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STUDIES ON SPECIAL BREAD MADE FROM DIFFERENT MIXTURES.

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ABSTRACT

Celiac disease is one of the most common food intolerance. The only effective treatment for celiac disease is a strict adherence to a gluten free diet throughout the patient's lifetime. Gluten-free products such as bread are not widely available and are usually more expensive than their gluten containing counterparts. Therefore, there is an urgent need to develop high-quality gluten-free products.

The blends of bread which prepared for celiac patient's were prepared from rice flour, corn flour, milk protein concentrate 70% (M.P.C.) and guar gum. The mixture of the four blends were (50% rice flour+30% corn flour+19% M.P.C.+1% guar gum), (60% rice flour+20% corn flour+19% M.P.C.+1% guar gum), (70% rice flour+10% corn flour+19% M.P.C. +1% guar gum) and (80% rice flour+19% M.P.C.+1% guar gum).

Studies were carried out to evaluated chemical, sensory and biological properties of the raw materials and the produced bread made from the four formulas and the control. Chemical results of raw materials showed that there were significant differences in protein, carbohydrates, fiber and calcium contents. On the other hand, with these additives levels, bread increase in protein, and fiber contents, such improvements could be deduced to higher protein content of milk protein concentrate and higher fiber content of guar gum.

While, the sensory evaluation of pan bread showed that there were slight differences between control and formulas. On the other side there was no different between the rats fed on pan bread diets compared with the rats fed on control bread (100% wheat flour), in food efficiency ratio, protein efficiency ratio, biological value, serum transaminases, creatinine, uric acid, serum glucose, hemoglobin (Hb) and relative weight of liver and kidney.

INTRODUCTION

In Egypt, bread and other wheat flour products main cereal- based staple foods, and it provides most of the calories and protein consumed by many people. About 134.000 tons of wheat are used annually for bakery products (Abd El-Gani and Ragab 1998). Bread is the staple food for many countries especially the developing ones. Bread in Egyptian diets makes up to 72% of the total calories and about 70% of the total protein intake precipitate (F.A.O. 1973).

Celiac disease is a genetically based autoimmune enteropathy caused by a permanent sensitivity to gluten (Hamer 2005; Hill *et al.*, 2005).Celiac disease is a condition in which the mucous membrane of the small intestine of gluten-intolerant people is damaged by gluten, resulting in poorly absorption of nutrients and, consequently, weight loss, diarrhea, anemia, fatigue, flatulence, deficiency of folate and osteopenia (Blades1997;

Thompson1997). The food of celiac patient's must be completely free of any gluten, so all the products from wheat, rye, barley and oat must be replaced with corn, rice, millet equivalents and various types of starch (corn, rice, potato) or appropriate mixtures (Gambus *et al.*,2001, Sanchez *etal.*,2002). The formulation of new, better recipes and technologies for gluten-free products is therefore a priorit (McCarthy *et al.*, 2005). Gluten-free bread contains less protein, lipids, vitamins and other nutritional important ingredients than ordinary bread. Moreover, the gluten-free products are often low in micronutrients therefore adding to the risk of deficiencies (Thompson *et al.*, 2005). For this reason it is so important to produce new gluten free products with added nutritional value.

(Renzetti *et al.*, 2008) reported that gluten is a fundamental component for the overall quality and structure of bread. The replacement of the gluten network in the development of gluten-free cereal products is a challenging task for the cereal technologist. Currently, many gluten free bread available on the market are of a low quality, exhibiting a dry crumbling crumb, resulting in poor mouth feel and a poor flavour (Gallagher *et al.*, 2002), the increasing demand for gluten free food has created a need to meet new consumer requirements (McCarthy *et al.*, 2005; Sanchez *et al.*, 2002), but these foods generally have a very short shelf life.

Therefore, this study was designed to produce free gluten bread for celiac patient's. This aim had been resulted by mixing different amounts of each of rice flour and corn flour under study in different percentages beside adding milk protein concentrate 70% to increases protein content and guar gum to improve quality and stability of the dough also as a thickener as a whole replacement of wheat flour which is the reason of gluten sensitivity. Then evaluated chemical composition of all raw materials and pan bread samples, evaluation organoleptic properties of different samples of bread was determined, biological experimental using fed animal rats followed by determination of food efficiency ratio (FER), protein efficiency ratio (PER), biological value (B.V), determination of serum transaminases, creatinine, uric acid, serum glucose, hemoglobin (Hb) and relative weight (liver and kidney) were determined.

MATERIALS AND METHODS

Materials:

This work was carried out on wheat flour *(Triticum spp.)* Sakha (69), 72% extraction, rice flour (*Oryza sativa*) Gross hybrid variety and corn flour *(zea mayz)* Giza 171 were obtained from field crops department, Agricultural Research Center, Giza, Egypt. Milk protein concentrates 70% was obtained from EL-Kasas Company for milk production, EL-Dakahlia Governorate, Egypt.Guar gum was obtained from LOBA CHEMIE PVT. LTD. Mumbai-India. Instant active dry yeast and salt (sodium chloride) were brought from local market of EL-Dakahlia Governorate, Egypt.

Methods:

Flour mixing:

Table (1) The flour mixtures were prepared according to the ratio outlined in Table (1)

Table (1): wheat flour 72% extraction, rice flour, corn flour 72% extraction, milk protein concentrate 70% and guar gum mixtures for bread:

No.	Wheat flour	Rice flour	Corn flour	M.P.C.70%	Guar gum
1	100%	---	---	---	---
2	---	50%	30%	19%	1%
3	---	60%	20%	19%	1%
4	---	70%	10%	19%	1%
5	---	80%	---	19%	1%

Production of pan bread:

The straight dough method was used for the production of pan bread according to the method described by (Alian *et al.*, 1997) as follows: (100 g) of wheat flour (72% extraction) sodium chloride (1.5 g), sugar (6 g), active dry yeast (1.5 g), corn oil (3g) and the required amount of water (determined by Farinograph test) were added and mixed, the dough was left for 30 min fermentation at 30 °C and 85% relative humidity then divided into (150g) dough pieces, dough pieces were round, moulded and placed in metal pan (15x5x6cm.) that tightly greased. The loaves were fermented at 30-35 °C and 85% relative humidity for one hour, and then baked at 220 °C for 15 min. Bread loaves were allowed to cool on racks for about one hour and packed in polyethylene bags, the last experiment was carried out by replacement of wheat flour by rice flour, corn flour, milk protein concentrate 70% and guar gum mixtures.

Chemical analysis:

All materials used in this study as well as the produced bread were chemically analyzed. Moisture,crude protein, crude fat, ash content and crude fiber were determined according to methods deacribed in (A.O.A.C. 1990).Total carbohydrates were calculated by difference as follows:

Carbohydrates =100 – (%moisture+% protein+% fat+% ash+% fiber).

Mineral analysis was carried out after digesting with mixture of concentrated sulfuric acid and percholoric acid as stated in (A.O.A.C. 1990). Phosphors was measured by flame photometry (Corning 400), while calcium, zinc and iron, were estimated using an AASI atomic absorption spectrophotometry (Perkin-Elmer Instrument Model 2380).

Organoleptic evaluation for bread :

As shown in Table (2), bread samples were evaluated organoleptically by a panel of ten experienced panelists according to the method described by (EL_Ferra *et al.*, 1982).

Table (2): Typical bread score card

Characteristics	Score
Appearance	20
Color of crust	10
Color of crumb	10
Distribution of crumb	20
Homogenous	10
Taste	20
Odor	10
Total	100

Biological experimental:

Bread was biologically evaluated with different analysis by using weaning male albino rates (30rats) with an average weight of (80- 120 grams) were used, temperature in animal house was 25°C and ratio of moisture was 16%.

Upon arrival. The rats were divided into 6 groups each of 5 rats the first group rats fed on basal diet (negative control), group 2: rats fed on 100% wheat flour bread (positive control), group 3: rats fed on 50% rice flour + 30% corn flour + 19% M.P.C. + 1% guar gum bread, group 4: rats fed on 60% rice flour + 20% corn flour + 19% M.P.C. + 1% guar gum bread, group 5: rats fed on 70% rice flour + 10% corn flour + 19% M.P.C. + 1% guar gum bread and group 6: rats fed on 80% rice flour + 19% M.P.C. + 1% guar gum bread. The analysis experiment were as next:

(1) Determination of food efficiency ratio (F.E.R.): was determined using the following equation according to (Chapman *et al.*, 1950).

FER = Daily food intake (g) / Daily body weight gain (g).

(2) Determination of protein efficiency ratio (P.E.R.): was determined according to the method describe by (Bender and Doehi 1957) and the following equations:

$$\text{PER} = \frac{\text{Gain in body weight (g)}}{\text{Protein consumed (g)}}$$

$$\text{Corrected PER} = \text{PER} \times \frac{2.5}{\text{Determined PER for reference standard casein}}$$

(3) Biological value (B.V): was estimated using the equation suggested by (Oser 1959):

$$B.V = 49.9 + 10.53\ PER$$

(4) Determination of serum transaminases: Serum Alanine transferase (ALT) and Aspartate transferase (AST) were calorimetrically determined according to the method described by (Reitman and Frankel 1959) using Du7400 spectrophotometer adjusted at 546 nm.

(5) Determination of creatinine: Creatinine was determined according to the method described by (Henry 1974).

(6) Determination of uric acid: Uric acid was determined according to (Barham and Trinder 1972).

(7) Determination of serum glucose: Blood glucose was determined in blood serum of experimental rats using the kits of Bicon Diagnostik, BD-GB-GLUL-O312 (Germany). The method of (Tietz 1995).

(8) Determination of hemoglobin (Hb): Hemoglobin was determined by cyanomethoglobia method according to (Drabkin 1949).

Statistical evaluation:

Statistical analysis for each of the collected data was done following the procedure outlined by (Gomez and Gomez 1984), the treatment were compared using the latest significant difference test (LSD) at the 5% level of probability as outlined by (Waller and Duncan 1969).

RESULTS AND DISCUSSION

Chemical composition of raw materials:

Table (3) represent the consitituents of wheat flour (72% extraction) containing 10.38% moisture followed by rice flour which recorded 10.33%, while the lowest value in flours was 9.83% for corn flour. These results are in agreement with (Khalil and Hussein 2003) who found that wheat flour (72% extraction) contained 10.60% moisture. (Huang *et al.*, 2004) found that rice flour contained 11% moisture. While (Abd El-Samad 2001) reported that corn flour contained 8.80% moisture

Table (3): Chemical composition of wheat flour, rice flour, corn flour, milk protein concentrate and guar gum (g/100g) :

Component / Raw materials	Moisture %	Crude protein%		Crude fat%		Ash content%		Crude fiber%		Carbohydrates %****	
		F.W.B.**	D.W.B.***	F.W.B.**	D.W.B.***	F.W.B.**	D.W.B.***	F.W.B.**	D.W.B.***	F.W.B.**	D.W.B.***
Wheat flour	10.38a	10.0b	11.15b	1.07d	1.19d	0.59c	0.65c	3.60b	4.01b	74.36b	82.97b
Rice flour	10.33a	5.75d	6.41d	1.65c	1.84c	0.76b	0.84b	3.28c	3.65c	78.23a	82.42a
Corn flour	9.83b	8.69c	9.63c	4.34b	4.81b	1.80a	1.99a	1.02d	1.13d	74.32b	87.24b
M.P.C.	8.69c	66.46a	72.78a	6.03a	6.60a	0.09e	0.10e	0.00e	0.00e	18.73c	20.51c
Guar gum	8.64c	5.01e	5.48e	0.08e	0.09e	0.51d	0.55d	81.14a	88.81a	4.62d	5.05d
F. test	*	*	*	*	*	*	*	*	*	*	*
L.S.D. 5% *****	0.43	0.56	0.62	0.12	0.13	0.06	0.06	0.15	0.16	0.79	0.87

** F.W.B: Fresh weight basis *** D.W.B: Dry weight basis

**** Carbohydrates = 100- (% moisture+% protein+ % fat+ % ash + % fiber).

*****L.S.D.: Least significant defference.

a,b,c,d,e: Mean within each row having similar later (S) are not significantly different ($P \leq 0.05$)

The obtained results in the same Table also indicated that values of crude protein content ranged between 5.48% to 72.78% (on dry weight basis). The highest value of milk protein concentrate 70%, followed by wheat flour that contained 11.15%. While, the lowest content was for guar

gum (5.48%). These results agree with those reported by (Bailey 2003) who found that the protein content of (M.P.C.) typically ranges from 40 to 88%. (Ragab, *et al.,* 2005) reported that protein content of wheat flour was 9.9 % . Protein content of guar gum was 4.3 %. (Dikeman *et al.,* 2006).

The crude fat content of raw materials was higher in milk protein concentrate 6.60% than corn flour 4.81%, rice flour 1.84% and wheat flour 1.19% (on dry weight basis). These results are in agreement with (Abd El-Samad 2001) who mentioned that corn flour contained 4.26% fat. (Ying *et al.,* 2007) who found that rice flour contained 1.26 % fat. Also (Ragab *et al.,* 2005) stated that wheat flour (72% extraction), contained 1.2 % fat.

Furthermore, the same results in Table (3) revealed that rice flour contained highest value of carbohydrates (87.24%) followed by wheat flour (72% extraction), corn flour, milk protein concentrate and guar gum which contained 82.97%, 82. 42%, 20.51% and 5.05% (on dry weight basis) respectively. These results are in accordance with the results of (Abdeen 1997) who studied that percentage of carbohydrate in rice flour was between 89.7-91.52%, and (Aly 2000) who reported that wheat flour (72% extraction), contained total carbohydrates between 72.99-84.33%. Corn flour contained 85.11% total carbohydrate. (Zahran 2000).

The obtained results in Table (3) also showed that corn flour had the highest content of ash (1.99%) followed by rice flour (0.84%) while the lowest value of ash in flours was (0.65%) in wheat flour 72% extraction (on dry weight basis). These results are in agreement with those obtained by (Ismail *et al.,* 2001) who reported that corn flour contained 1.46% ash. While, rice flour contained 0.63% ash. (Ying *et al.,* 2007), and wheat flour (72% extraction) contained 0.60% ash. (Khalil and Hussein 2003).

Table (3) showed that, guar gum contained the highest value of fibers (88.81%) followed by wheat flour (72% extraction), rice flour and corn flour which contained 4.01 %, 3.65 % and 1.13% (on dry weight basis) respectively. These results are in accordance with the results of (Dikeman *et al.,* 2006) who found that total dietary fiber content of guar gum was 82.3%. (Salmenkallio-Marttila *et al.,* 2001) found that wheat flour (72% extraction) fibers content was 2.7%. (U.S.D.A. 2009) reported that rice flour contained 2.4% fiber, also (Abd El-Samad 2001) found that corn flour contained 1.74 crude fiber.

Data in Table (4) showed that calcium content of raw materials used in this study was higher in milk protein concentrate 98 mg/100g, while wheat flour (72%extraction)14.3 mg/100g followed by guar gum 14 mg/100g, and the lowest content was in corn flour 8.1 mg/100g (on dry weight basis).These results approximately agree with (Abd El-Hameed 2004) who found that calcium content in wheat flour (72%extraction) was 14.13 mg/100g; (U.S.D.A 2009) reported that calcium content in corn flour was 7 mg/100g.

It could be concluded from Table (4) that the highest content of phosphorus was in corn flour 226 mg/100g and wheat flour (72%extraction) 103 mg/100g, followed by rice flour 95 mg/100g. On the other hand guar gum contained the lowest value 11 mg/100g (on dry weight basis). These results are in accordance with the results of (U.S.D.A 2009) which reported that

phosphorus content in corn flour and wheat flour (72%extraction) were (272, 108) respectively.

From the same Table, it could be noticed that the highest content of iron was in corn flour 2.25 mg/100g, followed by wheat flour (72%extraction) 1.11 mg/100g. On the other hand guar gum contained the lowest value 0.08 mg/100g (on dry weight basis). These results approximately agree with (Abd El-Hameed 2004) who found that iron content in wheat flour (72%extraction) was 1.53mg/100g; (U.S.D.A 2009) reported that iron content in corn flour and wheat flour (72%extraction) were (2.38 and 1.17 mg/100g) respectively.

Data in Table (4) showed that zinc content was higher in corn flour 1.68 mg/100g followed by rice flour 0.77 mg/100g. On the other hand guar gum contained the lowest value 0.09 mg/100g (on dry weight basis). These results agreement with (U.S.D.A 2009) reported that zinc content in corn flour and rice flour were (1.73and 0.80mg/100g) respectively.

Table (4):The minerals content in wheat flour, rice flour, corn flour, milk protein concentrate and guar gum (g/100g) :

Element / Raw materials	Calcium (mg/100g) D.W.B.**	Phosphorus (mg/100g) D.W.B.**	Iron (mg/100g) D.W.B.**	Zinc (mg/100g) D.W.B.**
Wheat flour	14.30b	103b	1.11b	0.66c
Rice flour	9.60c	95c	0.41d	0.77b
Corn flour	8.10c	226a	2.25a	1.68a
M.P.C.	98.00a	36d	1.03c	0.31d
Guar gum	14.00b	11e	0.08e	0.09e
F. test	*	*	*	*
L.S.D.5%***	2.93	3.25	0.04	0.04

**D.W.B: Dry weight basis

***L.S.D.: Least significant defference.

a,b,c,d,e: Mean within each row having similar later (S) are not significantly different (P≤ 0.05)

Chemical composition of ban bread:

Data presented in Table (5) showed the chemical composition of pan bread which prepared for celiac patient's. Results indicated that protein and ash contents of bread samples ranged between (18.37 to 23.76%) and (0.86 to 1.69%) respectively. Sample No. (5) had the highest protein and ash percentage (23.76, 1.69%) respectively, followed by the sample No.(4), No.(3) and No.(2) which recorded (23.72, 1.61%), (23.63, 1.47%) and (23.58, 1.44%), respectively (on dry weight basis). While the control sample No.(1) had the lowest percentage (18.37, 0.86 %). These results approximately agree with (Sarhan *et al.*, 1986) who found that the protein and ash contents in pan bread made from wheat flour (72%extraction) was 13.78% and 0.815% respectively. Such improvements in protein content could be deduced to higher protein content of milk protein concentrate 70%.

Results in Table (5) also indicated that the highest percentage of fat recorded for bread sample No. (1) it was (2.55%). Followed by the sample No.(2), No.(3) and No.(4) which recorded (2.22, 1.67 and 1.22%),

respectively. While sample No. (5) had the lowest percentage (0.99%) of fat (on dry weight basis).

From Table (5), it could be noticed that fiber content of sample No. (5) had the highest fiber percentage (2.43%), followed by the sample No.(4), No.(3) and No.(2) which recorded (2.36, 2.28 and 2.23%),respectively. While the control sample No.(1) had the lowest percentage 1.93%(on dry weight basis). These results agreement with (Hegazi 2008) who found that the fat and fiber contents in bread made from wheat flour (72%extraction) were 1.52% and 1.66%, respectively (on dry weight basis) . It could be clearly noticed that both fiber and ash contents are tended to the high fiber content of guar gum.

Results in Table (5) show that the control sample No. (1) had the highest carbohydrate percentage (76.72%). Followed by the sample No. (5), sample No.(4), sample No.(3) and sample No.(2) which recorded (71.10, 71.08, 70.93 and 70.50%), respectively (on dry weight basis). These results agree with those reported by (Abd El-Hameed 2004) who found that the carbohydrate content in bread made from wheat flour was 86.55%.

Table (5) Chemical composition of pan bread (g/100g):

Component / Samples	Moisture%	Crude protein%		Crude fat%		Ash content%		Crude fiber%		Carbohydrates% ****	
		F.W.B.**	D.W.B.***	F.W.B.**	D.W.B.***	F.W.B.**	D.W.B.***	F.W.B.**	D.W.B.***	F.W.B.**	D.W.B.***
(1)(Control) 100%wheatflour	23.97a	13.97 e	18.37e	1.94a	2.55a	0.66d	0.86d	1.47e	1.93e	57.99c	76.27a
(2) 50%riceflour +30%cornflour +19% M.P.C.+1% guargum	17.79b	19.39d	23.58d	1.83b	2.22b	1.19c	1.44c	1.84cd	2.23cd	57.96bc	70.50bc
(3) 60%riceflour +30%cornflour +19% M.P.C.+1% guargum	17.44b	19.51c	23.63c	1.38c	1.67c	1.22c	1.47c	1.89bc	2.28bc	58.56b	70.93b
(4) 70%riceflour +10%cornflour +19% M.P.C.+1% guargum	17.00c	19.69b	23.72b	1.02d	1.22d	1.33b	1.61b	1.96ab	2.36ab	59b	71.08b
(5) 80%riceflour +19% M.P.C.+1% guargum	16.76c	19.78a	23.76a	0.83e	0.99e	1.41a	1.69a	2.03a	2.43a	59.19a	71.10b
F.test	*	*	*	*	*	*	*	*	*	*	*
L.S.D.5%*****	0.4296	0.0771	0.0947	0.0786	0.0967	0.0511	0.0627	0.0761	0.0935	0.2206	0.2713

****F.W.B: Fresh weight basis** *****D.W.B: Dry weight basis**

******Carbohydrates = 100- (%moisture+ % protein+ % fat+ % ash + % fiber).**

*******L.S.D.: Least significant defference.**

a,b,c,d,e: Mean within each row having similar later (S) are not significantly different (P ≤0.05)

Regarding minerals in Table No. (6) it could be noticed that the control sample No. (1) had the highest content of calcium (168.00 mg/100g) followed by sample No. (5), No.(4), No.(3) and No.(2) which recorded (133.33, 129.67, 114 and 96.67 mg/100g),respectively (on dry weight basis). Phosphorus content of samples ranged from 163.00 mg/100g in control sample No.(1) to 313.33 mg/100g in sample No. (2) (on dry weight basis). These results agree with (U.S.D.A 2009), who reported that calcium and phosphorus contents in bread made from wheat flour (72%extraction) were (142, 155mg).

Table (6) The minerals in pan bread (mg/100g) :

Element / Samples	Calcium (mg/100g) D.W.B.**	Phosphorus (mg/100g) D.W.B.**	Iron (mg/100g) D.W.B.**	Zinc (mg/100g) D.W.B.**
(1) (Control) 100% wheat flour	168.00a	163.00e	4.12c	1.73e
(2) 50% rice flour +30% corn flour +19% M.P.C.+1% guar gum	96.67d	313.33a	5.29a	3.32a
(3) 60% rice flour +30% corn flour +19% M.P.C.+1% guar gum	114.00c	285.33b	4.21b	3.13b
(4) 70% rice flour +10% corn flour +19% M.P.C.+1% guar gum	129.67b	259.00c	3.19d	2.92c
(5) 80% rice flour+19% M.P.C.+1% guar gum	133.33b	233.67d	2.77e	2.59d
F. test	*	*	*	*
L.S.D. 5%***	4.7174	5.4775	0.0542	0.0514

****D.W.B: Dry weight basis**
*****L.S.D.: Least significant defference.**
a,b,c,d,e: Mean within each row having similar later (S) are not significantly different (P≤0.05)

Iron content of samples ranged from 2.77 mg/100g in sample No. (5) to 5.29mg/100g (on dry weight basis) in sample No. (2). While control sample No. (1) had 4.12 mg/100g (on dry weight basis). These results agree with those reported by (U.S.D.A 2009) who reported that iron content in bread made from wheat flour (72%extraction) were (3.46mg).

Zinc content of samples ranged from 1.73 mg/100g in control sample No.(1) to 3.32 mg/100g in sample No. (2) (on dry weight basis). These results agree with those reported by (Hegazi 2008) who reported that zinc content in bread made from wheat flour was (0.16mg).

The aforementioned blends were targeted initially as new resources of bakeries for celiac patients. Such results emphasized the improvement state in addition to production of pan bread with higher protein and minerals content.

Organoleptic evaluation of pan bread

Average sensory panel scores of appearance, color of crust, color of crumb, distribution of crumb, homogenous, taste and odor of pan bread are tabulated in Table (7).

The data indicated that the control sample No. (1) recorded highest total score of organoleptic evaluation value (96.2) followed by sample No.(5), sample No. (3), sample No. (4) and sample No. (2) which recorded (90.4, 88.8, 88 and 88 respectively).

Table (7) Organoleptic evaluation of pan bread

Panel test / Samples	Appearance /20	Color of crust /10	Color of crumb /10	Distribution of crumb /20	Homogenous /10	Taste /20	Odor /10	Total /100
(1) (Control) 100% wheat flour	19.3 a	9.2 ab	9.4 a	19.6 a	9.5 a	19.4 a	9.8 a	96.2
(2) 50% rice flour +30% corn flour +19% M.P.C.+1% guar gum	18.7 a	8.8 abc	7.9 bc	17.5 b	8.6 b	17.7 bc	8.8 b	88
(3) 60% rice flour +30% corn flour +19% M.P.C.+1% guar gum	18.5 a	9.2 ab	8. 6 ab	17.4 b	8.2 bc	18.0 b	8.9 b	88.8
(4) 70% rice flour +10% corn flour +19% M.P.C.+1% guar gum	18.4 a	9.1 ab	8.1 bc	17.2 b	8.0 bc	18.3 ab	8.9 b	88
(5) 80% rice flour +19% M.P.C.+ 1% guar gum	18.6 a	9.5 a	8.3 b	18.0 b	8.6 b	18.4 ab	9.0 b	90.4
F. test	*	*	*	*	*	*	*	
L.S.D. 5%**	1.171	0.637	0.841	1.418	0.686	1.058	0.501	

****L.S.D.: Least significant defference.**

a,b,c,: Mean within each row having similar later (S) are not significantly different (P≤0.05)

It can be concluded from the previous data that blends No. 5 (80% rice flour +19% M.P.C.+1% guar gum) can be considerd as the best blend compard with other studied samples for its nutritive value such as protein and calcium, this sample can be followed by sample 4 (70% rice flour +10% corn flour +19% M.P.C.+1% guar gum),sample 3 (60% rice flour +20% corn flour +19% M.P.C.+1% guar gum) and sample 2 (50% rice flour +30% corn flour +19% M.P.C.+1% guar gum). The other chemical component were more or less sufficient from nutritive value as the bread was not its only source in its diet. Meanwhile such studied blends showed the same trend for it's organoleptic evaluation.

Biological experimental

Effect of pan bread diets on body weight gain, food intake, food efficiency ratio, protein efficiency ratio (PER) and biological value (B.V):

Table (8) show mean values of initial weight, final weight, body weight gain, food intake, food efficiency ratio, protein efficiency ratio and biological value of rats fed on pan bread diets.

The data in Table (8) show no significant difference for initial weight and final weight between the groups under study. Also there are not significant difference for body weight gain and daily body weight gain whereas the highest value in body weight gain and daily body weight gain was (28 , 0.77 g/rat) in negative group (1), then group (4) and group (5) were (27, 0.72 g/rat, 27, 0.72 g/rat) respectively. While the lowest value in body weight gain and daily body weight gain was (19, 0.52 g/rat) in positive group (2).

The data in same table show no significant difference for food efficiency ratio, protein efficiency ratio and biological value between the groups under study. Whereas the highest value in protein efficiency ratio, biological value and lowest value in food efficiency ratio was (1.42, 64.81, and 26.69%) in negative group (1), then group (3) (1.38, 64.46 and 28.02%) respectively.

Table (8): Body weight gain, food intake, food efficiency ratio (FER), protein efficiency ratio (PER) and biological value (B.V) of rats fed on pan bread:

Variable / Groups	Initial weight (g)	Final weight (g)	Body weight gain (g)	Daily body weight gain (g)	Daily food intake (g)	Food efficiency ratio	Protein Efficiency ratio	Biological value
G1	127 a	155 a	28 a	0.77 a	20a	26.69 a	1.42 a	64.81 a
G2	133 a	152 a	19 a	0.52 a	20a	50.34 a	0.97 a	59.95 a
G3	143 a	170 a	28 a	0.75 a	20a	28.02 a	1.38 a	64.46 a
G4	150 a	177 a	27 a	0.72 a	20a	28.58 a	1.33 a	63.87 a
G5	142 a	169 a	27 a	0.72 a	20a	27.98 a	1.33 a	63.94 a
G6	143 a	169 a	25 a	0.68 a	20a	34.01 a	1.27 a	63.23 a
F. test	--	--	--	--	--	--	--	--
L.S.D. 5%*	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

*L.S.D.: Least significant defference.

a,b: Mean within each row having similar later (S) are not significantly different (P ≤ 0.05)

While the lowest value in protein efficiency ratio , biological value and highest value in food efficiency ratio was (0.97, 59.95 and 50.34%) in positive group (2).

So it can be concluded that the rats fed on pan bread diets increase protein efficiency ratio and biological value of rats compared the diets which contain (100% wheat flour), for its high content of protein.

Liver and kidney functions:

Effect of pan bread diets on aminotransferase enzymes GOT ,GPT activity (ALT and AST) levels and uric acid and creatinine:

Glutamic-pyruvic transaminase (GOT) was widely distributed in cells throughout the body. GPT was found predominantly in the cytoplasm of hepatic parenchymol cells and is widely considered to be specifically for the liver. GPT was cytoplasmic hepatocellular enzyme, whose increase in blood was highly indicative for liver damage by hepatitis, cirrhosis or hepatic tumors. If cell were damage, GPT will excreted into the blood. In the plasma, GPT has no biological function because the necessary substrates and Co-substrates were lacking there, and its activity in the liver was about 3.000 times higher than its activity in the serum (Thoma 2000).

While uric acid level in human plasma was very close to its soulbility limit (3.5 mg/dl, concentration > 6.0 mg/dl) uric acid salts causing gout and kidney stones. Creatinine was a waste product in the blood created by the normal breakdown of muscle during activity. Healty kidneys take creatinine out of the blood and put it in the urine to leave the body. When kidneys were not working well, creatinine builds up in the blood (Obata *etal.*, 2000).

Table (9) and show mean values of Glutamic-pyruvic transaminase (GOT),(GPT),uric acid and creatinine of rats fed on pan bread diets .

The data in Table (9) show no significant difference for Glutamic-pyruvic transaminase (GOT) and (GPT) between the groups under study. Whereas the highest value in (GOT) was (44 U/L) in group (4), then group (3) and group (6) were (38, 31 U/L) respectively. While the lowest value in (GOT) was (25 U/L) in positive group (2). The obtained results in the same Table also indicated that values of (GPT) ranged between 6 to 8 U/L.

The data in Table (9) show no significant difference for uric acid and creatinine between the groups under study. The obtained results in the Table also indicated that values of uric acid ranged between 2.72 to 3.55mg/dl. The highest value of group (5), followed by group (2) that contained 3.44mg/dl. While, the lowest content was for group (4) (2.72 mg/dl).

Table (9): Effect of pan bread diets on aminotransferase enzymes GOT and GPT activity (ALT and AST) levels and uric acid and creatinine

Variable / Groups	ALT U/L	AST U/L	Uric acid mg/dl	Creatinine mg/dl
G1	29 a	6 a	3.30 a	0.56 a
G2	25 a	7 a	3.44 a	0.73 a
G3	38 a	6 a	2.72 a	0.64 a
G4	44 a	8 a	2.95 a	0.64 a
G5	30 a	6 a	3.55 a	0.47 a
G6	31 a	6 a	3.21 a	0.81 a
F. test	- -	- -	- -	- -
L.S.D. 5%*	N.S	N.S	N.S	N.S

***L.S.D.: Least significant defference.**

a,b: Mean within each row having similar later (S) are not significantly different (P ≤ 0.05)

Also the obtained results in the Table also indicated that values of creatinine ranged between 0.47 to 0.81mg/dl., the highest value of group (6). While, the lowest content was for group (5).

Effect of pan bread diets on serum glucose and hemoglobin and relative weight of liver and kidney :

People with diabetes cannot properly process glucose, a sugar the body uses for energy. As a result, glucose stays in the blood, causing blood glucose to rise. At the same time, however, the cell of the body can be starved for glucose. Diabetes can lead to poor wound healing, higher risk of infections, and many other problems involving the eyes, kidneys, nerves and heart (Haffner *etal.*, 1999).

Table (10) show mean values of serum glucose , hemoglobin and relative weight (liver and kidney) of rats fed on pan bread diets.

Table (10): Effect of pan bread diets on serum glucose, hemoglobin and relative weight of liver and kidney:

Variable / Groups	Glucose mg/dl	Hemoglobin mg/100ml	Liver		Kidney	
			Weight (g)	Relative (ratio)	Weight (g)	Relative (ratio)
G1	115 a	6.88 a	5.28ab	3.40ab	1.33a	0.85a
G2	116 a	9.14 a	5.79a	3.80a	1.47a	0.96a
G3	122 a	6.94 a	5.02ab	2.95ab	1.18a	0.69a
G4	118 a	8.80 a	6.05a	3.41a	1.23a	0.69a
G5	129 a	7.18 a	3.84ab	2.27ab	0.77a	0.49a
G6	120 a	8.53 a	3.33b	1.97b	0.87a	0.51a
F. test	--	--	--	--	--	--
L.S.D. 5%*	N.S	N.S	N.S	N.S	N.S	N.S

*L.S.D.: Least significant defference.

a,b: Mean within each row having similar later (S) are not significantly different (P ≤0.05)

The data in Table (10) show no significant difference for serum glucose and hemoglobin between the groups under study. The obtained results in the Table also indicated that values of serum glucose ranged between 115 to129 mg/dl. The highest value of group (5), followed by group (3) that contained 122mg/dl. While, the lowest content was for group (1) (115 mg/dl).

The obtained results in the Table also indicated that values of hemoglobin ranged between 6.88 to 9.14 mg/100ml .The highest value of group (2) .While, the lowest content was for group (1).

The data in Table (10) show no significant difference for liver weight and kidney weight between the groups under study. The obtained results in the Table also indicated that liver weight ranged between 3.33 to 6.05g. The highest value of group (4), followed by group (2) that contained 5.79g. While, the lowest content was for group (6) (3.33g). Also the obtained results in the Table also indicated that kidney weight ranged between 0.77 to 1.47g.The highest value of group (2) .While, the lowest content was for group (6).

Conclusion:

It can be concluded from different obtained data that bread produced for celiac patient's from different studided blends were significant more or less have the same attitude of their nutritive value, organoleptic evaluation and bilogical evaluation compard with those made from wheat flour. So it can be a good caloric source for celiac patient's.

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دراسات على الخبز الخاص المصنع من خلطات مختلفة.

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** المركز القومى للبحوث، القاهرة.

يعد مرض الداء الزلاقي و المعروف بأسم مرض السيلياك واحدا من اهم الامراض المتعلقة بعدم القدرة على تحمل الطعام ومن اكثرها انتشارا ، و العلاج الوحيد الفعال لهذا المرض يتمثل باتباع حمية غذائية خالية من الجلوتين مدى الحياة ، بينما المنتجات الخالية من الجلوتين غير واسعة الانتشار و عادة ماتكون غالية الثمن ، لذلك فهناك حاجة ملحة لتطوير منتجات خالية من الجلوتين – وبخاصة الخبز- عالية الجودة و القيمة الغذائية.

تم تصنيع اربع خلطات للخبز من دقيق الذرة و دقيق الارز و مركز بروتين اللبن و صمغ الجوار لمرضى السيلياك بجانب العينة الكونترول (دقيق القمح استخلاص ٧٢%) ، و كانت الاربع خلطات بالنسب التالية (٥٠% دقيق ارز + ٣٠% دقيق ذرة +١٩% مركز بروتين اللبن +١% صمغ الجوار) و (٦٠% دقيق ارز + ٢٠% دقيق ذرة +١٩% مركز بروتين اللبن +١% صمغ الجوار) و (٧٠% دقيق ارز + ١٠% دقيق ذرة +١٩% مركز بروتين اللبن +١%صمغ الجوار) و (٨٠% دقيق ارز +١٩% مركز بروتين اللبن+١% صمغ الجوار) ، تم اجراء بعض الدراسات لتقييم الخصائص الكيميائية و الحسية و التغذوية للمواد الخام و الخبز الناتج من الاربع خلطات و العينة الكونترول .

أظهرت التحليلات الكيماتية للمواد الخام وجود فروق معنوية مابين المواد الخام فى محتواها من البروتين و الكربوهيدرات و الكالسيوم . و أوضحت النتائج ايضا ان الخبز المصنع ازداد محتواه من البروتين و الالياف و الاملاح المعدنية و هذا يرجع لتواجد نسب من مركز بروتين اللبن و صمغ الجوار ، بينما أظهر التقييم الحسى للخبز المصنع انه كانت تتواجد اختلافات بسيطة مابين العينة الكونترول و الخلطات ، على الجانب الاخر لم تظهر اى فروق معنوية بين المجاميع المختلفة بالنسبة لقيم الزيادة فى الوزن و كذلك الاستجابة الغذائية و القيمة الحيوية للاغذية وكذلك بالنسبة لقيم نشاط انزيم ALT و AST وقيم حمض اليوريك و الكيرياتين وكذلك لا يوجد اختلافات معنوية بين المجاميع المختلفة بالنسبة لقيم مستوى الجلوكوز و الهيموجلوبين فى الدم وكذلك بالنسبة لوزن الكبد و الكلى .

ومن هذة الدراسة ممكن الوصول للخلاصة التالية:

الخبز المصنع لمرضى السيلياك من الخلطات المتعددة تحت الدراسة كانت معنويا تقارب فى قيمتها الغذائية و الحسية و البيولوجية الخبز المصنع من دقيق القمح، و بهذا يكون الخبز المصنع من هذة الخلطات يحقق الغرض كغذاء صحى عالى الجودة و رخيص الثمن لمرضى السيلياك.

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