sodium stearoyl lactylate on starch crystallization during ageing of wheat starch gels. J. Cereal Sci. 1:207.

19.Finley, K.F. 1984. An Optimized, straight-dough, bread making method after 44 years. Cereal Chem. 61:20.

20.Galliard, J. 1986. flour and baked products: Chemical aspects of functional properties. In: Chemistry and Physics of Baking.J.M.V. Blanshard, P.J. Frazier and T. Galliard, eds. The Royal Society of Chemistry: Londan, England.

21.Gilles, K.A. 1967. Wheat as human foods. In: Proc. of the Symposium on the Great Plains of North America C.C. Zimmerman and S.Russell, eds. The Horth Dokota Institute for Regional Studies: Fargo ND.

22.Harris, R.H., Sibbitt, L.D. and Scott, G.M. 1950. Effect of variety on the milling and baking quality of bread and durum wheat flour blends. Cereal Chem. 24:421.

23.IWGA, International Wheat Gluten Association. 1981. Wheat Gluten: A Natural Protein for the Future-Today. IWGA: Overlend Park, K.S.

24.Jelaca, S.L. and Hlynka, I., 1971. Water binding capacity of wheat flour crude pentosans and their relation to mixing characteristics of dough, cereal Chemistry, 48(3): 211-222.

25.Junge, R.C. and Hoseney, R.C. 1981. A mechanism by which shortening and certain surfactants improve loaf volume in bread. Cereal Chem. 58:408b

26.Kemahlıoğlu, Ö.K. 1996 The Usability of durum clear flour at breadmaking Ph.D. Thesis, in Food Engineering Dept. Uni. of Ege, Turkey

27.Kowalczuk, M. and Krasnowska, B. 1978. Potential use of flour from Amber durum wheat. Zegadnienia Piekarstwa ZBPP 23:1.

28.Krimato, J. and Shelton, D.R., 1988, The effect of flour particle size on baking quality and other flour attributen, Cereal Foods World, 33 (5): 429-433.

29.Krog, N. 1973. Influence of food emulsifiers on pasting temperature and viscosity of various starches. Starch/Starke 25:22.

30.MacArthur, L.A. and D'Appolonia, B.L. 1976. The carbohydrates of various pin milled and air classified flour streams. II. Starch and pentosans. Cereal Chem. 54:669.

31.Matsuo, R.R. and Dexter, J.E., 1980, Comporison of experimentally milled durum wheat semolina to semolina produced by some canadian commercial mills, Cereal Chemistry, 57 (2): 117-122.

32.Matz, S.A. 1987. Ingredients for Bakers. Pan-Tech. international: Mc Allen, TX.

33.Mc Dermott, E.E. 1985. The properties of commercial glutens. Cereal Foods World 30:169.

34.Milatovic, L. and Mondelli, G. 1991. Pasta Technology Today. Chiriotti Editori: Pinerolo, Italy.

35.Mooner, H. and Kirsch, P., 1995, The integrated food approach in bakery products, Food Technology International Europe, 93-96.

36.Mousa, E., Shmey, W.C., Meneval, R.D. and Banasik, O.J., 1983, Farina and semolina for pasta production, I. Influence of wheat classes and granular mill streams on pasta quality, Association of operative Millers Bulletin, 4234-4237.

37.Özen, H. 1986. Effect on bread quality of addition of durum clear flour to bread flour. (In Turkish). M.S. Thesis. University of Ankara: Ankara, Turkey.

38.Özer, C. 1994, The Usability of durum clear flour at Some oven products M.S Thesis. University of Ege: İzmir, Turkey.

39.Patkakou, V.N., 1981, Uses of durum wheat and semolina other than pasta, International Collo quim on production and utilization of durum wheat in the mediterranean Basin and Europe, November (18-19,1981), Paris, France.

40.Pomeranz, Y. 1988. Chemical composition of kernel Structures. In: Wheat Chemistry and Technology. Y. Pomeranz. ed. Am. Assoc. Cereal Chem. : St. Paul, MN.

41.Pomeranz, Y. and Shellenberger, J.A. 1961. Histochemical characterisation of wheat and wheat products. V. Sulfhydryl groups; their localization in the wheat kernel. Cereal Chem. 38:133.

42.Pyler, E.J. 1988. Baking Science and Technology. 3 rd. ed. Sostand Publishing Company: Merrian K.S.

43.Rasper, U.F.1991, Qualty evaluation of cereals and cereal products. In Handbook of Cereal Science and Technology. K.S. Lorenz and K.Kulp, eds. Marcel Decker, Inc: Newyork, N.Y.

44.Risdal, N.W. 1971. Flour for pasta and macoranı J. 53:12.

45.Schiller, G.W. 1981. Bakery Flour Specifications. AIB Technical Bulletin Vol. III: 2. Am. Inst. of Baking: Manhattan, KS.

46.Seibel, W. 1968. Experences with the maturograph and ovenrise recorder. Bakers Digest 42:44.

47.Sokol, H.A. and Mecham, D.K. 1960. Review of the functional role and significance of the sulfhydryl group in flour. Bakers Digest 34:24

48.Stauffer, C.E. 1990. Functionel additives for bakery Foods. Van Nostrand Reinhold: New York, NY

49.Tanstorf, S., Jonsson, T.and Krog, N. 1986. The role of fats and emulsifiers in baked products. In Chemistry and Physics of Baking. J.M.V. Blanshard, P.J. Frazier and T. Galliard, eds. The Royal society of Chemistry: London, England.

50.Tenney, R.J. and Schmidt, D.M. 1968. Sodium Stearoyl 2. lactylate: its function in yeast-leavened bakery products. Bakers Digest 42:38.

51.Tsen, C.C. and Hoover, W.J. 1971. The shortening-sparing effect of sodium stearoyl-2 lactylate and calcium stearoyl-2 lactylate in bread making. Bakers Digest 45:38.

52.Tripless, K.H., 1969, The relation of starch damage of the baking performance of flour, Baker's Digest, 43(6):28-32,44.

53.Ünal, S.S., 1980. The effects of additives on dough properties. University of Ege (1), 13-55.

54.Weak, E.D., Hoosency, R.C., SEIB, P.A and Bıag, M. 1977. Mixograph studies I. Effect of certain compounds on mixing properties. Cereal Chem. 54:794.

55.Wichser, F.W., Shellen berger, J.A and Pence, R.O., 1947, Relationship of physical properties of wheat flour to granulation Cereal Chemistry, 24: 381-393.

56.Wostman, B. 1950. The cystine content of wheat flour in relation to dough properties. Cereal Chem. 27: 391.

57.Zentner, H. 1968. Effect of ascorbic acid on wheat gluten I. Sci. Food Agric. 19:464.