Maximize benefit from wheat grain by-products to reduce imported wheat

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ABSTRACT:

Food grains are considered one of the most important sources of food in the world, and wheat represents the important crop among these grains. In Egypt, wheat is considered a very important field crop for the production of various baked goods, as Egypt imports approximately 10 million tons of wheat annually, which is equivalent to about 50% of its consumption. With regard to the economic conditions that the world is going through, including Egypt, and also the continuation of the Russian-Ukrainian war until now (they are the two countries that the most export wheat to Egypt), which may lead to the emergence of some obstacles in this regard. Wheat is milled to produce two types of flour, first: - an extraction rate of 72%, which is used in the production of European baked goods, pastries and pasta. Second: 82% or 87.5% extracted flour for the production of subsidized bread. In this study, some by-products produced by mills with a 72% extraction rate, were carefully selected, and added to the flour, with a 87.5% extraction rate, at rates of 4, 5, and 6% using the traditional baking method currently used in local bakeries. The raw materials and mixtures were physically, chemically, and rheologically analyzed, and an economic study was conducted to determine the benefit of these treatments. Results indicated that all treatments lead to increase in protein, fiber and ash content, compared with control flour. Also all treatments increase the water absorption, mixing and development times. Regarding to sensory evaluation, adding clear flour alone leads to the production of bread that is very similar to control. When adding clear flour with white shorts the qualities of the bread decrease slightly, and the slightly more decreasing when the clear flour is present with white and red shorts. This study aims to reduce the amount of imported wheat in proportions that match the proportions of added by-products, Ministry of Supply reported that any addition to wheat flour at a rate of 5.5% will lead to a reduction in imported wheat by about half a million tons annually. From the economic study, it is clear that adding 6% of the mixture leads to saving more than half a million tons of imported wheat.

Keywords:

INTRODUCTION

It is known that Egypt consumes about 20 million metric tons of wheat annually, and its production does not exceed 9 million metric tons, the rest is imported from abroad. To reduce the amount of imported wheat, many researchers have added many types of flour from other grains, for example white corn flour, sorghum, broken rice, barley, soybeans, quinoa, oats, lentils, lupine, chickpeas, some legumes, and some tubers such as potatoes and cassava and others. Considering the characteristics of the bread resulting from these additives, we observed that all additives led to a decrease in the overall sensory properties compared to the control (made from 100% wheat flour). The reason for this may be due to some factors, including the differences in the physical, chemical, and rheological properties of each additive from its wheat flour counterparts, and the degree of starch gelatinization and protein denaturation differs for each wheat flour additive. In addition, the absence of gluten and inhomogeneity in particle size for these additives have a direct effect on the resulting flour mixture. The degree of decrease in the sensory evaluation of bread is a positive proportional to the percentage of addition of these additives. *Azizi et. al. (2006)* investigated the effect of flour extraction rate (70, 75, 80, 83, 86, 88, 90 and 93%) on flour composition, dough rheological characteristics and the quality of Iranian flat breads. Results indicated that, by increasing the extraction rate, the protein, fat, fiber, ash, wet gluten, color , water absorption, and the dough mixing increased but the falling number, dough stability, decreased. Sensory analysis of breads in respect to overall quality and staling indicated that the desirable rates of extraction for flat breads are 88 and 90. Sudha et al. (2007) reported that consuming products rich in fiber has many health benefits. Water-soluble fiber reduces glucose absorption. From the results, the percentage of ash, total protein, and dietary fiber in the bran samples increased. *Lin S.Y. et, al, (2012)* incorporated the clear flour alone or in combination with wheat flour for making Chinese noodles. Some of the Rapid Visco Analyzer parameters and Farinograph parameters of wheat flour-clear flour blends, as well as cooked noodle brightness and whiteness index decrease as the clear flour proportion in the blends increased. The water absorption and the mixing tolerance index for wheat flour-clear flour blends showed the reverse tendency. However, incorporation of clear flour improved the tensile force, the textural attributes of cooked noodle, and revealed the greater mouth-feel and overall acceptance. Cauvain, S.P. (2015) analysis some extraction rates of wheat flour. He found that protein content ranged from (10.5 to 12%), ash content (0.48 to 0.58%) for Straight grade (patent flour) flour, and protein from (12 to 16%), ash from (0.60 to 1.3%) for Clear flour, compared with protein from (9 to 14%), and ash from (1.5 to 2%) for Whole-wheat flour. Regarding to fiber, the highest values recorded with Whole-wheat flour then for Clear flour and the lowest values were for Straight grade flour. Sami Hemdane et. al. (2015) investigate the relationship between wheat milling by-products rich in dietary fiber and their impact on bread making, from coarse and fine bran to low-quality flour (red dog). They found that starch and fat content increased. Although all milling by-products can be reconstituted with their flour supplement to form a complete meal, little information can be found about their functions in relation to each other in bread making. Moradi et. al. (2016) study of the rheological behavior of the wheat flour dough with different extraction rates (64%, 82% and 90%). The lower bran concentration (high extraction rate) in flours showed a better-pronounced effect on dough properties. In spite of the fact that no significant correlation among all parameters of the methods was observed, some parameters of the measuring had very strong correlation included water absorption, tenacity (P), extensibility (L), P/L, swelling index (G) of alveograph, energy and the resistance to constant. Taha Rababah et. al. (2019) evaluate the effect of different flour extraction rates (78%, 79%, 80%, 81%, 82%, 83%, and 84%) on physiochemical and rheological characteristics. The results indicated that the gluten index, color, and falling number decrease gradually with an increase in extraction rate, whereas, ash, crude fiber, crude protein, wet gluten were increased. Water absorption and dough development time were increased, but dough stability and weakening of the dough were reduced. Shuang Liu et, al, (2020) using fine wheat bran which contains the husk, epidermis, nuclear layer, aleurone layer and germ, which resulted in significantly higher levels of protein, amylose, and dietary fiber compared to wheat flour. Therefore, starches formed during extrusion reduce the digestibility of wheat bran powder and maintain colonic fermentation with health-promoting potential targeting gut microbiota. Nikhil Upadhyay (2021) defines some of the terms used in the milling industry as follows: 1st Clear Flour – The portion of flour remaining after removing the “patent” flour, clear flour is usually higher in ash and protein than patent. 2nd Clear Flour - The lower grade portion or section of “first clear flour” that has a higher ash and poorer color than that of the first clear flour. Patent Flour - The most refined flour that is milled (mixture of flour streams) from the front of the mill, Red Dog - a low grade of flour, actually a mixture of endosperm and bran taken from the tail of the mill, which has a high ash content, a high protein content and is dark in colour. Shorts - an inseparable mixture of bran, endosperm and germ, which remains after the flour has been extracted usually used for animal feed. Wenfei Tian et. al. (2021) investigated the health benefits of consuming widely recognized whole wheat products. The results indicated that whole wheat flour bread resulting from reconstitution of bran and flour had the best overall acceptability bread and pancakes quality. Yamina De Bondt et. al (2021) investigate the hypothesis. Gluten-starch model systems to study the effect of substitution of part of the starch by bran in combination with different water absorptions. They found that wheat bran incorporation in bread has multiple health benefits, but also a detrimental effect on overall bread quality. Bran is hypothesized to withdraw water from gluten, resulting in less optimal viscoelastic dough properties and a lower gas retention capacity, in turn resulting in a decreased bread loaf volume. Bakex Millers Limired (2022) declared that Wheat Pollard is a highly valuable by-product that extracted from the aleurone layer of the wheat grain during milling. Wheat pollard used as a raw material in the production of animal feeds. Bakex Millers produces top quality wheat pollard that has numerous nutritional benefits to your livestock making it a very valuable feed component. It is high in dietary fibres and is a good source of protein, calcium, phosphorus and lysine. The wheat pollard produced is versatile, palatable and is the kind of feed component that can used to feed everything in farm. Wanzi Yao et. al. (2022) summarize the physicochemical properties and digestive behaviors of rice bran and wheat bran fibers and their effects on the gut microbiota. Rice bran and wheat bran fibers act as prebiotics. US flour corporation (2022) concluded that using the apparent flour fraction improve the performance of some baked goods. For example, in low fat and sugar applications, using clear flour will create biscuits that are longer, easier to break, and denser than those made with patent flour. Casas and Hans Stein (2023) reported that red-dog consists mainly of the aleurone layer that lies between the bran and the endosperm, along with small particles of bran, germ, and flour. Wheat and wheat co-products contain more non-starch polysaccharides (NSP) than other grains energy. Mad Barn Feed Bank (2024) published some minerals analysis for wheat red-dog flour consists mainly of aleurone - the layer between the bran and the endosperm of the wheat kernel. It also contains the leftover particles of bran, germ and flour produced during the milling process, some minerals were as follows: Protein 17.8% - Calcium 80 mg - Iron 8.15 mg – Zinc 8.51 mg and Phosphorus 840 mg. In addition, reported that Wheat middlings consists of leftover particles of bran, germ and flour produced during the milling process. Some analysis were: Protein 15.5 % - Calcium 130 mg - Iron 11 mg – Zinc 10 mg and Phosphorus 1090 mg. Statista Inc.(2024) published that Egypt imported wheat 11 million metric tons in 2023, consumption 20.6 million metric tons and production 8.67 million metric tons in the same year (2023). Thus the aim of this research was to study the effect of reconstituted the same wheat flour (mainly by-products) in the calculated amount (from different layers of wheat grains “Clear flour, White short and Red short”) to wheat flour at the extraction rate of 87.5 % currently used in making local bread, on chemical composition of mixed flour, dough rheology and sensory evaluation of resulting bread. A commercial flour mill can produce up to 20 individual streams of flour that can be fully or partially blended to produce different types of flour with different flour specifications.

MATERIALS AND METHODS

Materials

Samples of 87.5% wheat flour, clear flour, white shorts, and red shorts were collected from a number of governmental and private sector mills in the Giza and Cairo governorates, namely: North Cairo flour Mills co., Ebn El-Khattab flour mill Co., (Amoon Mill), Moa’teber flour Mills group, Al-Salamouni flour mill, and Al-Taj (Crown) flour mill.

Similar types of were mixed and combined well to obtain complete homogeneity and stored until laboratory analyzes and the baking process was performed.

Other baking ingredients (instant active dry yeast and salt) were obtained from local markets of Giza governorate.

Methods

Preparation of flat bread:

The wheat flour 87.5% extraction rate was mixed with different ratios of clear flour, white shorts and red shorts as presented in the *table (1)* to preparation of flat bread using *Traditional Baking Method (TBM)* according to *Safia Bedre-dine, et. al. (2023) with some modifications* as follows: (1000g) wheat flour 87.5 % extraction rate, (10g) instant active dry yeast, (10g) salt and sufficient amount of water to obtains the suitable dough consistency around (750 - 850 ml), mix for 10 – 15 minutes. Dough was left as a bulk fermentation for about 20 minutes, manually divided into around (100g) for each dough piece, arranged on a wooden board sprinkled with a layer of fine bran and left to ferment for about 45 minutes at 30°C and 85 % relative humidity. The fermented dough pieces were flattened to about 18 cm diameter, baked at 450 – 500 °C in oven for 60 – 90 seconds and finally, loaves were cooled before evaluation.

Determination the Color Attributes

A Hunter Lab Color QUEST II Minolta CR-400 (Minolta Camera, Co., Ltd., Osaka, Japan) was used to determine the color parameter L* (100: white; 0: black), and b* (+, yellow; -, blue). The procedure was outlined in (Francis 1983).

Chemical analysis

Chemical analysis (protein, crude fiber, and ash content were assessed according to the method described in ***A.O.A.C. (2010).***

Rheological parameters

The extensograph and farinograph apparatus The extensograph and farinograph apparatus were applied to determine the rheological properties in Department of bread and dough at the Food Technology Research Institution in Giza, Egypt, to assess the rheological properties of each of the aforementioned flour portions under inquiry, as reported by *AACC (2010).*

The average results of the physical properties and chemical analysis, as well as the rheological properties, were obtained, which were conducted in two different laboratories (laboratories of the Bread and Pastry Department at the Food Technology Research Institute) and in the laboratories of Ebn - Al-Khattab Mills Group - using the DA 7250 NIR Analyzer (the third generation diode array NIR instrument from PerkinElmer) for physical and chemical properties

Sensory evaluation of bread

Ten panelists from the Bread and Pastry Research Department of the Food Technology Research Institute's Agric Research Center evaluated each sample. The sensory evaluation of the flat bread loaves focused on their general appearance, layer separation, crumb texture, crust color, taste and flavor

were determined according to Sallam et al. (1995).

RESULTS AND DISSCUSION

Data showed in table (2) showed the physical and chemical properties of raw materials used in this investigation. Results declared that protein, fiber and ash content for wheat flour 87.5% extraction rate were 10.8%,1.2% and 0.9%, for clear flour were 14.3, %, 2.9% and 2%, while for white shorts were 15.5%, 6.3% and 3.1%; finally for red shorts were 17.8%, 8.8% and 5.5%, respectively.

From the same data, it can be noticed that red shorts was a darker by-product than other ingredients, followed by white shorts, then clear flour. It also observed that the whiteness of clear flour was closer to wheat flour 87.5% extraction rate (control). The whiteness color values (L) were 74 and 78, for red shorts, white shorts. While for clear flour was 90.4 compared to 91.2 for wheat flour 87.5%, respectively. These results were in agreement with Azizi et. al. (2006), Cauvain, (2015), Moradi et. al. (2016).

Physical and chemical properties of blended flour:

Data illustrated in table (3) showed the physical and chemical properties of flour blends used in this investigation. Results indicated that protein content ranged from 11.66% to 11.99% for (group CF- 6), which means that (clear flour in this group equal to 6%) and ranged from 11.52% to 11.85% for (group CF- 5), which means that (clear flour in this group equal to 5%) and from 11.37% to 11.71% for (group CF- 4), which means that (clear flour in this group equal to 4%) compared with 10.8% for wheat flour 87.5% extraction rate (control), respectively. The highest protein content was recorded for treated sample No. 4 (100% WF + 6% CF +1% WS + 1% RS) while lowest content was for treated sample No. 8 (100% WF + 4% CF). Concerning the fiber content in (group CF-6), it is noted that by adding either white shorts or red shorts to the clear flour, the percentage of fiber in the mixture increases.

Values ranged from 1.37% to 1.53% compared to 1.20% for control sample. The same trend was observed with (group CF – 5) and (group CF – 4). The same trend also observed with ash content either within each group or with all groups. As for the whiteness of flour mixtures, it represents that incorporating white or red shorts into the mixture results in a dark mixture and an increase in darkness if white and red shorts are present together. The relationship between color (L) and whiteness is a direct relationship (the higher the value of color (L), the whiter the flour).

Rheological properties of flour blends:

From the data shown in *table (4)*, it is clear that the water absorption percentage of samples (group CF-6) increases slightly when CF is present alone compared with control, then the water percentage increases in the presence of white shorts, and increases more when both white and red shorts added together.

The same trend was observed in the other groups (group CF-5) and (group CF-4). This finding may be high protein and fiber content of white and red shorts. Water absorption values recorded 60.8% for sample contain 6% clear flour only (sample No.2) then increased to 61.1% for sample contain 6% clear flour plus 1% white shorts (sample No.3) and increased to 61.8% for sample contain 6% clear flour plus 1% white shorts and 1% red shorts (sample No.4), compared to 60.4% for the control sample (wheat flour 87.5% extraction rate). The same trend was shown in other groups. Regarding to mixing time (MT) and dough development time (DDT), it could be observed that both (MT and DDT) within (group CF-6) gradually increased with the addition of white shorts and / or red shorts to the samples, the reason for this may be the high content of soluble and insoluble fibers in shorts, which leads to an increase in absorption time for water hydration and achieve a good consistency of dough. Values of (MT) and (DDT) were 1.6 and 2.1 min., 1.8 and 2.3 min. and 1.7 and 2.6 min. for samples No. 2, 3 and 4, compared to 1 and 1.5 min. for control sample , respectively. For (group CF-5) and (group CF-4), It is also noticed that decreases the rate of increasing of (MT) and (DDT), the reason for this is due to the decrease in the percentage of clear flour CF in these groups than (group CF-6). With respect to the (group CF-6), It declared that stability time of the dough decreases compared to the control, and the decreasing rate is increases in the presence of the white shorts and the red shorts (samples No. 3 and 4). Stability values were 6.2, 6.0 and 5.7 min. for samples No. 2, 3 and 4, compared to 7.5 min. for control sample. The same trend was observed with (group CF-5) and (group CF-4). These results may be due to the clear flour contain high protein content but non-glutenous protein which had a negative effects on the stability, in addition of white and red shorts contains high fiber which also had an negative effects on stability. These data were in agreement with those obtained by Azizi et. al. (2006), Moradi et. al. (2016).

Sensory evaluation

Table (5) represented the external and internal parameters of flat bread prepared from wheat flour 87.5% extraction rate mixed with different ratios of clear flour, white shorts and red shorts compared with flat bread prepared from wheat flour 87.5% extraction rate only (control C-1). From the data shown in this table, it can be seen that the total scores for most samples in general were adjacent and close to control C-1. Sample 400 (4% of CF, 0% of WS and 0% of RS added to 100% WF) obtained the highest score (93.5) compared to control C-1 (94.5) and was one of the highest properties - followed by sample No. 500, then sample No. 600, and the values were 93 and 92.5, respectively. Perhaps the reason for this is due to the high percentage of low quality protein in the clear flour, as the percentages of its addition increase, it leads to a slight decrease in the quality of the resulting bread. When adding 1% of white shorts with clear flour to wheat flour, this led to a slight decrease in the qualities of the resulting bread. The total score values were (91), (89) and (88) for samples 410, 510, and 610, respectively. It is clear that the characteristics of the bread were negatively affected by these additions, given that white shorts contains insoluble fibers and non-glutenous protein. When combination of 1% white shorts and 1% red shorts with clear flour and added to wheat flour, it resulted in a significant decrease in the quality of the resulting bread. The total score values were (79), (76), and (72) for the samples 411, 511, and 611, respectively. Perhaps the reason for this significant decrease in bread properties is that white shorts and red shorts contain greater proportions of insoluble fiber and non-glutenous protein. The general arrangement in descending order according to total acceptability was as follows: sample number 400 - 500 - 600 - 410 - 510 – 610 - 411 - 511 and finally 611. Values were 93.5, 93, 92.5, 91, 89, 88, 79, 76 and 72, respectively. These results were in agreement with Sami Hemdane et. al. (2015), Wenfei Tian et. al. (2021), US Flour Corporation (2022).

Economical study of bread prepared from different blends

Table (6) shows an economic study on the benefits of adding

by-products mixture (clear flour, white shorts and red shorts) in total percentages of 4, 5, and 6%, these additions, lead to increase the water absorption of the flour, and the weight of the dough produced increases, consequently the number of loaves produced from bag of flour (100 kg) increase.

For example, when adding the mixture at a rate of 4% to the bag of flour, 87.5% of the weight of 100 kilograms, the number of loaves produced increases to 1,500 loaves, compared to 1,450 loaves for the control (100 kilograms of flour, 87.5%), meaning an increase of 50 loaves per one bag. Since the daily production of subsidized local bread is 275 million loaves and the average bag production of 1,450 loaves, the number of bags used daily is about 189,655 bags weighing 100 kilograms.

Hence, it is clear that the increase in the number of loaves as a result of adding 4% per day amounts to 9,483,000 loaves, equivalent to 3,461,113,000 (three billion, four hundred and sixty-one million, one hundred and thirteen thousand) loaves annually - at a saved cost of 4,326,391,000 (four billion, three hundred and twenty-six million, three hundred and ninety one thousand) Egyptian pounds annually - with this amount it is possible to save approximately 400,600 (four hundred thousand and six hundred tons of wheat) annually.

When the addition rate is raised from 4% to 5%, the amount of annual savings increases to 5,768,521,000 (five billion seven hundred and sixty-eight million five hundred and twenty one thousand pounds), enough to buy 534,122 (five hundred and thirty-four thousand and one hundred and twenty-two tons of wheat).

In the case of using 6 % of the addition mixture, the annually saving becomes about 7,210,651,000 (seven billion two hundred and ten million six hundred and fifty-one thousand Egyptian pounds), allowing the purchase of 667,653 (six hundred and sixty-seven thousand six hundred and fifty-three tons of wheat)

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Table 1: Different blends used in to produce flat bread.

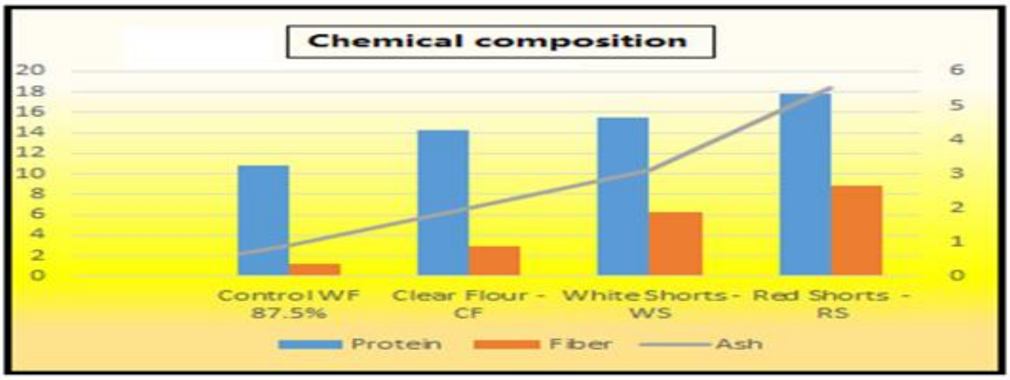
	Treatments	WF %	CF%	WS%	RS%
1	C -1 (WF – 87.5%)	100			
2		100	6	0	0
3		100	6	1	0
4		100	6	1	1
5		100	5	0	0
6		100	5	1	0
7		100	5	1	1
8		100	4	0	0
9		100	4	1	0
10		100	4	1	1

C –1 = Control (wheat flour 87.5%) WF = Wheat flour 87.5 % extraction
CF = Clear Flour WS = White Shorts RS = Red Shorts

Table 2: Physical and chemical composition of wheat flour, clear flour, white shorts and red shorts.

	Protein	Fiber	Ash	Color	
	%	%	%	L*	b*
Control WF 87.5%	10.8	1.2	0.9	91.2	11.7
Clear Flour - CF	14.3	2.9	2	90.4	11.8
White Shorts - WS	15.5	6.3	3.1	78	13.2
Red Shorts - RS	17.8	8.8	5.5	74	16.4

L* (lightness with L = 100 for lightness, and L = zero for darkness) b* [chromaticity on blueness to yellowness].



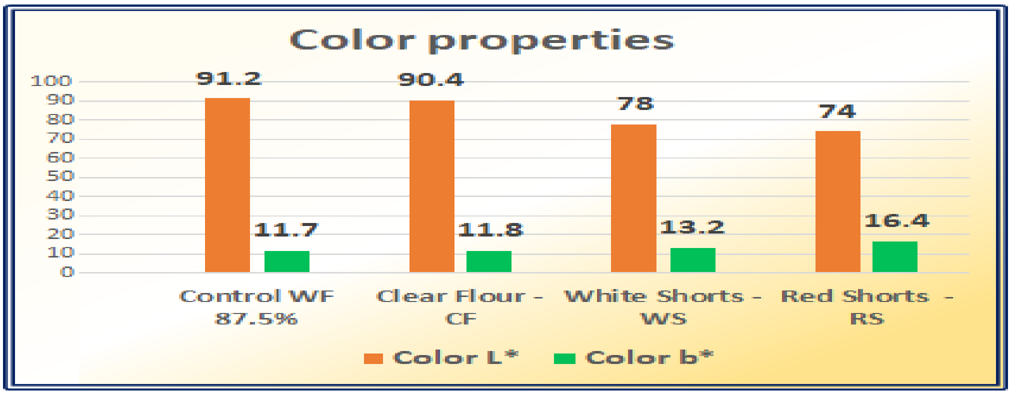


Table 3: Physical and Chemical composition of flour blends.

						Protein	Fiber	Ash	Color	
						%	%	%	L*	b
		WF	CF	WS	RS					
C-1	1	100				10.8	1.2	0.9	92.2	11.7
Group CF-6	2	100	6	0	0	11.66	1.37	1.02	86.8	11.73
	3	100	6	1	0	11.81	1.44	1.05	85.2	11.85
	4	100	6	1	1	11.99	1.53	1.11	83.7	11.92
Group CF-5	5	100	5	0	0	11.52	1.35	1.00	87.7	11.59
	6	100	5	1	0	11.67	1.41	1.03	86.1	11.71
	7	100	5	1	1	11.85	1.50	1.09	84.6	11.82
Group CF-4	8	100	4	0	0	11.37	1.32	0.98	88.6	11.48
	9	100	4	1	0	11.53	1.38	1.01	87	11.66
	10	100	4	1	1	11.71	1.47	1.07	85.5	11.74

* Color (L) = Whiteness WF= Wheat flour CF= Clear flout WS = White shorts
RS = Red shorts

Table 4: Farinograph parameters of flour blends

	Sam. No.	WF	CF	WS	RS	WA %	MT min	DDT min	DS Min	DW B.U.
Group CF-6	1	100	%	%	%	60.4	1	1.5	7.5	60
	2	100	6	0	0	60.8	1.6	2.1	6.2	52
	3	100	6	1	0	61.1	1.8	2.3	6.0	50
	4	100	6	1	1	61.8	1.7	2.6	5.7	47
Group CF-5	5	100	5	0	0	60.7	1.5	2	6.7	56
	6	100	5	1	0	60.9	1.6	2.2	6.4	54
	7	100	5	1	1	61.1	1.7	2.4	6.0	51
Group CF-4	8	100	4	0	0	59.8	1.1	1.6	7.3	58
	9	100	4	1	0	60.3	1.2	1.7	7.1	57
	10	100	4	1	1	60.8	1.5	1.9	6.9	55

WA= Water absorption MT= Mixing time DDT = Dough development time
DS = Dough stability DW = Degree of weakening

Table 5: Sensory evaluation of flat bread prepared from different blends.

	Sample No.					External Properties				Internal Properties			Total Score
						Loaf rising	Crust quality	Crust color	Crumb uniformity	Crumb color	Odor	Taste	
						Score							
		WF	CF	WS	RS	10	10	10	10	25	10	25	100
C- 1	1	100				9.5	9	9.5	9.5	24	9	24	94.5
Group CF - 6	2	100	6	0	0	9.5	9	9	9	23	9	24	92.5
	3	100	6	1	0	8	8.5	8.5	8.5	22	9	23.5	88.0
	4	100	6	1	1	7.5	7.5	7.5	7.5	22	8	22	82.0
Group CF - 5	5	100	5	0	0	9	9	9.5	9.5	23	9	24	93.0
	6	100	5	1	0	8	9	8.5	8.5	22.5	9	23.5	89.0
	7	100	5	1	1	8	8	8	8	22	8.5	22.5	85.0
Group CF - 4	8	100	4	0	0	9	9	9.5	9.5	23.5	9	24	93.5
	9	100	4	1	0	9	9	9	8.5	23.5	8.5	23.5	91.0
	10	100	4	1	1	8	8.5	8	8.5	22	9	23	87.0

Table 6: Economical study of flat bread prepared from different blends.

		C	4%	5%		6%		
Wheat flour 87.5% extraction	bag	100	100	100	100	100	100	100
Clear flour %	%	---	4	4	5	4	5	6
White shorts %	%	---	0	1	0	1	1	0
Red shorts %	%	---	0	0	0	1	0	0
Total weight of the mixture	Kg	100	104	105		106		
Weight of added water	Kg	75	76	77		78		
Total weight of dough	Kg	175	180	182		184		
Number of loaves produced/bag (100kg)	Loaf	1450	1500	1517		1533		
Increase in the number of loaves/bag (100kg)	Loaf	0	50	67		83		
The price of the increase in the number of loaves/bag	LE	0	63	83		104		
Number of baked flour bags/day	bag	189,650	189,650	189,650		189,650		
Increase in the number of loaves/day	Loaf	0	9,482,500	12,643,333		15,804,167		
The price of the loaves increase/day	LE	0	11,853,125	15,804,167		19,755,208		
Increase in the number of loaves/yea	Loaf	0	3,461,112,500	4,614,816,667		5,768,520,833		
The price of the loaves increased/year	LE	0	4,326,390,625	5,768,520,833		7,210,651,042		
Number of loaves produced daily - control	Loaf	274,992,500						
Number of loaves produced daily - treatment	Loaf		284,475,000	287,635,833		290,796,667		
The corresponding imported wheat	(tons)	0	400,592	534,122		667,653		

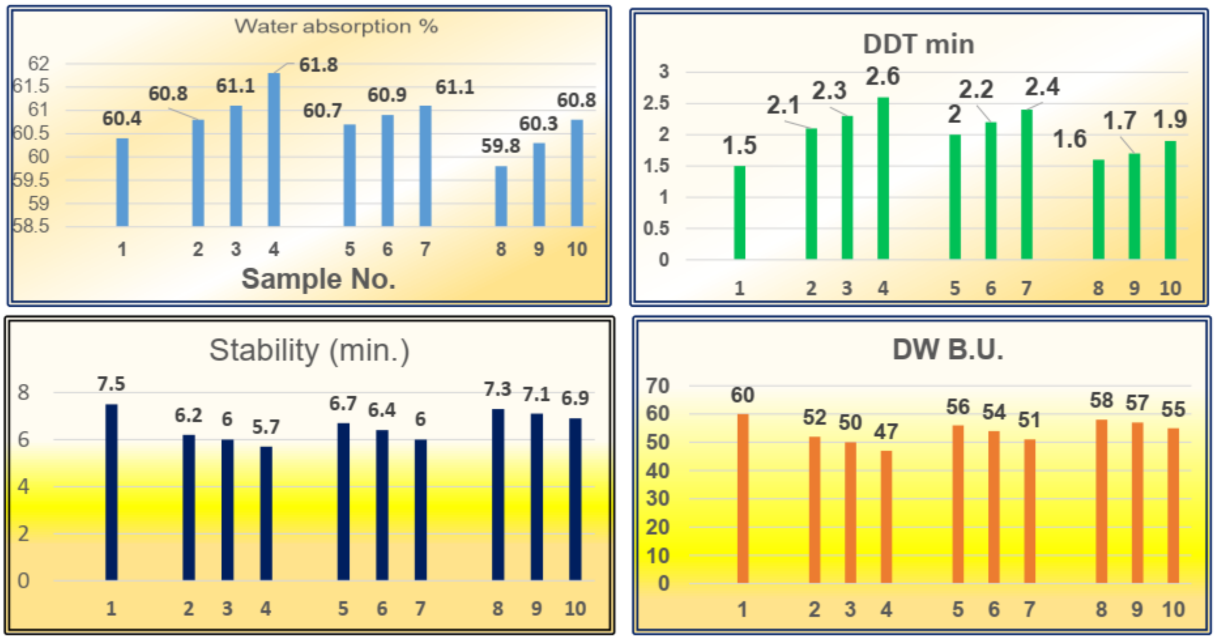
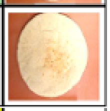
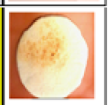
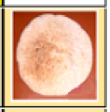
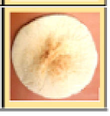


Fig. (3): Water absorption, development time, stability and degree of weakening.

Ranking	CF %	WS %	RS %	Total Score	Sample No.	
1 Control				94.5	1	
2	4	0	0	93.5	8	
3	5	0	0	93	5	
4	6	0	0	92.5	2	
5	4	1	0	91	9	

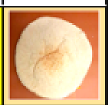
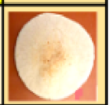
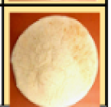
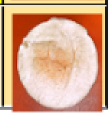
Ranking	CF %	WS %	RS %	Total Score	Sample No.	
6	5	1	0	89	6	
7	6	1	0	88	3	
8	4	1	1	87	10	
9	5	1	1	85	7	
10	6	1	1	82	4	

Fig. (4): Flat bread prepared from different

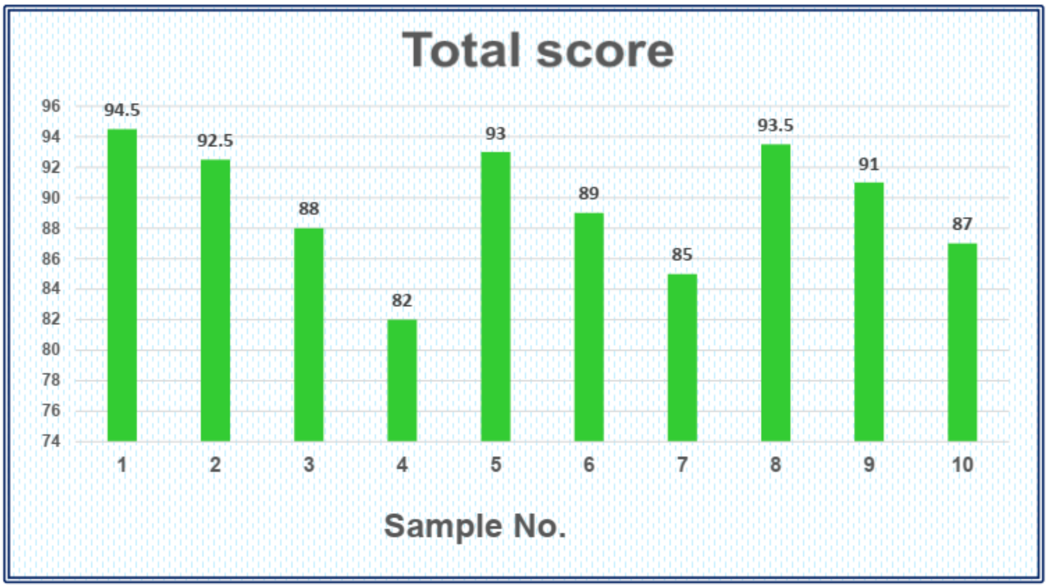


Fig. (5): Total score of bread prepared from different blends.

تعظيم الاستفادة من المنتجات الثانوية لحبوب القمح لتقليل القمح المستورد

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الملخص العربي:

تعتبر الحبوب الغذائية من أهم مصادر الغذاء في العالم ويمثل القمح المحصول المهم بين هذه الحبوب. وفي مصر، يعتبر القمح من المحاصيل الحقلية المهمة جدًا لإنتاج المخبوزات المختلفة، حيث تستورد مصر ما يقرب من 10 مليون طن قمح سنويًا، وهو ما يعادل حوالي 50% من استهلاكها. وفيما يتعلق بالأوضاع الاقتصادية التي يمر بها العالم، بما في ذلك مصر، وأيضا استمرار الحرب الروسية الأوكرانية حتى الآن (وهما الدولتان الأكثر تصديرا للقمح لمصر)، مما قد يؤدي إلى ظهور بعض العقبات في هذا الصدد. يتم طحن القمح لإنتاج نوعين من الدقيق أولا: - نسبة استخلاص 72%، والذي يستخدم في إنتاج المخبوزات الأوروبية والمعجنات والمكرونة. ثانياً :- الدقيق المستخرج بنسبة 82% أو 87.5% لإنتاج الخبز البلدي المدعم. وفي هذه الدراسة تم اختيار بعناية بعض المنتجات الثانوية التي تنتجها المطاحن استخلاص 72% وإضافتها إلى الدقيق استخلاص 87.5% بنسب ٤ و٥ و ٦ % باستخدام طريقة الخبز التقليدية المستخدمة حاليا في المخابز البلدية. وتم تحليل المواد الخام والخلطات فيزيائيا وكيميائيا وريولوجيا - كما تم عمل دراسة اقتصادية لمعرفة فائدة تلك المعاملات تهدف هذه الدراسة إلى تقليل كمية القمح المستورد بنسب تتطابق مع نسب المنتجات الثانوية المضافة حيث أن كل إضافة 5.5% تؤدي إلى خفض كمية القمح المستورد بمقدار نصف مليون طن سنويا (وزارة التموين). ومن الدراسة الإقتصادية يتضح ان إضافة ٦% من الخليط يؤدى لتوفير أكثر من نصف مليون طن قمح مسنورد.

الكلمات الاسترشادية: تعظيم , الاستفادة , القمح , الحبوب