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إعداد وتقييم قمح الديورم لإنتاج المكرونة .

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الملخص العربي

تهدف هذه الدراسة إلى إمكانية استخدام النواتج الثانوية لطحن قمح الديورم في إنتاج أصناف جديدة من المكرونة عالية الجودة ذات محتوي عالي من الألياف الغذائية وبالتالي بقيم سعريه منخفضة بحيث يمكن استعمالها بواسطة الأشخاص الذين يتبعون الحمية الغذائية (رجيم) وكذلك مرضى السكر.

استعمل في هذه الدراسة قمح ديورم محلي "بني سويف ١" حيث تم طحن القمح بالطريقة المتبعة في شركات صناعة المكرونة وتم الحصول على نواتج الطحن وهي تتمثل في السيمولينا الناعمة، السيمولينا الخشنة، الدقيق الناعم، الدقيق الخشن، الردة الناعمة، الردة الخشنة.

التحليل الكيمياوي و تقدير الالياف الغذائية و مكوناتها (ذائبة و غير ذائبة) و جودة الطبخ و كذلك تقييم الخواص العضوية الحسية تم تقديرها في كل من المواد الخام و المكرونة المصنعة .

ولقد أظهرت النتائج تحسن في القيمة الغذائية مع زيادة معدل استخدام نواتج طحن القمح كما أنه لم يظهر تأثير سلبي على الخواص الحسية في ما عدا لون المكرونة المصنعة .

DURUM WHEAT PREPARATION AND EVALUATION FOR PASTA PRODUCTION

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ABSTRACT: *The objective of this study was to develop newer varieties of pasta with improved nutritional quality produced by using wheat durum semolina as a base plus the addition of different durum wheat milling fractions compared with pasta made from only semolina.*

Chemical analysis, Dietary fiber and its fractions (soluble, insoluble), cooking quality and sensory evaluation were performed. Results show that, increase the substitution level improve the nutritional quality. Also, using durum wheat milling fractions to contrary limit enhance the nutritional quality of pasta without affecting its sensory properties negatively.

Key words : *Durum, pasta, milling fraction, dietary fiber, soluble, insoluble.*

INTRODUCTION

The word pasta is a generic term used in reference to the whole range of products commonly known as spaghetti, macaroni, vermicelli and noodles. Pasta is the second to bread in world consumption, It's nearly wide acceptance is attributed to its low cost, ease of preparation, versatility, sensory attributes and long shelf- life. Raimondo *et. al*., (2007).

Kratzer *et al*., (2008), showed that, pasta is currently at the top of food consumption charts in the world.

Mariela *et al*., (2011), reported that, pasta products are among the most ancient forms in which wheat has been consumed. They are probably antedated only by bulgar and various forms of porridge. Wheat is grown in almost every corner of the world and this, together with the various degrees of sophistication of the people in the world, means that virtually all forms of pasta are produced.

Pasta products are made from semolina which is milled from hard wheat by a special process, the highest quality pasta are made from durum wheat Borrell *et al.,* (2006).

Durum wheat are the best for making pasta because the tough horney endosperm easily produced semolina, durum wheat are high in carotenoid pigments, these are what give the pasta its yellow color. Beside, it also requires little water compared to other wheat to form a dough Edward *et al.,* (2007).

Fibers from cereals exert a pronounced effect on the colon, cellulose containing fibers decrease transit time which is increased by soluble fibers Jenkins *et al.,* (2002).

Several sources of dietary fiber, such as wheat bran has been incorporated into food products as fiber ingredients Koh-Benerjee *et al.,* (2004).

It is worth to mention that today's consumers hold high standards for the foods they consume. They demand foods that taste great and calorie- reduced, and they are interested in foods that provide added health benefits and become more concerned about consuming additional fiber. So, fiber could be used as an ingredient in bakery and pasta products to reduce calories and add possible health benefits Abo-zeid, (2002). However, for these products to succeed in the market place they must also have adequate sensory appeal.

Health Council of the Netherland, (2008) defined dietary fiber as "substances that are not digested or absorbed in the human small intestine, and which have the chemical structure of carbohydrates, compounds analogous to carbohydrates, Lignin and related substances".

In the mouth and stomach, dietary fibers extend the chewing time and dilute the energy content of the food Meyer and Tungland, (2001) which extends the consumption time and reduces the amount of food consumed and also the intake of calories. fibers can prolong satiety and appear to influence colon physiology Morgan *et al.,* (2008) where the ferment ability and bulking capacity of fibers are essential in maintaining gastrointestinal health.

Health aspects of wheat bran

Wheat bran and weight control:

High fiber foods may help reduce the risk of obesity. Thereby, decreasing food intake because insulin stimulates appetite, and they decrease energy absorption Toller *et al.,* (2001).

Wheat bran and colorectal cancer:

Terry *et al.,* (2001), found that, certain kinds of dietary fiber, especially fiber from wheat bran, play a role in the etiology of colon cancer, strengthening the (hypothesis) regarding insoluble fiber and cancer Mai *et al.,* (2001) showed that, dietary fiber particularly whole grain cereals and particularly bread, may reduce the production and excertion of fecal mutagens and decrease the concentrations of secondary bile acids that play a role in colon carcinogenesis.

Production pasta from whole wheat durum

Recently, whole wheat grain flours have been the focus from new food materials from the view point of high nutritional and functional values including dietary fibers, minerals and antioxidants. However, the partial utilization of whole wheat flour is not as common in our daily diet as it is in the United States or Europe, wheat flour is normally white because of the removal of bran and germ Maeda and Morita, (2003).

Tomoko *et al.,* (2004), reported that, whole wheat durum meal is produced by grinding clean grain with a disc, hammer or stone mill. Because durum, mills are designed to produce semolina, some whole wheat meal is produced by regarding to the bran and germ removed during milling process and blending them back into the semolina.

Effect of adding durum bran on sensory evaluation of pasta

D'Egidio and Nardi, (1998) showed that, bran is the coarse outer layer of the wheat kernel and contained 7.5-12.0% crude fiber. Also, they added that, the choice of bran to be used in a specific application depends upon the flavor, color and appearance desired.

Rao *et al.,* (2001) showed that, processed spaghetti by adding durum bran (5-30%) to semolina indicated that, 10% bran spaghetti received the most favorable rating for spaghetti containing no bran. All constituents (protein, insoluble dietary fiber, phytic acid, calcium, iron, magnesium, manganese, zinc and phosphorus) were significantly higher (probability = 0.95). In 10% bran spaghetti provided almost 3.5 times dietary fiber than did the no bran spaghetti and increased calcium content by 40% and manganese by 150% of the six minerals assayed. Zinc showed an overall increase, in concentration from the unprocessed bran- semolina blends to the cooked spaghetti, the concentration levels of manganese and iron were varied while calcium, magnesium and phosphorus were decreased.

Marlett, (1992), showed that, using extrusion cooking is increased in the processing of cereal- based foods. Thus, thermal processing can make a fraction of the starch available to enzymes.

Pasta products constitute a major source of the calorie intake. Therefore, preparation of low calories pasta is of great interest. Semolina could be mixed with different levels of wheat bran or use whole wheat durum for the preparation of different formula containing high protein, high fiber, low available carbohydrate and low energy pasta Wang *et al.,* (2002).

Miller *et al.,* (2009), reported that, Insoluble fiber sources that resist fermentation, like wheat bran, have benefits for human health, which, increase stool bulk and thus reduce constipation.

Numerous physiochemical factors have been suggested to explain the different rates of starch degradation measured after the consumption of starchy foods. Which impact on the glycemic index. At the microscopic level, interactions between food components, such as the encapsulation of starch by soluble fiber or proteins. Singh, *et al.,* (2009), Bustos *et al.,* (2001), reported that, a modificed pasta structure by insoluble fiber affect the rate of starch degradation (or starch digestibility) which affects the glycemic and insulinemic index.

MATERIALS AND METHODS

Materials

Durum wheat (Beni Suef-1) :

It was obtained from Regina Company for pasta and food industries, El-Sadat City, Egypt. It was tempered to 14% moisture for 24hr., and then milled by Hammer mill then it was separated automatically to its fractions.

Milling Fractions.

Fine Semolina (S_1):

It is the free flowing fine particles of endosperm obtained during the early stages of the milling process. It sieved through 560 mesh sieve.

Coarse Semolina (S_2):

It is the free flowing coarse particles of endosperm obtained during the early stages of the milling process. It sieved through 550 mesh sieve.

Fine Flour (F_1):

It sieved through 225 mesh sieve.

Coarse flour (F_2):

It sieved through 180 mesh sieve.

Fine bran (F.B):

It is the fine particles of outer layer obtained during the later stages of the milling process, it sieved through 160 mesh sieve .

Coarse bran (C.B):

It is the residue in, milling process and It often use for animals feed.

-Methods

Preparation of different blends:

Different blends were prepared by partial replacement of semolina with durum wheat milling fractions as indicated in Table (1) .

Chemical analysis :

Determination of moisture, crude fat , ash. wet and dry gluten , carotenoid pigments , crude fiber and minerals contents of raw materials and produced pasta were determined according to method described in A.O.A.C.,(2002) .

Determination of crude protein

The crude protein was determined using the macro keldahl method according to A.A.C.C. (2000) .

Table (1): Different blends of replacement semolina with durum wheat milling fractions .

Blends	Semolina 1 (%)	Semolina 2 (%)	Flour 1 (%)	Flour 2 (%)	Fine Bran (%)	Coarse bran (%)
Control	100	-	-	-	-	-
1	70	-	-	-	30	-
2	60	-	-	-	40	-
3	-	70	-	-	30	-
4	35	35	-	-	30	-
5	47	19.5	8.7	2	6.4	16.4

Determination of lignin:

Lignin was determined according to the method of Lee, *et al*. (1992).

Determination of Cellulose:

Cellulose was determined according to the method described by Prosky *et al.,* (1992).

Determination of total dietary fiber:

Total dietary fiber (TDF) was determined according to the method described by Da Silva *et al.* (2005).

Determination of total carbohydrate:

Total carbohydrates was calculated by difference.

Determination of water holding capacity (WHC):

Water holding capacity (WHC) was determined in the uncooked and cooked pasta by the method described by Childs and Abjtian, (1976).

Determination of fat absorption capacity (FAC):

Fat absorption capacity (FAC) was determined in the uncooked and cooked pasts by the method described by Sosulski *et al,* (1976).

Estimation of caloric value:

Total calories of cooked pasta were determined according to Martinez *et al.,* (2007) from the following equation:

E= 4 (% protein + carbohydrate) + 9 (%fat).

E: energy as calories per 100gm of food dry basis.

Determination of pasta cooking quality:

Cooking quality of pasta were determined according to the method of Edwards *et al.,* (1993).

Sensory evaluation of pasta:

The quality of cooked pasta were evaluated by panelists from staff Regina Company for pasta and food industries, El-Sadat City, Minoufiya Governorate, Egypt.

The evaluation was accomplished according to the method of Dexter *et al.,* (1990).

Statistical analysis:

The obtained data were analyzed using statistical analysis system, SAS (1996).

RESULTS AND DISCUSSION

The percentages of milling fractions in durum wheat "Beni Suef-1" grain

Results in Table (2) revealed that, fine semolina represented a major content of whole durum grain (47.0%) followed by coarse semolina (19.0%). Meanwhile, coarse flour represented a lowest content (2.0%) durum wheat *"Beni Suef-1"* grain contains (22.8%) bran (6.4% fine bran, and 16.4% coarse bran). These results coincide with results of *Peterson and Fulcher, (2002).* Who reported that, The grain of durum wheat contain about (67.0%) semolina, (10.05%) flour and (21.9%) bran.

Table (2): The percentages of milling fractions in durum wheat grain "Beni Suef-1".

Milling fractions	Fraction (%)
Fine semolina (S1)	47.00
Coarse semolina(S2)	19.00
Fine Flour (F1)	8.70
Coarse flour(F2)	2.00
Fine bran	6.40
Coarse bran	16.40
Total	100.00

Chemical Composition:

Chemical composition of whole durum wheat "Beni Suef-1" meal:

The protein content was found to be (13.20%) while, crude fiber was (3.32%) in whole durum meal.

The ash content of whole durum *"Beni Suef-1"* meal was in high concentration (1.87%). These results agree with these reported by *Dexter and Marchylo., (2000)* who stated that, considerable amounts of protein, minerals and ash were associated with dietary fiber components.

Gluten quantity is important factor in producing pasta with good quality. Wet and dry gluten content of durum wheat *"Beni Suef-1"* meal are presented in Table (3). Results revealed that, the wet and dry gluten content of durum wheat *"Beni Suef-1"* meal had high value which were, 27.22% and 4.3% to wet and dry gluten respectively these results coincide with these reported by *Liu et. al., (1996)*.

Concerning carotenoids content of whole durum meal *"Beni Suef-1"*. Results presented in Table (3) which elucidate that *"Beni Suef-1"* is characterized to its high carotenoids Content (4.129 ppm) These results can be confirmed as exhibited by *Santra et al., (2003)* who denoted that carotenoids are important for both pasta quality and nutritional value because it acts as a are precursor of vitamin A.

Chemical composition of durum wheat "Beni Suef-1" milling fractions:

From results in Table (4) it is evident that coarse semolina had (12.65%) protein while fine semolina had (12.60%) Mean while, coarse flour was the lowest one (9.46%).

Regarding the lipid content, the same results reflected that, coarse bran had (1.57%). In lipid content while fine bran had (1.52%).Mean while, fine flour was the lowest one (0.39%). Meanwhile, fine semolina and coarse semolina had a same amount of lipid (0.86%).

Concerning to the ash content of different fractions of durum wheat milling. It is evident from the results in Table (4) that, coarse bran had (1.78%) ash. Which possibly due to its high content of crude fiber. while fine bran (1.67%). Meanwhile, fine semolina was the lowest one (0.58%) while , fine flour had (0.7%). In this concept, the ash content associated with dietary fiber occurred mainly in the soluble fiber fraction as pointed out by *Frolich and Asp, (1985)*.

In the concept of crude fiber content, results in Table (4) show that, fine semolina and fine flour had the lowest amount of crude fiber (0.47%). Meanwhile, coarse bran had the highest amount (8.46%), followed by fine bran (7.77%).

Table (3): Chemical composition of whole durum meal "Beni Suef-1". On dry weight basis.

Components	%
Protein	13.20
Wet gluten	27.22
Dry gluten	4.3
Total lipids	1.87
Crude fiber	3.32
Total Carbohydrate	68.71
Carotenoide (ppm)	4.13
Ash	1.87

Moisture content was 10.94% .

Table (4): Chemical Composition of durum wheat "Beni Suef-1" milling fractions:*on dry weight basis

Durum wheat milling fractions	Protein (%)	Total lipids (%)	Ash (%)	Fiber (%)	Total Carbohy-drates (%)
Fine semolina	12.60	0.86	0.58	0.47	85.49
Coarse semolina	12.65	0.86	0.78	0.49	85.22
Fine Flour	10.99	0.39	0.7	0.47	87.45
Coarse flour	9.46	0.59	1.07	1.22	87.66
Fine bran	10.3	1.52	1.67	7.77	78.74
Coarse bran	10.51	1.57	1.78	8.46	77.68

* Moisture content was from 8.46% to 1.8%

These results are in agreement with these found by *Peterson and Fulcher, (2002)* who stated that, fiber content increase in outer layer of cereals grain.

Total dietary fiber content and its fractions of whole durum meal "Beni Suef-1" and in its different milling fractions".

Total dietary fiber (TDF) now plays an important role in food products and nutrition. Therefore, The total dietary fiber and its fractions as cellulose, lignin and other fractions (hemi-cellulose, pectin, gum and mucilage) were determined in whole durum wheat and in milling fractions. results were calculated and presented as percentages as shown in Table (5).

In relation to dietary fiber content, the data in table (5), declared that, the whole durum meal*" Beni Suef-1"* had (12.865%) total dietary fiber, which considered an adequate amount.

Also, results in the same table showed that, the whole durum meal *"Beni Suef-1"* could be considered a source of insoluble dietary fiber (11.27%) while, soluble dietary fiber in whole durum meal *"Beni Suef- 1"* was very low (1.59%). These obtained results are in the range previously attained by several investigators, who found that, the total dietary fiber (TDF) of whole durum meal was (13.0%) as reported by *Oak et. al, (2004).*

Among the different durum wheat *"Beni Suef-1"* milling fractions, It could be observed from the results in Table (5) that, coarse bran had the highest amount of total dietary fiber (40.24%) followed by fine bran (38.0%). While, it was only (1.75%) in fine semolina. Meanwhile, coarse semolina and fine flour had the same amount of TDF (2.5%) coarse flour was superior to fine flour which had (5.73%) TDF.

Concerning the solubility of total dietary fiber. Results in table (5) indicate that, durum wheat milling fractions had major content of insoluble dietary fiber. Coarse bran had the highest value of insoluble dietary fiber (29.287%) our results agree with these obtained by *Venma and Vande Sandt, (2002)* who reported that, In cereals, as wheat, bran contained 2.4%, 26.3% and 48.7% of soluble, insoluble and total dietary fiber, respectively.

Cellulose, a dietary fiber fraction, was found to be in a high amount in coarse bran (6.4%) then in fine bran (5.99%) followed by coarse flour (1.07%). While, fine semolina, coarse semolina and fine flour had a very little amount (0.45, 0.42%, 0.37% respectively) Meanwhile, the cellulose content of whole durum meal *"Beni Suef-1"* was (2.8%).

Minerals Content of whole durum meal "Beni Suef-1" and in its different milling fractions:

From the results presented in Table (6), it could be noticed that, the whole wheat meal contained the highest mineral matter content of Mg, Fe and Zn compared with other milling fractions. However, coarse bran contained appreciable high amount of Na (12.9 mg/100 g), Ca (63.7 mg/ 100 g) and Mn (0.75 / 100 g).

Table (5): Total dietary fiber content and its fractions in whole durum meal "Beni Suef-1" and in its milling fractions on dry weight basis :

Raw Materials	Solubility (%)		Total Dietary Fiber (TDF) (%)	Dietary Fiber Fractions (%)		
	Soluble Dietary Fiber (SDF)	Insoluble Dietary Fiber (IDF)		Cellulose	Lignin	Other Fiber
Whole durum wheat	1.595	11.27	12.865	2.80	0.192	10.83
Fine semolina	0.49	1.259	1.75	0.45	0.0193	1.28
Coarse semolina	0.564	2.026	2.59	0.42	0.066	2.004
Fine Flour	0.571	1.94	2.52	0.37	0.099	2.051
Coarse Flour	1.494	4.236	5.73	1.07	0.026	4.634
Fine bran	9.99	28.001	38.0	5.99	1.331	30.679
Coarse bran	10.953	29.287	40.24	6.40	1.627	32.20

Other fiber = TDF- (Cellulose + Lignin) Toma *et al.,* (1979)

Table (6): Minerals content of whole durum meal "Beni Suef -1" and in its milling fractions (on dry weight basis):

Raw Materials	Macroelements (mg/100g)			Mmicro elements (γ/100g)		
	Calcium (Ca)	Sodium (Na)	Magnesium (Mg)	Iron (Fe)	Zinc (Zn)	Manganese (Mn)
Whole wheat meal	60.3	10.79	45.00	1.9	1.3	0.56
Fine Semolina	41.7	8.46	11.26	0.8	0.8	0.07
Coarse Semolina	44.3	9.39	10.045	1.00	0.7	0.08
Fine flour	36.5	9.37	15.04	1.2	0.8	0.01
Coarse flour	44.1	12.262	15.875	1.1	0.9	0.05
Fine bran	51.1	12.3	15.04	1.9	1.00	0.34
Coarse bran	63.7	12.9	13.855	1.8	1.2	0.75

Concerning the macroelements, results in the same table showed that, Ca constituted the major element in whole wheat meal and in its milling fractions followed by Mg. Meanwhile, Mn was the minor element.

Fine flour had the lowest amount of Ca (36.5 mg/ 100 g) and also contained lowest amount of Mn (0.01γ / 100 g) compared with other milling fractions.

Bran (Fine and Coarse) had an adequate amount of micro elements and had the highest amount of macroelements. In this respect Ranhotra *et al.,* (1996) reported that, bran is a rich source of calcium, magnesium, potassium and phosphorus.

Chemical composition of different pasta samples

With regard to chemical composition of pasta, the obtained data in Table (7) revealed that, the control sample contained the highest amount of total carbohydrates and protein. On the contrary, it contained the lowest amount of lipid, crude fiber and ash.

Table (7): Chemical Composition of different pasta samples (on dry weight basis)

Pasta samples	Protein (%)	Total Carbohydrates (%)	Total lipids (%)	fiber (%)	Ash %	Total Calories (K.cal/100gm)
Control*	18.1	78.24	1.07	1,89	0.70	394.9
Sample No.(1) 70% S_1 + 30% F.B	16.14	70.86	1.98	9.38	1.64	365.8
Sample No.(2) 60% S_1 + 40% F.B	15.01	63.9	3.10	15.86	2.12	343.5
Sample No.(3) 70% S_2 + 30% F.B	16.24	69.89	2.04	10.09	1.74	362. 8
Sample No.(4) 35% S_1 + 35% S_2 + 30% F.B	14.89	70.73	2.30	10.32	1.76	363.2
Sample No.(5) 47% S_1 + 19.5% S_2 + 8.7 F_1 + 2% F_2 + 6.4% F.B + 16.4% C.B	15.85	66.43	2.13	13.79	13.79	348.3

*Control is pasta made from 100% semolina.
Moisture content were from 9.3 % to 10.21 %

Data reported in Table (7) indicated that, pasta sample no.(2) recorded highest amount of fiber(15.86%) and lowest total calories(343.9K.cal/100gm). While, pasta sample no.(1) had the lowest value of fiber (9.38%%) and highest total calories (365.8K.cal/100gm) compared to other substituted pasta samples . The ash content of different pasta samples were affected by the dietary fiber substitution levels as shown in Table (7) .

Total dietary fiber and its fractions of different pasta samples:

In relation to dietary fiber content , the data in Table (8) declared that. Control sample was theve lowest in TDF ,SDF and IDF.

The fiber content increased as the additional level increase, the increase was in TDF,SDF and IDF , otained results revealed that, pasta sample no. (2) had the highest amount of TDF,SDF and IDF (15.86?%,4.47%and 11.36% resectively) . Meanwhile, pasta sample no. (1) had lowest amount of TDF,SDF and IDF (9.38%, 2.63% and 6.75% respectively). These results are in agreement with these reported by Manthey and Schrono, (2002) who denoted that, thermal treatment caused distribution of insoluble to soluble dietary fiber as appeared in Table (8) .

Minerals content of different pasta samples :

Control sample had the lowest amount of mineral matter content. Ca constituted the major element in different pasta samples, macrominerals in different pasta samples ranked in order of decreasing abundance as follows: Ca, Mg and Na. While, micro elements were ranked as follows: Fe, Zn and Mn as shown in Table (9).

Obtained data showed that , pasta sample no.(2) had approximately high amount of most macro and micro minerals . While , pasta sample no.(1) had less amount of the same minerals compared to other substituted pasta samples . and these results coincide with those found by Frolich and Asp ,(1985)who stated that wheat bran as a source of fiber was considered as a rich source of minerals which could be applied to pasta products .

Water holding capacity and fat absorption capacity of different pasta samples :

The WHC and FAC had higher values of uncooked pasta than in cooked pasta. Results in Table (10) revealed that, control pasta either uncooked or cooked was lower in WHC and FAC than other samples. concerning to substituted pasta samples . pasta sample no. (5) had highest values of

WHC in uncooked and cooked pasta (145.41% and 132.00% respectively) . Meanwhile , pasta sample no.(1) had less values of WHC (121.03% and 111.96%) for uncooked and cooked pasta respectively . pasta sample no.(1) had also the lowest values of FAC (109.03% and 98.45% for uncooked and cooked pasta respectively) . Meanwhile, sample no.(9) had the highest values (127.19% and 116.02%) for uncooked and cooked pasta respectively .

Table (8) : Total dietary fiber and its fractions of different pasta sample : (on dry weight basis).

Pasta samples	Solubility (%)		Total Dietary Fiber (%)	Dietary fiber fractions (%)		
	Soluble Dietary fiber (SDF)	Insoluble Dietary Fiber (IDF)		Cellulose	Lignin	*Other Fiber
Control**	0.38	1.51	1.89	0.57	0.19	1.13
Sample No.(1) 70% S_1 + 30% F.B	2.63	6.75	9.38	1.68	0.01	7.69
Sample No.(2) 60% S_1 + 40% F.B	4.47	11.38	15.86	2.75	0.828	12.28
Sample No.(3) 70% S_2 + 30% F.B	2.75	7.34	10.09	1.67	0.384	8.03
Sample No.(4) 35% S_1 + 35% S_2 + 30% F.B	2.97	7.35	10.32	1.72	0.25	8.35
Sample No.(5) 47% S_1 + 19.5% S_2 + 8.7 F_1 + 2% F_2 + 6.4% F.B + 16.4% C.B	1.62	12.172	13.79	1.89	0.08	11.82

*Other fiber=TDF – (Cellulose+ Lignin).
**Control pasta made from 100% semolina.

Table (9): Minerals content of different pasta samples (on dry weight basis**):**

Pasta Samples	Macro elements (mg/100g)			Micro elements (100g)		
	Calcium (Ca)	Sodium (Na)	Magnesium (Mg)	Iron (Fe)	Zinc (Zn)	Manganese (Mn)
Control	133.70	8.23	22.81	0.12	0.80	0.04
Sample No.(1) 70%s1+30% F.B	135.20	8.89	25.18	0.40	0.98	0.19
Sample No.(2) 60%S1 +40%F.B	151.80	8.12	33.02	1.00	1.00	0.31
Sample No.(3) 70%S2+30%F.B	140.80	9.15	25.18	0.70	0.90	0.20
Sample No.(4) 35%S1+35%S2+30%F.B	144.30	10.63	36.43	1.10	1.00	0.30
Sample No.(5) 74%S1+19.5%S2+8.7%F1+ 2%F2+6.4%F.B+16.4%C.B	148.20	11.32	40.9	0.9	0.93	0.25

Control is Pasta made from 100% semolina**.**

Table (10): Water holding capacity and fat absorption capacity of different Pasta samples "uncooked and cooked":

Pasta samples	water holding capacity (WHC)%		Fat Absorption Capacity (FAC)%	
	Uncooked Pasta	Cooked Pasta	Uncooked Pasta	Cooked Pasta
control	78.66	67.39	63.20	58.75
sample No.(1) 70%S1+30%F.B	121.03	111.96	109.03	98.45
sample No.(2) 60%S1+40%F.B	126.74	118.66	113.11	109.43
sample No.(3) 70%S2+30%F.B	124.74	115.29	114.11	103.67
sample No.(4) 35%S1+32%S2+30%F.B	137.60	127.14	122.92	110.42
sample No.(5) 47%S1+19.5%S2+8.7%F1+2 %F2+6.4%F.B+16.4% C.B	145.41	132.20	127.19	116.02

Control is Pasta made from 100% semolina**.**

Cooking quality of different pasta samples :

In Table (11) declared that, control pasta sample recorded the lowest percentages of weight and volume. Meanwhile, Among the substituted pasta with different durum wheat milling fractions, It could be shown that, as the bran replacement level increased, percentage of cooking loss increased. These results are coincide with results of Brennan *et. al.,* (2002) who reported that, bran containing pasta samples had higher cooking loss that attributed to higher amounts of water soluble component in bran.

Sensory evaluation of different pasta samples

It could be shown from the results in Table (12) that, the control pasta had the highest score for all the organoleptic properties. Concerning substituted pasta samples , sample no.(5) had highest score for overall acceptability (70.9) on the contrary , pasta sample no.(3) had the lowest score (60.4) The decreasing values of appearance and color are accordance with those reported by Manthey and Schorno, (2002) who appeared that, pasta made from bran-semolina or whole wheat meal was darker than pasta from only semolina.

Table (11): Cooking quality of pasta substituted with different durum wheat milling fractions:

Pasta Samples	Weight Increase (%)	Volume Increase (%)	Cooking Loss (T.S.S) (%)
Control	102.43	110.41	2.90
Sample No.(1) 70% S_1 + 30% F.B	145.76	120.23	4.63
Sample No.(2) 60% S_1 + 40% F.B	187.12	228.60	15.7
Sample No.(3) 70% S_2 + 30% F.B	135.21	148.21	8.44
Sample No.(4) 35% S_1 + 35% S_2 + 30% F.B	126.96	146.56	5.21
Sample No.(5) 47% S_1 + 19.5% S_2 + 8.7 F_1 + 2% F_2 + 6.4% F.B + 16.4% C.B	152.27	160.18	11.99

Control is pasta made from 100% semolina.

Table (12): Sensory evaluation of pasta substituted with different durum wheat milling fractions:-

Pasta Samples	Appearance	Color	Texture	Flavor	Stickiness	overall acceptability
Control	17.8^{a}	18.2^{a}	22.7^{a}	17.8^{a}	13.2^{a}	89.7^{a}
Sample No.(1) 70%s1+30% F.B	14.2^{def}	13.6^{efg}	16.5^{bcd}	13.1^{def}	8.1^{def}	65.5^{def}
Sample No.(2) 60%S1+40% F.B	13.2^{fg}	12.7^{g}	15.5^{bcd}	12.7^{f}	7.4^{fg}	61.5^{g}
Sample No.(3) 70%S2+30% F.B	12.7^{g}	12.9^{g}	15.1^{cd}	12.8^{ef}	6.9^{g}	60.4^{g}
Sample No.(4) 35%S1+35% S2+30% F.B	13.7^{defg}	13.2^{fg}	14.9^{d}	13.0^{def}	7.9^{ef}	62.7^{fg}
Sample No.(5) 74%S1+19.S%S2+8.7%F1+2%F2+6.4%F.B+16.4% C.B	15.4^{bc}	14.9^{bc}	16.8^{bcd}	14.5^{c}	9.3^{c}	70.9^{c}
L.S.D	1.0609	0.949	1.974	1.0545	0.839	1.175

* Values of similar superscripts are significantly not different at probability < 0.5%.

Conclusion

In conclusion, it could be deduced that, produced pasta using durum wheat milling fractions were ameliorated the nutritional value of pasta and the health benefits thereby, pasta produced is considered useful for diabetics and dietetics persons.

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إعداد وتقييم قمح الديورم لإنتاج المكرونة .

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الملخص العربي

تهدف هذه الدراسة إلى إمكانية استخدام النواتج الثانوية لطحن قمح الديورم في إنتاج أصناف جديدة من المكرونة عالية الجودة ذات محتوي عالي من الألياف الغذائية وبالتالي بقيم سعريه منخفضة بحيث يمكن استعمالها بواسطة الأشخاص الذين يتبعون الحمية الغذائية (رجيم) وكذلك مرضى السكر.

استعمل في هذه الدراسة قمح ديورم محلي "بني سويف ١" حيث تم طحن القمح بالطريقة المتبعة في شركات صناعة المكرونة وتم الحصول على نواتج الطحن وهي تتمثل في السيمولينا الناعمة، السيمولينا الخشنة، الدقيق الناعم، الدقيق الخشن، الردة الناعمة، الردة الخشنة.

التحليل الكيمياوي و تقدير الالياف الغذائية و مكوناتها (ذائبة و غير ذائبة) و جودة الطبخ و كذلك تقييم الخواص العضوية الحسية تم تقديرها في كل من المواد الخام و المكرونة المصنعة .

ولقد أظهرت النتائج تحسن في القيمة الغذائية مع زيادة معدل استخدام نواتج طحن القمح كما أنه لم يظهر تأثير سلبي على الخواص الحسية في ما عدا لون المكرونة المصنعة .