EVALUATION OF WHEAT TYPE AND EXTRACTION LEVEL IN FLAT BREADS

by

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INTRODUCTION

Bread is the staple cereal food for much of Egypt (Faradi and Rubenthaler 1983), Iran (Ranhotra et al 1981), West Pakistan and a large percentage of the population of India (Lindell and Walker 1984). Of the cereals, wheat is the most abundantly consumed in the countries mentioned above even though the production of wheat has not always been sufficient to meet the demands of those populations. The quantity of the wheat varieties varies in these countries, making it necessary for large amounts of wheat to be imported primarily from the United States, European Economic Community and Australia. Smaller quantities are imported from Canada and Argentina (U. S.) Wheat Associates 1985). Soft white winter ,SWW, wheat has been preferred for import, primarily because of color. Most imported wheat is used to produce traditional leavened and unleavened flat breads. The Middle East and South Asia have a great variety of flat breads, which include baladi consumed in Egypt;terablesa in Tunisia; sangak,barbari, taftoon and lavash, Iran;and chapati and roti in India. While the shape and texture of flat breads vary from region to region,the basic ingredients ,basic processing characteristics such as leavening and baking, as well as the overall appearance share a number of similarities. Flat breads in general have an extremely short shelf life.

The traditional leavening of flat bread is a sour dough fermentation. The organisms responsible are airborne wild bacteria and yeasts incorporated in the dough naturally rather than added by the bread producers (Rashid 1983). A general bread formulation consists of flour, water, salt, a naturally fermented dough "starter" plus either baker's yeast, soda or both. A number of other optional ingredients, e.g. sugar, nonfat dry milk, butterfat or vegetable shortening, may be included in the formulation to enhance the aroma, texture and the taste of the product (Rubenthaler and Faridi 1981).

Wheat varieties currently grown in Middle Eastern and North African countries for use in the production of flat breads are of variable quality. The wheat varieties vary greatly in their chemical, nutritional and functional properties (Faridi et al 1981). Desirable flat bread wheat flours produce easily machinable dough and golden brown bread with a soft, creamy crumb. Ingredient variability, primarily flour, makes mechanizing flat bread production difficult (Faridi and Finney 1980). In the last few years there has been an attempt to mechanize flat bread production.

A potential market exists for uniform Kansas wheats whose end use would be flour for the production of flat breads.

For this market to be developed,more information is needed relating to the varieties of wheats and the protein levels that will produce acceptable flat breads.

Flat bread consumers prefer a white colored bread to a whole wheat flour bread. In general, flat breads are produced from higher extraction rate soft white wheat flours, (eg. 77% - 95%), than those used to produce American white pan bread (eg. 70% - 75%).

In America there has been a great deal of interest in the consumption of variety breads, including flat breads. There is a potential market for Kansas wheats to be used in the United States in the production of flat breads.

The objectives of the research were:

1. To determine the acceptability of various Kansas hard red winter, HRW, wheats for producing representative different types of flat breads. A SWW wheat, from Washington state, served as a control, due to its traditional acceptability in producing flat breads.

2. To assess quality characteristics (color, texture, organoleptic properties) of flat breads produced with the above flours utilizing organoleptic (sensory panel) techniques.

LITERATURE REVIEW

FLAT BREAD TYPES

BARBARI

Wheat is the major crop in Iran. Bread and other cereals provide between 50-90% of total caloric and protein intake of the Iranian people (Faridi and Finney 1980). Barbari, a very popular Iranian bread (Rubenthaler and Faridi 1981) is a leavened,oval bread with a length of 70 to 80 cm, a width of 25 to 30 cm and a thickness of 3.5 cm (Figure 10). Barbari bread, which is thicker and heavier than other Iranian breads (Faridi and Finney 1980),is typically eaten after dipping it in soups and gravies.

BALADI

In Egypt, bread is the main staple (Mousa et al 1979) and an important segment of the caloric contribution of the diet (Dalby 1963).Leavened bread is believed to have originated in the lower Nile Valley (Dalby 1963) during the time of the pharaohs. The flat bread of today is related to the bread from the time of the pharaohs.The most popular flat bread of the 40 different breads produced in Egypt is baladi bread. Baladi bread is a pocket bread, ie. a flat, circular loaf about 16 cm in diameter comprised of a top and bottom crust (Figure 11) with a central pocket. It is eaten as a carrier of foods such as vegetable salads, cooked, ground, spicy meat or a combination of both (Rashid 1984).

CHAPATIS

Chapatis, the staple food in Western Pakistan and India (Chaudhry 1968), have been known to people of the Indo-Pakistan area for centuries. The art of preparation of chapatis has been practised by the housewife with little change over the years. The baked bread is approximately 15.2 to 17.8 cm in diameter and 0.6 to 1.3 cm thick (Figure 12). The chapatis are traditionally served with side dishes such as vegetables, meat and milk (Lindell and Walker 1984). They are often made in the morning and carried to the fields for lunch. They are usually stacked in a pile, wrapped in cloth, and stored in baskets (Murty and Subramanian 1982).

WHEAT AND FLOUR EXTRACTION

The United States is a major wheat exporting country. At present,countries in the Middle East and North African areas are not able to satisfy their domestic demand for wheat. Research has been done to evaluate the acceptability of U.S. wheats for the production of selected flat breads (Faridiet al 1981, Mousa et al 1979 and Chaudhry 1968). In general, leavened and unleavened flat breads are produced from flours of 80 percent extractionor lower. In rural areas flours of 90 percent extraction or higher are also used (Haq and Chaudhry 1976).

BARBARI

Soft white wheats are generally used to produce Iranian breads (Kouhestani at al 1969). Faridi et al (1981) evaluated 5 U.S. hard and soft wheat varieties and a western white wheat composite in the production of the four most popular Iranian breads: barbari, lavash, taftoon and sangak. In their study, SWW were generally found to be the most suitable for Iranian breads. The HRW wheat was less satisfactory. HRW wheat doughs were too strong and difficult to handle. The darkness of the HRW wheat flour at the higher extraction levels made the bread crust too dark to be acceptable. The wheat flour extraction levels for this work ranged from 77 percent to 87 percent.

BALADI

Dalby (1963) reported that acceptable Baladi bread was prepared using a 75:25 blend of 82 percent extraction level Egyptian flour and 72 percent extraction level American flour. Mousa et al (1979) evaluated the effects of several U.S. wheat classes,flour extractions, and baking methods on the quality of baladi bread. They milled two commercial HRW and HRS wheats samples to 85, 90 and 95 percent extractions respectively. With these flours they were able to produce baladi bread of acceptable quality. Tobekhi and El-Esley (1982) used a 87.5 percent extraction flour for the production of baladi bread. In more recent research Faridi and Rubenthaler (1983) evaluated U.S. wheats for the production of baladi bread at an extraction level of 82 percent. The HRW wheat milled at the 82 percent level gave the bread an undesirable color. Soft white and club wheats performance varied among different varieties. Differences were noted in the crumb texture and crust color among the varieties. The baking quality variations that were observed were not a function of protein quantity.

CHAPATIS

Chapatis are prepared from atta, a coarsely ground wheat flour with an extraction rate of 80-95%. (Chaudhry 1968). Most chapatis are made from atta milled at the 95% extraction level (Kent 1975). Research done by Chaudhry (1968) examined U.S. wheats in the production of chapatis. He concluded that white wheats produced chapatis with better color, flavor and acceptability scores. Color was the major factor in reducing the acceptability of chapatis made from red wheat flour.

FORMULATION AND BAKING

BARBARI

Until recently, no standard method of preparation existed to experimentally evaluate the barbari flat bread. A standard method to produce barbari flat bread was introduced by

Maleki et al (1981) to study its staling pattern. The traditional method for producing barbari bread was described by Faridi and Finney in 1980;this method was modified by Faridi et al (1981) to standardize a micro baking evaluation method. This method was used to examine several U.S. wheat classes for suitability in Iranian breads. Barbari bread was one of the four types of breads evaluated. The modified experimental baking method utilized a conventional oven. In Iran, the bread is baked in a dome-shaped oven, made of fire resistant bricks and heated by petrol burners (Faridi and Finney 1980). The present study used the modified experimental baking method.

BALADI

Baladi bread is the most popular of all Egyptian breads. It is baked typically at a high temperature (840 C) for a short period of time (105 sec) (Faridi and Rubenthaler 1984). Absorption has a substantial effect on the physical characteristics and flavor of baladi bread. According to Faridi and Rubenthaler (1984) high absorption will generate more internal steam during baking. This in turn, produces finer and more uniform crumb and crust. The extremely high baking temperature results in the generation of steam that leavens the bread with explosive speed thereby producing the pocket. A number of studies have evaluated different aspects of baladi bread quality. Dalby (1969) and Hallab et al (1974) baked acceptable baladi bread at an oven temp.of 400 to 600 degrees C anda baking time of 40 to 60 sec. Faridi and Rubenthaler (1983) developed an experimental method for baking baladi bread. This study used that method.

CHAPATIS

There is no uniform and standardized method of preparation of chapatis. Preparation techniques vary from person to person. In general, atta is made into dough of the "desired consistency" by the addition of water (Mann 1970). The dough is prepared by hand kneading and is left for an hour to rest. In the past, dough sizes used to evaluate chapatis have not been constant. Chaudhry (1968) used 50 gram dough pieces to evaluate chapatis made from different U.S. wheats. One method of cooking chapaties involves placing them on the walls of a tandour, a simple oven with mud walls (Aziz and Bhatti 1982). Chapatis may also be prepared on flat iron plates over an open flame (Chaudhry and Muller 1970) or an iron plate heated by electricity (Aziz and Bhatti 1962). A modified version of Chaudhry's (1968) method of chapati production was used in this research. The modification is described later in the materials and methods section.

QUALITY EVALUATION

BARBARI

Barbari bread has been evaluated subjectively in studies by Maleki et al (1981) and Faridi et al (1981). The former study organoleptically evaluated the texture,crust color and crumb color of barbari from a control flour and the same flour plus anti-staling additives. The same study utilized the Instron Universal Testing Machine to determine staling characteristics of barbari bread. The latter study, conducted by Faridi et al (1981) evaluated different varieties of U.S. wheat by experimental baking. Evaluations and comparisons were made of dough handling properties from each flour. The baked breads' crust color and texture were analyzed. A shiny, golden brown crust with white docking marks and a few small surface bubbles were deemed desirable for the exterior bread characteristics. The bread interior should have a soft texture and light colored crumb.

BALADI

The Egyptian baladi bread has been evaluated both subjectively and instrumentally. Mousa et al(1979) organoleptically evaluated the crust color, crust characteristics, crumb color, grain and texture, flavor, taste and texture by chewing. A group of 10 native baladi consumers made up the panel. In a later study, Faridi and Rubenthaler (1983) evaluated the upper crust to lower crust ratio, pocket formation, crumb texture, crust color and rheological value. Rheological value is an instrumental value equal to the pressure in grams needed to cut through a 1 cm slice of bread with a 0.25 mm diameter wire. Pocket formation is the most important factor governing acceptability of baladi bread (Faridi and Rubenthaler 1983). The interior crumb should be very soft and moist (Dalby 1963). A shiny, light crust with brown spots, an equal ratio of upper to lower crust and a soft, moist, light crumb are desired.

CHAPATIS

Chapatis have been subjectively evaluated in a number of studies. The biggest problem in evaluating the characteristics of chapatis and defining criteria for acceptablity is that they vary from region to region and culture to culture (Lindell and Walker 1984). Mason and Hoseney (1980) subjectively characterized acceptable chapatis on the following desirable characteristics: minimal thickness, puffing throughout, centering of cleft between upper and lower surfaces, flexibility, tan to golden-brown surface color, uniformity of texture and color, adequate internal cooking and chewy texture.

This study evaluated three types of flat breads made from U.S. wheats. The wheat primarily studied were HRW varieties. Experimental methods for the production of the breads from previously-cited studies were used. The study evaluated these flat breads produced from Kansas,HRW, wheats with protein levels of 11%, 12% or 13%. The SWW control wheat from Washington state had a protein level of 9%. The wheat was milled at three extraction levels 70-75 percent,80-85 percent and 95 percent. Each bread was baked from flour milled at the native countries normal extraction level and also at the 70-75 percent extraction level. This study will provide information on the effects of wheat variety, protein level and extraction level on flat bread quality.

MATERIALS AND METHODS

MATERIALS

Five wheats were used to produce 4 flours. Two HRW wheats and one SWW wheat were milled individually. The two remaining HRW wheats were combined in a 50-50 ratio and milled. Three hard red winter wheats were obtained from the Kansas State University Agronomy Department Farms (Manhattan, KS). The fourth Kansas hard red winter wheat, a Newton variety from

TABLE I

Wheat Varieties, Classes, Composites and Extraction Rates Used for Evaluation

VARIETY	CLASS	1983	1984	PROTEIN[4]	EXT. RATE (%)
Stephens	SWW[2]		X	9%	70-75,80-85,95
Newton Blend[1]	HRW[3]	X	X	11%	70-75,80-85,95
Newton Sandyland	HRW		X	12%	70-75,80-85,95
Arkan	HRW		X	13%	70-75,80-85,95

1. 50-50 blend of a KSU Agronomy Dept. Farm 1984 wheat, protein level 10.5%, and KSU Dept. of Grain Science and Industry 1983 wheat, protein level 11.5%, to obtain a 11% protein level flour
2. Soft white winter
3. Hard red winter
4. Kjeldahl N X 5.7, 14% moisture basis

Riley county, was obtained from the Kansas State University Department of Grain Science and Industry (Manhattan, KS). One SWW wheat variety, Stephen, was obtained from the USDA Western Wheat Quality Laboratory, Pullman, WA. Varietal details and protein levels for each wheat are given in Table I.

All wheats were milled to three extraction levels, 70-75 percent, 80-85 percent and 95 percent by the methods described below.

METHODS

Cleaning and Testing

After thorough cleaning in a Hart-Carter Dockage tester (Hart-Carter Co., Minneapolis,MN), the individual wheat samples were stored in polyethylene bags at room temperature until needed for further testing and milling. Each of the 5 wheats were evaluated for test weight, seed count, 1000 kernel weight, pearling value and kernel density by standard methods (The Wheat Quality Council,1981).

Conditioning

The moisture content of the untempered wheat was determined with a Motomco Model 919 moisture meter (Motomco, Inc. Clark, N.J.). Cleaned wheat samples were tempered by the the addition of sufficient water to raise their moisture content to 15% (SWW wheat) or 16% (HRW wheat). The amount of water required for tempering was calculated according to the the formula of Scott (1951)

$$\frac{100 - M_1}{100}(W_1) = \frac{100 - M_2}{100}(W_2)$$

where W_1 = Initial weight (grams) of wheat

W_2 = Final weight of wheat

M_1 = Initial moisture content (%) of wheat

M_2 = Final moisture content (%) of wheat

since the amount of dry matter in the grain remains constant;

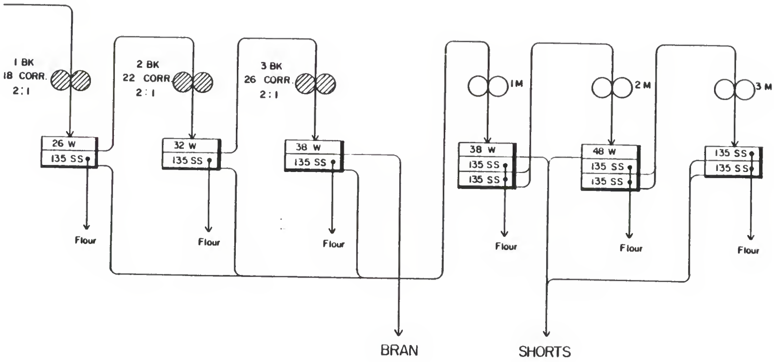
$$W_2 = \frac{100 - M_1}{100 - M_2}(W_1).$$

The conditioning was done in batches of 75,45 and 30 pounds for the 70-75%,80-85% and 95% extraction rates respectively.

For each batch, the wheat and the calculated amount of water were mixed in a rotating tempering mixer for one hour. After which the wheat was tempered overnight (12-15 hours). The following morning the wheat was placed in a polyethylene bag for storage until milling.

MILLING

Figure 1. Experimental milling flow diagram



BUHLER EXPERIMENTAL MILL

Tempered samples of each wheat were milled on the Buhler Experimental Mill to the three extraction levels given in Table I. A flow diagram of the milling process is presented in Figure 1. Each wheat was milled in 5,3 and 2 sets of 15 pounds each for the 70-75%, 80-85% and 95% extraction levels respectively. The break and reduction streams from the 5 relevent sets produced were combined to produce the 70-75% extraction level flour. For the 80-85% extraction level flour, the appropriate shorts and bran fractions were reground in a Hobart Coffee Grinder, then resieved through a 9XX stainless steel screen. The thrus were added to their break and reduction streams to obtain the desired extraction rate. The 95% extraction level flour was produced by grinding and sieving the shorts and bran by the same procedure as for the 80-85% extraction level flour. This was followed by regrinding the remaining shorts and bran in an Alpine Kolloplex 160Z Laboratory Pinmill (Alpine,Augsburg, Germany) and resieving them over a 70GG sieve. The thrus were then combined with their break and reduction streams. All flours were stored in polyethylene bags, kept in cans at 32 degrees F until studied.

ANALYTICAL METHODS

Flour moisture, ash and kjeldahl protein (N X 5.7) were determined according to AACC standard methods, 44-15A (AACC 1967), 08-01 (AACC 1961) and 46-11 (AACC 1976) respectively.

FLOUR COLOR

Flour color was analyzed according to AACC method 14-30 (AACC 1974) with a Agtron reflectance spectrophotometer model M-500A (Magnuson Engineers, Inc., San Jose,CA). Zero% and 100% reflectance levels were set using disc standards 63 and 85 respectively.

AMYLASE ACTIVITY

A Falling Number apparatus Model 1400 (Falling Number AB, Stockholm, Sweden) was used to evaluate the amylase activity of all flours according to AACC method 56-81B (AACC 1972). Results are expressed as seconds.

GLUTEN EXTRACTION

The wet and dry gluten contents of all flours were determined using Glutamatic 2200 gluten washer (Falling Number AB, Stockholm, Sweden) by the method of Greenway and Watson (1975). Results are reported as percent gluten on a 14% moisture basis.

PHYSICAL DOUGH TESTS

Farinograph: Farinograms were obtained using AACC method 54-21 (AACC 1961) with the 50-gram brass-alloy bowl. Three farinograph water absorption levels were determined. The water (%) required to center the 1st peak on the 500, 400 and 200 B.U. lines respectively was measured. Mixing, arrival and departure times, stability, valorimeter reading and mixing tolerance index were determined according to AACC method 54-21 (AACC 1961).

Extensograph: Extensograms were obtained according to AACC method 54-10 (AACC 1961) after 45,90 and 135 min rests. Results were reported as extensibility, cm, and resistance to extension,B.U., for each dough at each rest time.

Mixograph: Mixograms were obtained on ten gram flour samples by the method of Finney and Shogren (1972). The water absorption, peak height, mixing time were determined according to AACC method 54-40 (AACC 1961).

BREAD PROCESSING

The baking order for the 70-75, 80-85 and 95 percent extraction level flours were selected randomly. The study was run by baking 2 replications for each flour. Each replication involved 4 pieces of bread.

Barbari: The conditions and protocol for production of Barbari bread were those of Faridi et al (1981). Optimum baking absorption was determined by centering the farinograph curve at the 400 B.U. line. The mixograph mixing time was used as a guide in establishing the optimum mixing time using the absorption obtained above. Bread formulas are given in Table

II. After the ingredients were optimally mixed (National Mfg. Co. pin mixer, National Mfg. Co., Lincoln, Nebr.) doughs were fermented for 2 hours at 85 degrees F and 90% r.h. then punched and rested for 20 min. Dough pieces (50g) were sheeted to 3.0 mm thickness and trimmed to a 19 X 10 cm oval. The doughs were floured when necessary to aid in sheeting. One and one-half teaspoons of a paste (10 g flour boiled in 200 ml water) was spread on the dough surface and three lengthwise grooves were cut on the dough, mainly for esthetic purposes. Doughs were proofed for 15 min (85 degrees F, 90% r.h.) then baked for 12 min at 500 degrees F in a conventional reel oven. The baked bread was cooled for 1/2 to 2 hours before being scored by a sensory evaluation.

Baladi: The processing conditions and protocol for Baladi bread were also those of Faridi et al (1983). The optimum baking absorption centered the farinograph on the 200 B.U. line. Mixograph mixing time at optimum absorption was used as a guide in establishing the optimum mixing time. The baladi bread procedure is presented in Table II. All ingredients were mixed to optimum development, (National Mfg. Co. pin mixer, National Mfg. Co., Lincoln, NE). Doughs were fermented in bulk for 60 min at 85 degrees F and 90% r.h.. Pieces 75 g were then manually degassed on a heavily floured board and flattened to a thickness of 2 mm and a diameter of 16 cm with a specially designed moulder (Rubenthaler and Faridi 1982). Moulded doughs

TABLE II

Flat Bread Formulas

Ingredients[a]	BREAD Barbari %	Baladi %	Chapati %
Flour	100	100	100
Salt	2	1.5	0.0
Water[b]	variable	variable	variable
Yeast[c]	0.4	0.4	0.0

[a] On 14% flour moisture basis

[b] Determined by farinograph 400, 200 and 500 B.U. line respectively

[c] Instant Active Dry Yeast (Fermipan)

were transferred to a floured board and proofed for 30 min (85 degrees F, 90% r.h.). After proofing, a floured wooden paddle was used to slide the dough onto two firestone bricks positioned on the floor of a modified electric kiln oven(Model S18FL Olympic Kilns, Orahugen Manufacturing Inc., Atlanta GA) Figure IV. The pieces were baked 105 sec at 840 degrees F. The kiln modification was made to decrease the change in oven temperature that occured when the door was opened. The diameter of the kiln opening was decreased by the addition of five specially cut firestone bricks. A piece of thermoplate was cut to make a new, smaller door. Sensory evaluation of bread was conducted 1/2 to 2 hours after baking.

Chapatis: The processing and protocol for the production of Chaudhry (1968) method chapatis was modified by layering the dough with vegetable oil when sheeting the dough. Optimum baking absorption was determined by the farinograph centered at the 500 B.U. line. The bread formula is given in Table II. The ingredients were mixed in the Hobart Mixer Model N-50 (Hobart Corporation,Troy OH) for 30 sec on speed 1 and 4 to 5 min on speed 2. The dough was fermented in bulk at 78-80 degrees F for 1 hour in a greased stainless pan covered with a damp cloth. Dough pieces 50g were sheeted to a thickness of 1 mm, and 1/2 teaspoon of vegetable oil was spread on the top surface. The dough was folded into 5 triangular folds on the top surface and the edges were sealed. The oil was used to create layers and puff the chapatis. The specially designed moulder (Rubenthaler and Faridi 1982) was floured when necessary to assist in rolling out the dough. After layering, the dough was again sheeted to 1 mm thickness, and a circular piece 15.2 cm in diameter was cut. The circular dough piece was baked in a cast-iron pan at 280-290 degrees C. The pan was heated by an electric burner. The bread was baked for a total of 2 min. During baking each piece was turned approximately every 30 sec. The bread was stored between layers of paper towels and Saranwrap. Sensory evaluation was conducted 1/2 to 2 hours after baking.

Figure 2. Barbari bread: Production details

STEPS	NOTES
MIXING	National Mfg. Co. Mixer 225g, 14% mb
↓	
FERMENTATION	2 hours/ 85°F/ 90% rh
↓	
DIVIDING, MOULDING	75g dough balls
SHEETING	3mm thick
TRIMMING	10 X 19cm oval, decorative paste
↓	
PROOFING	15 min/ 85°F/ 90% rh
↓	
BAKING	12 min/ oven/ 500° F

Figure 3. Baladi bread: Production details

STEPS	NOTES
MIXING	National Mfg. Co. Mixer 225g, 14% mb
↓	
FERMENTATION	60 min/ 85°F/ 90% rh
↓	
DIVIDING	75g dough balls
DEGASS & MOULD	
SHEETING	2mm, diameter 16cm
↓	
PROOFING	30 min/ 85°F/ 90% rh
↓	
BAKING	105 sec/ modified electric kiln / 840°F

Figure 4. Modified Electric Kiln Oven

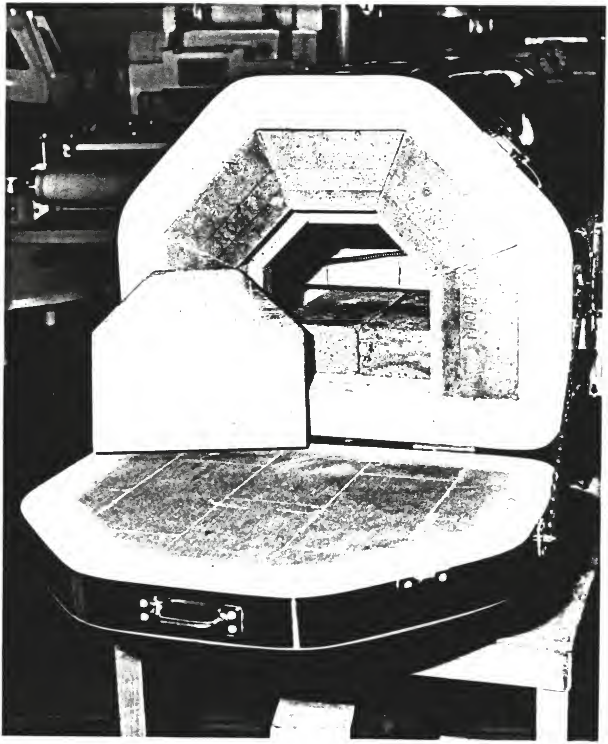


Figure 5. Chapatis: Production details

STEPS	NOTES
MIXING	Hobart Mixer N-50 225g, 14% mb
↓	
FERMENTATION	60 min/ 78-80°F
↓	
DIVIDING	50g dough balls
LAYERING	1/2t vegetable oil
SHEETING	1mm, diameter 15.24cm
↓	
BAKING	2 min/ cast-iron pan / 280-290°C

SENSORY EVALUATION

Sensory evaluation of 1/2 - 2 hour old bread was carried out by a trained panel of graduate students and faculty members from Kansas State University. Score sheets (Figures 6-8) for the evaluations were modified from those designed by Rashid (1984) for a similar purpose. Characteristics evaluated for each bread were as follows: for barbari, crust color, crumb color, crumb texture and crumb cell size; for baladi, crust color, ratio of upper to lower crust, pocket formation and crumb texture; for chapatis, color flavor, texture and over-all acceptance.

Panel members were instructed to mark by a vertical line their evaluation of each quality characteristic on the appropriate 15 cm horizontal line. Evaluations were based on the two end standard inserts 0.5 cm from line ends. Raw data for each characteristic were the distances (to 0.1 cm) from the left end of the line to the evaluation mark. This value was divided by the total line length and multiplied by 100 to give evaluations as percents of the possible score. Data is reported as means of 12, 10 and 10 measurements for barbari bread, baladi bread and chapatis, respectively.

Figure 6. Sensory Evaluation: BARBARI

Sensory Evaluation of Flat Bread
(Barbari)

Please evaluate each sample for the following characteristics. Examine the characteristics in the order that you prefer. Rank each attribute according to the indicated scale. The actual line length is 15 cm.

Crust Color	Very Light	Very Dark
Crumb Color	Very Light	Very Dark
Texture	Very Soft	Very Firm
Crumb Cell Size	Very Fine	Very Coarse

Figure 7. Sensory Evaluation: BALADI

Sensory Evaluation of Flat Bread
(Baladi)

Please evaluate each sample for the following characteristics. Examine the characteristics in the order that you prefer. Rank each attribute according to the indicated scale. The actual line length is 15 cm.

Crust Color	White	Brown
Upper Crust to Lower Ratio	Top Thicker	Bottom Thicker
Pocket Formation	Tearing of Crust	No Pocket
Crumb Texture	Soft and Moist	Dry and Firm

Figure 8. Sensory Evaluation: CHAPATI

Sensory Evaluation of Flat Bread
(Chapati)

Please evaluate each sample for the following characteristics. Examine the characteristics in the order that you prefer. Rank each attribute according to the indicated scale. The actual line length is 15 cm.

	Poorest	Best
Color	|————————————	————————————|
Flavor	|————————————	————————————|
Texture	|————————————	————————————|
Over-all Acceptance	|————————————	————————————|

RESULTS AND DISCUSSION

MILLING

The SWW wheat did not mill or sift as cleanly as the HRW wheat. With an equal quantity of SWW and HRW wheat, the time taken to mill and to resieve the SWW was greater than for the HRW, as expected.

FLOUR COMPOSITION

The results of the analyses of flour moisture, protein, ash and flour color are given in Table III. The protein levels of the three extraction level flours ranged from 8.0 to 8.7 percent for the SWW wheat,Stephens, and 12.1 up to 13.0 percent in the HRW wheat, Arkan. As expected, each flour protein level increased as extraction level increased.

The individual flour ash percentages increased with an increase in extraction level. A higher ash level is associated with darker flour color. At each extraction level, Stephens, flour had the lowest ash level and the lightest flour color. Each flour became darker as its extraction level increased due to an increase of bran in the flour. At the 95 percent extraction level all flours were so dark that color readings were off the scale.

Table III. Flour Quality Data*

BREAD	WHEAT VARIETY	PROTEIN[a,b] (%)	MOISTURE (%)	ASH[a] (%)	FLOUR COLOR[c]
Barbari Baladi, Chapatis <u>70-75% ext.</u>	Stephens	8.0	13.0	0.43	76
	Newton				
	Blend	9.4	13.0	0.55	51
	Sandyland	10.0	13.1	0.48	57
	Arkan	12.1	13.2	0.53	56
Barbari, Baladi <u>80-85% ext.</u>	Stephens	8.1	12.1	0.59	59
	Newton				
	Blend	9.8	13.3	0.67	31
	Sandyland	10.7	12.6	0.81	24
	Arkan	12.3	12.6	0.73	36
Chapati <u>95% ext.</u>	Stephens	8.7	11.0	0.97	< 0
	Newton				
	Blend	10.3	11.1	1.26	< 0
	Sandyland	11.1	11.8	1.27	< 0
	Arkan	13.0	12.0	1.37	< 0

* Average of two replications

a 14% moisture basis

b N x 5.7

c Agtron color

PHYSICAL DOUGH CHARACTERISTICS

Physical dough characteristics, as determined by the farinograph are shown in Figure 9. The representative data obtained from measuring these curves and the mixogragh curves are presented in Tables IV,V VI and VII. The farinograph absorptions were run at the 500 B.U.,400 B.U. and 200 B.U. values.

As flour extraction levels increased, farinograph water absorption values increased, for all flours, with the exception of the Newton Blend on the 400 B.U. and 200 B.U. absorption lines. It has been found that when testing flour blends on the farinograph, the absorption can vary. The farinograph curve produced by a blend depends upon the influence that the individual flours comprising the blend have on one another (The Farinograph Handbook,1972). This influence can be attributed, in part to the absorption of each individual flour. This may help to explain the variability of the data for the Newton Blend flours. The doughs created at the 200 B.U. water absorption line were extremely slack and sticky due to their high water content. For the SWW flour the peak times for the 500 B.U. line farinographs increased slightly with increasing extraction levels. The HRW wheat flour peak times were variable among the extraction levels, without trends. In spite of this they were longer than those of the corresponding SWW flours at the same extraction levels. A relationship was observed between higher protein levels and longer peak times. As noted in Table IV, the HRW 70-75 percent extraction level flours, as expected, had the greatest stability.

The MTI (Mixing Tolerance Index) for the HRW flours ranged from good to excellent. Thus, they all had a high tolerance to mixing. The SWW flours' tolerance to mixing was poor. A relationship was observed between the higher stability of the HRW flours and their low MTI values.

The mixograph mixing times generally decreased as the flour extraction levels increased from 70-75 percent to 80-85 percent and to 95 percent (Table VII). The single exception to this trend was the Newton Blend flour, from the 80-85 percent to the 95 percent extraction level. The mixing time for 95 percent extraction level flour increased. The unpredictable effect of flour blends can be used to explain the mixing time variability of the Newton Blend 95% extraction level flour. The Stephens SWW flours had the shortest mixing time at each extraction level.

The extensograph data, extensibility and resistance to extension, generally gave lower values for SWW flours. The behavior of the 3 SWW flours followed this trend. The HRW flours had the greatest extensibility and resistance to extension, as expected. As the extraction levels for the HRW flours increased from 70-75% to 95%, the extensibility decreased. The Newton Blend flour showed an increase in resistance to extension as the extraction level increased from 70-75% to 95%.

Figure 9. Farinograms of experimental flours

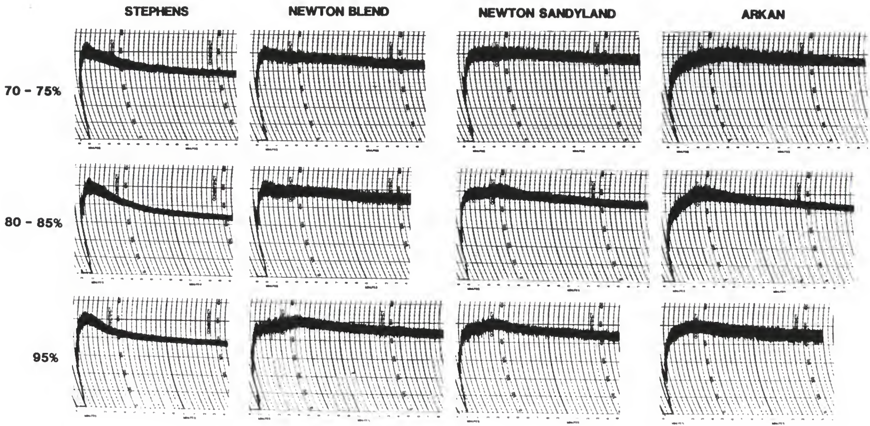

STEPHENS
NEWTON BLEND
NEWTON SANDYLAND
ARKAN
70 - 75%
80 - 85%
95%

Table IV. Farinogram Data of Flours 500 B.U. Line

Flour	Water Abs. (%)	Arrival Time (min)	Peak Time (min)	Stability (min)	Departure Time (min)	MTI*	VV**
70-75% ext.							
Stephens	54.9	1.1	1.6	2.1	3.2	108	38
Newton Blend	57.1	1.4	2.0	5.6	7.0	34	54
Newton Sandyland	59.0	1.3	2.9	12.1	13.4	18	60
Arkan	57.1	3.4	7.0	12.8	16.2	28	64
80-85% ext.							
Stephens	57.5	1.1	1.7	1.9	3.0	140	33
Newton Blend	57.3	1.2	1.9	7.9	9.1	30	54
Newton Sandyland	63.8	1.8	4.7	6.9	8.7	50	60
Arkan	59.3	3.2	5.4	5.7	8.9	43	58
95% ext.							
Stephens	63.1	1.2	1.9	2.2	3.4	102	37
Newton Blend	65.7	1.8	5.0	8.4	10.2	40	55
Newton Sandyland	69.6	2.8	4.4	4.1	6.8	43	51
Arkan	64.7	2.3	4.1	7.9	10.2	25	25

* Mixing Tolerance Index MTI (B.U.)

** Valorimeter Value

Table V. Farinogram Data of Flours 400 B.U. Line

Flour	Water Abs. (%)	Arrival Time (min)	Peak Time (min)	Stability (min)	Departure Time (min)	MTI*	VV**
<u>70-75% ext.</u>							
Stephens	59.6	1.0	1.5	2.3	3.3	55	29
Newton Blend	63.3	1.6	2.5	11.0	12.6	5	42
Newton Sandyland	65.2	2.5	8.0	17.5	20.0	15	68
Arkan	62.4	5.1	10.0	18.1	23.2	12	75
<u>80-85% ext.</u>							
Stephens	61.8	1.2	1.5	3.2	4.3	85	27
Newton Blend	62.0	1.6	6.0	16.9	18.5	20	48
Newton Sandyland	69.0	3.5	6.0	8.0	11.5	25	58
Arkan	64.5	4.7	6.5	14.3	19.0	15	62

* Mixing Tolerance Index MTI (B.U.)

** Valorimeter Value

Table VI. Farinogram Data of Flours 200 B.U. Line

Flour	Water Abs. (%)	Arrival Time (min)	Peak Time (min)	Stability (min)	Departure Time (min)	MTI*	VV**
70-75% ext.							
Stephens	67.6	3.5	5.0	4.0	7.5	20	65
Newton Blend	74.0	36.0	51.0	24.0	60.0	5	100
Newton Sandyland	74.4	35.0	46.0	22.0	57.0	5	100
Arkan	73.5	21.0	28.5	20.0	41.0	5	100
80-85% ext.							
Stephens	69.6	3.3	4.5	3.2	6.5	28	63
Newton Blend	72.5	17.0	22.0	13.0	30.0	5	98
Newton Sandyland	80.0	11.0	15.0	8.0	19.5	5	91
Arkan	74.0	11.0	19.0	21.0	32.0	9	95

* Mixing Tolerance Index MTI (B.U.)

** Valorimeter Value

Table VII. Mixograph Data of Flours*

Flour	Water Abs. (%)	Peak Height (cm)	Mixing Time (min)
70-75% ext.			
Stephens	51.0	1.7	1.8
Newton Blend	52.0	1.9	1.6
Newton Sandyland	57.0	3.7	3.0
Arkan	55.0	3.2	2.2
80-85% ext.			
Stephens	55.0	0.6	0.8
Newton Blend	54.0	2.1	1.5
Newton Sandyland	57.0	2.7	2.4
Arkan	59.0	2.7	1.9
95% ext.			
Stephens	59.0	0.4	0.6
Newton Blend	58.0	3.1	2.1
Newton Sandyland	58.0	2.9	2.0
Arkan	58.0	2.2	1.6

* Average of two replications

Table VIII. Extensogram Data for Experimental Flours

Flour	Extensibility (cm) (a)			Resistance to Extension (B.U.) (b)			b/a (B.U./cm)		
	45	90	135	45	90	135	45	90	135
<u>70-75% ext.</u>									
Stephens	166	157	163	208	247	250	1.3	1.6	1.5
Newton Blend	208	206	199	361	439	490	1.7	2.1	2.5
Newton Sandyland	208	203	191	453	506	560	2.2	2.5	2.9
Arkan	258	237	207	521	701	770	2.0	3.0	3.7
<u>80-85% ext.</u>									
Stephens	163	158	169	130	138	164	0.8	0.9	1.0
Newton Blend	196	187	183	418	503	521	2.1	2.7	2.9
Newton Sandyland	217	235	240	224	271	296	1.0	1.2	1.2
Arkan	218	268	259	188	268	346	0.9	1.0	1.3
<u>95% ext.</u>									
Stephens	139	132	133	166	203	233	1.2	1.5	1.8
Newton Blend	150	140	135	316	427	585	2.1	3.1	4.3
Newton Sandyland	158	154	142	209	315	426	1.3	2.1	3.0
Arkan	187	189	180	280	449	583	1.5	2.4	3.2

Data an average of three replications

DOUGH HANDLING PROPERTIES

In preparation of the doughs, several dough characteristics were evaluated. These included dough sheeting and the ability of the dough pieces to maintain the desired shape after being cut to size.

The HRW wheat flour doughs were the most difficult to roll into shape. This was true for all three types of flat breads tested. For each bread the lower extraction level flours (70-75 percent) were the most difficult to roll out. They exhibited a great deal of elastic recovery after they had been cut to shape. Greater farinograph stability, lower MTI values and higher ratio values (b/a), resistance to extension/extensibility , were observed with the lower extraction HRW flours. Such characteristics relate to a stronger, more elastic dough.

In contrast, the SWW flours were the most extensible, least elastic, and easiest to roll into shape. In some cases, the wheat doughs were so extensible that they stretched to a larger SWW than desired shape. The SWW flours were the least stable as measured by the farinograph and had the highest MTI values. The extensogram ratio data (b/a) for the SWW doughs indicated that they were less elastic and more extensible than the HRW doughs. The behavior characteristicsof the three experimental flat bread doughs are listed in Appendix C,D and E.

The doughs made from the lowest extraction level flours were the most difficult to handle according to characteristics previously mentioned. At each extraction level, the SWW Stephens dough was the easiest to work with. An acceptable flour can not be selected based on dough characteristics alone. The physical characteristics of the baked bread are the most important criteria to evaluate in selecting acceptable wheat flours.

PRODUCT CHARACTERISTICS

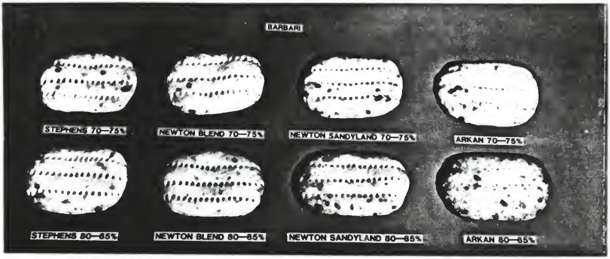
BARBARI

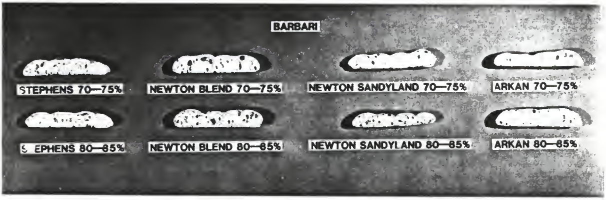
Barbari bread was baked with the previously described 4 different flours, each milled to two extraction levels, 70-75 percent and 80-85 percent. Characteristics of the baked loaves based on visual inspection are presented in Figure 10. Observations on bread noted by the author are listed in Table IX.

Crust color of loaves made from SWW flour, Stephens, was lightest at both extraction levels. These observations are similar to those of Faridi et al (1981). In Iran, the barbari bread consumers prefer a golden brown crust. The four breads produced from 80-85 percent extraction level flour were darker than their corresponding 70-75 percent extraction level breads. The darker color of the higher extraction level HRW wheat breads is due to the presence of red pigment in the bran.

The average of four replications duplicated for volume, weight and specific volume are presented in Table X. The SWW 70-75 percent extraction level bread had significantly less volume than the remaining breads as shown in Table X. The 70-75 percent extraction SWW dough did not maintain its cut oval shape. The cut shape stretched out more than desired, and the final bread thickness was undesirably thin. This could be the reason for the reduction in volume and

Figure 10.   Barbari flat bread


BARBARI
STEPHENS 70—75%
NEWTON BLEND 70—75%
NEWTON SANDYLAND 70—75%
ARKAN 70—75%
STEPHENS 80—85%
NEWTON BLEND 80—85%
NEWTON SANDYLAND 80—85%
ARKAN 80—85%


BARBARI
STEPHENS 70—75%
NEWTON BLEND 70—75%
NEWTON SANDYLAND 70—75%
ARKAN 70—75%
NEWTON BLEND 80—85%
NEWTON SANDYLAND 80—85%
ARKAN 80—85%

weight previously mentioned. In addition, the larger the surface area the greater the water lost from the bread surface during baking. This is consistent with the two SWW Stephens breads weighing less than the HRW wheat breads. The specific volumes for all the barbari breads were not significantly different (P=0.05).

Table IX. BARBARI Bread Appearance

Flour	Appearance
<u>70-75% ext.</u>	
Stephens	white crust, a few brown surface spots, oval shape, too flat
Newton Blend	cream crust with brown spots and edges, oval shape
Newton Sandyland	cream crust with brown edges,oval shape
Arkan	cream crust with brown spots and edges, oval shape
<u>80-85% ext.</u>	
Stephens	cream crust with brown edges, prefer more color, oval to square shape
Newton Blend	beige crust with brown edges, oval shape
Newton Sandyland	dark beige crust with brown edges, oval shape
Arkan	dark beige crust with brown on the edges,oval shape ends not perfect

Observations made by the author

Table X. Baking Data: BARBARI *

Flour	Volume (cc)	Weight (g)	Specific Volume (cc/g)
70-75% ext.			
Stephens	372.5b	127.8abc	2.9a
Newton Blend	425.0ab	136.1a	3.1a
Newton Sandyland	416.9ab	133.4ab	3.2a
Arkan	417.5ab	134.4ab	3.1a
80-85% ext.			
Stephens	403.8ab	124.0c	3.3a
Newton Blend	445.0a	128.1abc	3.5a
Newton Sandyland	392.5ab	126.4bc	3.1a
Arkan	431.9ab	129.5abc	3.4a

* Average of 4 replications duplicated

Numbers with the same letters do not differ significantly (P=0.05)

BARBARI SENSORY EVALUATION

The sensory evaluation scores for crust color, crumb color,texture and crumb cell size were calculated from the sensory evaluation scale (preferred value of 0.5). The most weighted characteristic was the crust color. Data are presented in Table XI. Scores obtained for the characteristics are the average of 8 scores assigned by 6 panel members.

At the 70-75 percent extraction level, all the breads had acceptable crust and crumb color as observed in Table XI. The texture of all the 70-75 percent HRW breads were satisfactory. The crumb cell size at the 70-75 percent extraction level breads was unacceptable for the HRW, Arkan breads. The HRW Newton Blend and Newton Sandyland flours produced breads that were statistically similiar in all four characteristics to the control bread. The HRW 80-85 percent extraction level Newton Blend and Arkan flours had satisfactory crust color. The Arkan ,HRW, bread had standard crumbcolor. All the HRW 80-85% extraction level breads had acceptable texture values. The HRW Newton Sandyland and Arkan had satisfactory crumb cell size. The Arkan ,HRW, flour produced breads that were satisfactory in all four criteria. This Arkan flour produced the most acceptable 80-85% extraction level breads. This is interesting since the Arkan flour had a considerably higher protein level than the Stephens control. Both the Stephens and Arkan doughs were easy to roll but,

Table XI. Mean Scores and Statistical Significance of Sensory Evaluation Data: BARBARI

Flour	Crust Color	Crumb Color	Texture	Crumb Cell Size
<u>70-75 % ext.</u>				
Stephens	*34.0c	*33.9c	39.3d	*38.6d
Newton Blend	*38.4c	*37.0c	*43.8cd	*44.2bcd
Newton Sandyland	*37.5c	*38.4c	*47.3bc	*50.1abc
Arkan	*46.1bc	*41.4bc	*44.6cd	55.5a
<u>80-85% ext.</u>				
Stephens	44.8bc	42.3bc	49.6abc	42.3cd
Newton Blend	*55.8ab	58.3a	*55.3a	52.5ab
Newton Sandyland	62.5a	63.9a	*53.3ab	*49.9abc
Arkan	*44.2bc	*49.0b	*49.9abc	*49.3abc

Average of 4 replications duplicated and tested by 6 evaluators

Numbers with the same letter in the same column do not differ significantly (P=0.05)

*
Means with * did not differ significantly from Stephens 80-85%

neither dough held its shape well after being cut. Data for extensogram extensibility and resistance to extension for those two 80-85% extraction level flours were not similiar. This may be explained by the physical characteristics of both the Stephens,SWW, and Arkan,HRW, wheats.

PRODUCT CHARACTERISTIC

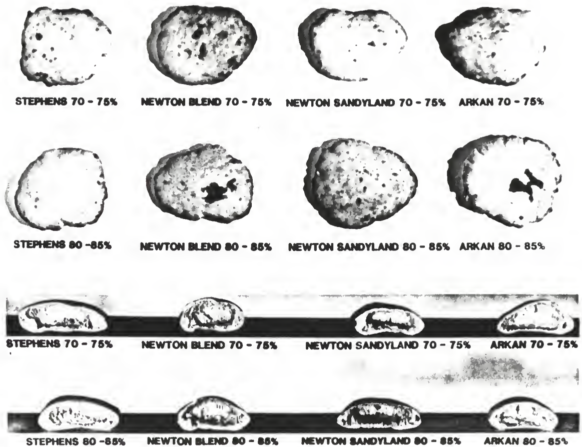
BALADI

As with barbari, baladi bread was baked with the experimental flours each milled at the same two extraction levels, (70-75 percent and 80-85 percent). The baked breads are shown in Figure 11. Observations on baladi bread appearance noted the author are listed in Table XII.

A light shiny crust with brown surface spots is desired in baladi loaves. Crust color of the bread produced from the SWW flour, Stephens, was lightest for both extraction levels (70-75 percent and 80-85 percent). The fact that SWW wheats produced desireable crust color has been previously observed by Faridi and Rubenthaler (1983). The four 80-85 percent extraction level flours produced darker crusts than their corresponding 70-75 percent extraction level flours. Pocket formation is also an important characteristic when evaluating baladi bread (Faridi and Rubenthaler 1983). Generally, the weight, volume and specific volume were not affected by the flour type or the extraction level at which they were milled.

Figure 11. Baladi flat bread

BALADI



STEPHENS 70 - 75%
NEWTON BLEND 70 - 75%
NEWTON SANDYLAND 70 - 75%
ARKAN 70 - 75%
STEPHENS 80 -85%
NEWTON BLEND 80 - 85%
NEWTON SANDYLAND 80 - 85%
ARKAN 80 - 85%
STEPHENS 70 - 75%
NEWTON BLEND 70 - 75%
NEWTON SANDYLAND 70 - 75%
ARKAN 70 - 75%
STEPHENS 80 -85%
NEWTON BLEND 80 - 85%
NEWTON SANDYLAND 80 - 85%
ARKAN 80 - 85%

Table XII. BALADI Bread Appearance

Flour	Appearance
<u>70-75% ext.</u>	
Stephens	white crust with brown surface spots, oval shape
Newton Blend	creamy crust with a few brown spots, circular to square
Newton Sandyland	creamy crust with brown ridges and surface spots, oval shape
Arkan	white with brown spots and edges,one edge too thick,symmetry terrible
<u>80-85% ext.</u>	
Stephens	creamy crust with light brown edges and surface spots,circular
Newton Blend	creamy crust,light brown spots,circular to oval shape
Newton Sandyland	beige crust with brown edges and a few brown spots,one thick edge,square-oval
Arkan	creamy crust with brown surface spots and edges,oval shape

Observations made by the author

Table XIII. Baking Data: BALADI*

Flour	Volume (cc)	Weight (g)	Specific Volume (cc/g)
70-75% ext.			
Stephens	551.9ab	64.1ab	8.6a
Newton Blend	487.5b	61.4b	7.9a
Newton Sandyland	553.8ab	65.1ab	8.5a
Arkan	558.1ab	68.1a	8.2a
80-85% ext.			
Stephens	581.9a	68.6a	8.5a
Newton Blend	532.5ab	66.6ab	8.0a
Newton Sandyland	522.5ab	65.4ab	8.0a
Arkan	528.8ab	64.6ab	8.2a

* Average of 4 replications duplicated

Numbers with the same letters do not dffer significantly (p=0.05)

BALADI SENSORY EVALUATION

The sensory evaluation scores for crust color, ratio of upper crust to lower crust, pocket formation and texture were calculated from the sensory evaluation scale (preferred value of 0.5 for the first three variables and the lowest value for texture). Data are presented in Table XIV. Scores obtained for the various quality characteristics are the average of 8 scores assigned by each of 5 panel members.

At the 70-75 percent extraction level all the HRW flours had acceptable bread crust color, one of two primary important bread characteristics. For the other important characteristic ,pocket formation, all the, breads were satisfactory.All of the 70-75% extraction level flours produced breads that were acceptable in both of the 2 most important evaluating characteristics, crust color and pocket formation. The Stephens, SWW, produced breads that had all the desireable characteristics at the 70-75 percent extraction level.

At the 80-85 percent extraction level all the HRW flours produced breads with standard crust color, pocket formation and texture. The 80-85 percent extraction level HRW flour, Newton Blend produced the most satisfactory bread. This HRW, Arkan bread was acceptable in every characteristic except ratio of upper crust to lower crust. At the Arkan 80-85% extraction level was the second most acceptable bread of all the flours tested.

Table XIV. Mean Scores and Statistical Significance of Sensory Evaluation Data: BALADI

Flour	Crust Color	Ratio of Upper Crust to Lower Crust	Pocket Formation	Texture
<u>70-75% ext.</u>				
Stephens	*49.5a	*46.0ab	*47.9b	*28.1ab
Newton Blend	*28.1b	50.8a	*55.8ab	*27.4ab
Newton Sandyland	*38.6ab	*43.3ab	*48.9b	24.6b
Arkan	*42.1ab	54.9a	*61.8a	*27.8ab
<u>80-85% ext.</u>				
Stephens	42.9ab	37.1b	53.8ab	35.5a
Newton Blend	*24.3b	*44.8ab	*60.6ab	*31.5ab
Newton Sandyland	*51.8a	49.9a	*54.6ab	*26.1ab
Arkan	*34.6ab	50.0a	*59.6ab	*28.0ab

Average of 4 replications duplicated and tested by 5 evaluators

Numbers with the same letter in the same column do not differ significantly (P=0.05)

*

Means with * did not differ significantly from Stephens 80-85%

PRODUCT CHARACTERISTICS

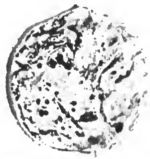
CHAPATIS

Chapatis were baked with the four experimental wheats, each milled to extraction levels of 70-75 percent and 95%. Pictures of the baked chapatis are shown in Figure 12. Observations on chapati appearance are listed in Table XV.

The lower extraction level flours produced chapatis that were white with brown surface spots. At this extraction level the edges of the breads were split. The higher extraction level breads were light cream colored to creamy beige. Previous research in this area selected the 95 percent extraction flour as being most desirable based on color (Chaudhry 1968). As was the case for its flour, the darker color of the 95 percent extraction level bread from hard red winter wheat flour was due to the red pigment in the bran. The two ,SWW, Stephens extraction level chapatis weighed more than each of their corresponding HRW chapatis. The reason for this is unclear.

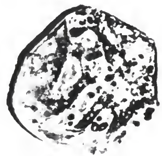
Figure 12. Chapati flat bread

STEPHENS 70 - 75%



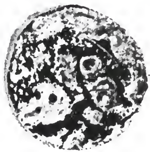
NEWTON BLEND 70 - 75%

NEWTON SANDYLAND 70 - 75%



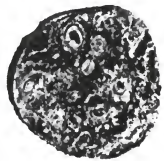
ARKAN 70 - 75%

STEPHENS 95%



NEWTON BLEND 95%

NEWTON SANDYLAND 95%



ARKAN 95%

Table XV. CHAPATI Appearance

Flour	Appearance
<u>70-75% ext.</u>	
Stephens	white with brown spots
Newton Blend	white with brown spots, split edges
Newton Sandyland	white with brown edges, split edges
Arkan	white with brown edges, split edges
<u>95% ext.</u>	
Stephens	light cream with brown spots
Newton Blend	creamy beige with brown spots
Newton Sandyland	creamy beige with brown spots
Arkan	creamy beige with brown spots

Observations made by the author

CHAPATI SENSORY EVALUATION

The sensory evaluation scores for color,flavor,texture and over all acceptance were calculated from the sensory evaluation scale with the (preferred value being 1.0). Data are presented in Table XVI. Scores obtained for the characteristics are the average of 8 scores assigned by 5 panel members.

The 70-75 percent extraction level flours produced bread that scored lower than the accepted control (Stephens 95% extraction level) bread. In every characteristic in the evaluation, the 70-75 percent extraction level breads were not satisfactory. The HRW, Newton Blend and Arkan 95% extraction level breads were statistically comparable to the control, SWW, Stephens bread. The remaining HRW Newton Sandyland bread was not satisfactory in over all acceptability.

Table XVI. Mean Scores and Statistical Significance of Sensory Evaluation Data: CHAPATI

Flour	Color	Flavor	Texture	Over-all Acceptance	Wt. (g.)
70-75% ext.					
Stephens	36.8b	22.9b	33.8b	30.0c	36.4a
Newton Blend	39.8b	28.1b	34.3b	31.0c	35.1ab
Newton Sandyland	28.3b	23.1b	23.8b	24.5d	35.5ab
Arkan	39.1b	26.6b	26.1b	26.6cd	32.0b
95% ext.					
Stephens	66.4a	65.1a	57.3a	64.5a	36.1a
Newton Blend	*62.8a	*64.8a	*63.0a	*64.1a	33.3ab
Newton Sandyland	*59.3a	*59.6a	*56.0a	57.3b	33.5ab
Arkan	*60.3a	*67.6a	*60.0a	*62.6a	34.9ab

Average of 4 replications duplicated and tested by 5 evaluators

Numbers with the same letters in the same column do not differ significantly (P=0.05)

*

Means with * did not differ significantly from Stephens 95%

SUMMARY

The objective of the present study was to determine the suitability of American grown wheats,particuarly those from Kansas, for use in producing barbari, baladi and chapati flat breads. The HRW wheats were selected on the basis of their protein levels and a SWW wheat was used as the control. Each wheat was milled at three extraction levels 70-75 percent, 80-85 percent and 95 percent. The flours were tested to determine proximate composition. The physical characteristics of the dough were studied in the farinograph, mixograph and extensograph. As the extraction levels increased, the farinograph absorption values increased. The absorption values were greater for the higher protein HRW flours than the SWW flours. The HRW Newton Blend gave inconsistent data on the farinograph, attributable in part to the influence of the absorptions of each individual flour in the blend. A relationship was observed between higher protein levels and longer farinograph peak times. As expected, the HRW 70-75 percent extraction level flours had the greatest mixing stability. A correlation was also observed between the higher stability of the HRW flours and their low MTI values. The mixogragm mixing times decreased as the flour extraction level increased from 70-75 percent to 80-85 percent and to 95 percent. The mixing times of the flat bread doughs also decreased as the extraction level increased.

The extensogragh data suggested that the HRW doughs were elastic in comparison to the SWW doughs.

The following characteristics where observed when handling the doughs: dough sheeting, and the ability of the dough pieces to maintain the desired shape after being cut to size. The HRW 70-75 percent extraction level doughs were the most difficult to roll out. The SWW dough at each extraction level was the easiest to work with.

A sensory evaluation was conducted of the three baked flat breads. The color of barbari breads made with 70-75 percent extraction level HRW were satisfactory. The Newton Blend and Newton Sandyland (HRW) flour produced the most acceptable barbari bread at the 75 percent extraction level flour. The 80-85 percent extraction level Arkan (HRW) flour produced the most acceptable breads relative to the control (Stephens) flour. The two remaining 80-85 percent extraction level HRW flours did not produce satisfactory barbari breads. The 70-75% extraction level flours produced a larger number of acceptable barbari breads than did the 80-85% extraction level flours.

At the 70-75 percent extraction level all the breads had acceptable baladi crust color. At both extraction levels all of the flours produced breads that were acceptable in both of the two most important evaluating characteristics, crust color and pocket formation. At the 70-75 percent extraction level the SWW Stephens flour produced the most acceptable bread. At the 80-85 percentextraction level, the HRW Newton Blend flour produced the most acceptable breads. The flour from Arkan and Newton Sandyland, HRW, 80-85% extraction level, produced the second most satisfactory breads.

In every chapati characteristic the 70-75 percent extraction level breads were unacceptable. The breads produced by all the 95 percent extraction level flours were satisfactory in almost every characteristic. The HRW,Newton Blend and Arkan 95% extraction level breads were acceptable,compared with the control SWW, Stephens bread.

The Arkan and Newton Blend, HRW, wheat flours produced the largest number of acceptable flat breads. The Stephens SWW, 70-75% extraction level flour produced only one satisfactory bread. Over all,the HRW higher extraction level flours appeared to be the most acceptable flours for the production of the flat breads studied in this project.

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APPENDIX

APPENDIX-A. Falling Number Values*

Wheat	Extraction		
	70-75%	80-85%	95%
Stephens	321	352	326
Newton Blend	421	446	454
Newton Sandyland	455	466	486
Arkan	413	438	480

* An average of four replications

APPENDIX-B. Gluten Values*

Flour	Wet	Dry	Flour 14% m.b.
<u>70-75% ext.</u>			
Stephens	20.6	8.1	7.9
Newton Blend	21.8	9.0	9.0
Newton Sandyland	24.8	9.8	9.8
Arkan	32.5	13.0	13.0
<u>80-85% ext.</u>			
Stephens	21.7	8.4	8.2
Newton Blend	22.1	9.0	9.0
Newton Sandyland	25.6	10.2	10.0
Arkan	33.2	13.5	13.3
<u>95% ext.</u>			
Stephens	21.1	8.5	8.2
Newton Blend	23.6	9.3	9.0
Newton Sandyland	25.9	11.3	11.0
Arkan	31.8	13.0	12.7

* Average of two replications

APPENDIX-C. Behavior of Experimental Doughs: BARBARI

Flour	Mixing	Moulding
70-75% ext.		
Stephens	smooth,silky	extensible,didn't hold its shape well
Newton Blend	sticky	machineable,shrunk up after cutting oval
Newton Sandyland	sticky	difficult to roll out, shrunk up after oval shape was cut
Arkan	slighty sticky	difficult to roll out, bubbly,shrunk after oval shape was cut
80-85% ext.		
Stephens	smooth,slack	machineable,didn't hold oval shape after dough was cut or docked
Newton Blend	extremely sticky	difficult to roll out, shrunk up after oval shape was cut
Newton Sandyland	sticky	mouldable, slightly difficult to roll out
Arkan	sticky	too,extensible, didn't hold its shape well

Observations made by the author

APPENDIX-D. Behavior of Experimental Doughs: BALADI

Flour	Mixing	Moulding
<u>70-75% ext.</u>		
Stephens	slightly sticky	easy to roll out, square-oval
Newton Blend	sticky	difficult to roll out, circular to oval
Newton Sandyland	sticky	shape oval-square
Arkan	sticky	difficult to roll out
<u>80-85% ext.</u>		
Stephens	slightly sticky	easy to roll out,circular
Newton Blend	sticky	difficult to roll out, circular to oval
Newton Sandyland	sticky	difficult to roll out, oval to square
Arkan	sticky	oval shape

Observation made by the author

APPENDIX-E. Behavior of Experimental Doughs: CHAPATIS

Flour	Mixing	Moulding
<u>70-75% ext.</u>		
Stephens	sticky	extensible, easy to roll out
Newton Blend	sticky	dough shrunk up after rolling and cutting
Newton Sandyland	sticky	dough shrunk up after rolling and cutting
Arkan	sticky	dough shrunk up after rolling and cutting
<u>95% ext.</u>		
Stephens	sticky	easiest to sheet
Newton Blend	sticky	easy to roll out
Newton Sandyland	sticky	easy to sheet, held its shape well
Arkan	sticky	easy to roll out

Observations made by the author

APPENDIX-F. Wheat Quality Data

Wheat	Protein (%)	T.W.* #/b	K.W.** (g)	P.V.***	Density (g/cc)
Stephens	9.0	62.3	48.3	57.4	1.49
Newton Blend	11.0	67.6	29.7	74.4	1.51
Newton Sandyland	12.0	62.6	31.0	73.8	1.50
Arkan	13.0	66.3	27.9	68.8	1.48

[a] All determinations based on three replications

* Test Weight (lb/bushels), ** 1000 Kernal Weight

*** Pearling Value

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EVALUATION OF WHEAT TYPE AND EXTRACTION LEVEL IN FLAT BREADS

by

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AN ABSTRACT OF A MASTER'S THESIS

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ABSTRACT

Four HRW wheats and one SWW wheat were evaluated for the production of three flat breads. The flat breads were barbari, baladi and chapati. Each wheat sample was milled to 70-75,80-85 and 95 percent extraction level flours. Analytical tests of flour and physical tests of dough were performed. During processing the HRW 70-75 percent doughs were the most difficult to sheet. The SWW doughs were the easiest to handle. Flat bread samples were evaluated by sensory panels. The Arkan and Newton Blend, HRW, wheat flours produced the largest number of acceptable flat breads. Over all, the higher extraction level flours appeared to be the most acceptable flours for the production of the flat breads studied in this project.