مجلة علمية محكمة - ربع سنوية
Scientific Refereed Journal - Quarterly
South-South Dialogue

Physico-chemical composition , minerals content and sensory evaluation of psyllium husks toast bread

التركيب الفيزيائي والمحتوي المعدني والتقييم الحسي لقشور السيليوم لخبز التوست

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المجلد السادس – العدد ٢١ – أبريل ٢٠٢٤

الترقيم الدولي

P-ISSN: ٢٥٣٥-٢٢٢٩ O - ISSN: ٣٠٠٩-٦٠١٤

موقع المجلة عبر بنك المعرفة المصري https://hgg.journals.ekb.eg/

العنوان: كلية التربية النوعية – جامعة أسيوط – جمهورية مصر العربية

Add: Faculty of Specific Education-Nile street- Assiut
العنوان : كلية التربية النوعية –شارع النيل – أسيوط
Print ISSN: 2535-2229
On Line ISSN: 3009-6014
Office / Fax 088/2143535 فاكس / مباشر :
Tel 088/2143536 تليفون :
Mob 01027753777 موبايل :
https://hgg.journals.ekb.eg

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Abstract

Psyllium husks have a high nutritional value in terms of fiber and protein. So the present study aims to investigate the chemical composition, minerals content , physical and sensory evaluation of toast bread mixed with different levels of psyllium husks(PSH) (٥٪,١٠٪ and ١٥٪).The results revealed that the gross chemical composition of toast bread fortified with ١٥٪ (PSH) recorded a high ratio in protein and fiber (١٥,٢٢٪,٣١,٧٩٪ and ٣,٥١٪,٧,٣٣٪); respectively on a wet weight basis and dry weight basis ,while toast bread fortified with ١٥٪(PSH) had the lowest value of crud fat, total carbohydrates and caloric value (٠,٢٢٪ ,٠,٤٦٪ ;١٥,٨٨٪,٣٣,١٧٪ and ١٢٦,٣٨٪ ,٢٦٣,٩٥٪) ;respectively on a wet weight basis and dry weight basis. Results also indicated a more significant difference in minerals content between toast bread fortified with psyllium husks and wheat toast bread (control) .The toast bread fortified with ١٥٪(PSH) recorded the highest values in Na, Ca and Fe (٣١,١١ , ٤٠,٤٣ and ٢,٢٣) mg/١٠٠g ; respectively , as well as sensory evaluation .The scores revealed that the sample with of toast bread fortified with٥٪ psyllium husks was most acceptable among the panelists due to its texture ,graining , oder and taste as compared to other proportions of toast bread fortified with psyllium husks .The physical characteristics of toast bread with ١٥٪ (PSH) recorded a higher value in terms of weight was(١٩٩,٢٣ g) and volume (٣٣٢,٤٠ ml), Consequently ,it is recommended to utilize psyllium husks to raise the nutritional value of products as a source of fiber.

Keywords: psyllium husks, chemical composition, minerals content, Toast bread

Introduction

Wheat bread is a very popular foodstuff in the daily diets of most of the population .Bread is rich in carbohydrates , fat and energy but low in protein,minerals and vitamins (Amnah,٢٠١٨)and(Bouchra *et al.*,٢٠١٨) .Bread is a baked product produced from wheat flour .There are different varieties of bread depending on shape ,weight,crust hardness,crumb cell structure ,softness and color (Islamiyat *et al.*,٢٠١٩) . Wheat is a major cereal crop in many parts of the world. It belongs to the Triticum family, of which there are many species; *T. aestivum* and *T.durum* are the most important commercially. Wheat is used to produce different kinds of foods ,such as bread, pasta, noodles, pastry ,breakfast cereals and baby foods. To produce these products ,wheat must first be processed into flour (Mckevith,٢٠٠٤)and(Swapnil *et al.*, ٢٠١٦).Wheat bread prepared from refined flour luck complex carbohydrates (Elena *et al.*,٢٠٢٣) ,while (Sulieman ,٢٠٠٥) found that the fiber content of wheat flour (٧٢٪extraction) was ٢,٣٥٪. increased awareness of health issues the bakery industry is moving to provide functional and healthy foods , mainly via fortification with satiating and active ingredients ,such as proteins, fibers ,minerals and vitamins (Marwa,٢٠٢٢). Dietary fiber is a group of food components which is resistant to digestive enzymes and are found mainly in cereals ,fruits and vegetables. Dietary fiber and whole grains contain a unique blend of bioactive components including resistant starches ,vitamins ,minerals ,phytochemicals and antioxidants (Semih and Selin,٢٠١٤) .Dietary fiber plays a very important role in the human diet. Soluble fiber is known for its hypocholesterolemic effect and insoluble fiber is known for a reducing the risk of colon cancer .B-glucan is known for a reduction in the risk of colon cancer and is known to reduce the absorption of glucose in the digestive system (Ionescu *et al.*,٢٠٠٩)and(Aharon *et al.*,٢٠١٢) .Psyllium(*Plantago ovata*) belongs to the plantaginaceae family and is an annual herb indigenous to the Mediterranean region especially Southern Europe, North Africa and west Asia .that grows to a height of ٣٠-٤٥cm,and leaves are ٧,٥-٢٣cm long and ٠,٥-١cm broad (Ivan ,٢٠٠٥) and (Rai *et al.*,٢٠١٧).Psyllium husks can swell ١٠-١٤ times of their original volume are non- absorbable (Desai *et al.*,٢٠٠٧) ,psyllium husks possess very good gel-forming and high water absorption ability capacities .The major compounds of psyllium husks are pectin, cellulose ,gum ,lignin and mucilage Elena *et al.*,(٢٠٢٣) .The results

of the other research indicate highly increased water absorption and improved workability of the dough with psyllium addition (Ewa *et al.*,٢٠١٨). Psyllium husks contain ٠,٩٤٪ protein ,٤,٠٧٪ ash and ٨٤,٩٨٪ carbohydrates,٧٨٪ soluble fibers and ١٣٪insoluble fibers (Sukhija *et al.*,٢٠١٦). Its source of natural dietary fiber , And therefor be applied in food production as a novel functional ingredient Yi Ren *et al.*, (٢٠٢٠). It contains high levels of Fe, Ca ,K and Na.in addition to Mg ,Zn, Mn and Cu (Samah,٢٠١٨). Psyllium husks have been added to many food products like (cakes ,biscuits , ice cream and yogurt) due to their high nutritional value. Psyllium is well recognized for the treatment of constipation, irritable bowel syndrome symptoms ,abdominal pain ,cancer prevention ,diarrhea inflammatory bowel disease -ulcerative colitis, obesity , diabetes and hypercholesterolemia .(Elisangela *et al* ., ٢٠٢٠) . Therefore, this study aims to determine the chemical composition, minerals content, and physical and sensory evaluation of toast bread mixed with different levels of psyllium husks

Materials and Methods

Materials

Three kg of Psyllium husks (*plantago ovata forsk*) were obtained from the Agriculture Research Center, Giza, Cairo Egypt, in the year٢٠٢٢. Wheat flour (٧٢٪ extraction) (*EL-Duha)*,dry yeast and salt were purchased from the local market (Kheir Zaman) in Assiut city.

Methods

Ingredients of toast bread

The formula are presented in Table(١). The bread was fortified by replacing part of the flour with psyllium husks at ٥٪,١٠٪ and ١٥٪ . (EL-Hadidy,٢٠٢٠)

Dough preparation

Flour, water , salt ,dry yeast and psyllium husks were mixed by using the ratios given in Table(١) to produce four samples . Theh ingredients were mixed manually for ١٠ minutes. Fermentation was performed at ٣٠ $C^{\circ} \pm 2$ for ١٣٥ minutes with a humidity ٨٠-٨٥٪.

Table (١):The ingredients of toast bread*

Ingredients	Quantities	Samples of toast bread		
		٥٪	١٠٪	١٥٪
Wheat flour ٧٢٪extraction (g)	١٠٠	٩٥	٩٠	٨٥
Sodium chloride (g)	١	١	١	١
Dry yeast (g)	٠,٥	٠,٥	٠,٥	٠,٥
Psyllium husks(g)	----	٥	١٠	١٥
Corn oil(ml)	١.٥	١,٥	١,٥	١,٥
Water(ml)	٦٠	٦٠	٦٠	٦٠

***Rossi *et al.*,(٢٠٢٠)**

Preparation of toast bread

The dough was pressed to release CO_2 and molded with corn oil (about ١,٥ ml) in pans with dimensions of length of ١٢ cm ,width ٦ cm and height of ٨cm . Baking was carried out in an electric oven at ٢٣٠ – ٢٤٠ C° for ٢٠-٢٥ minutes .The bread top was subjected to a wet brush to enhance the crust its appearance immediately after being removed from the oven (Rossi *et al.*, ٢٠٢٠).

Preparation of different blends of toast bread

Blends of bread were prepared using wheat flour at a ٧٢٪extraction rate as a control and fortified bread with Psyllium husks at ٥٪,١٠٪ and١٥٪.

Determination of the chemical composition of toast bread

The moisture, ash ,protein , crude fiber and crud fat contents were determined as described by (A.O.A.C., ٢٠١٠).The total carbohydrates were calculated by differences as follows:

Calories value was calculated by Seleet,(٢٠١٠).

Determination of minerals content of toast bread

Sodium(Na) content was determined by a flame photometer (corning ٤٠٠). Calcium (Ca) and Iron(Fe) contents in the samples were determined by ICP(ICAP) according to (Isaac and Johnson,٢٠٠٢) .

Physical evaluation of bread

Loaves were weighed in grams after two hours from of baking and the volume in (ml) of each loaf was determined using the seed displacement method using clover seeds. The specific loaf volume(S.L.V) and loaf weight were calculated according to (Rossi *et al.*,٢٠٢٠) using the following equation

$$\frac{\text{Volume (ml)}}{\text{Weight (g)}}$$

Sensory evaluation of bread

Sensory evaluation for the color (crust and crumb) ,graining , texture , odor , taste and overall acceptability of bread was done in order to determine consumer ceptability . A numerical hedonic scale ranging from ١ to ١٠ (١ is very bad and ١٠ is excellent) was used for sensory evaluation by Mostafa and Othman (١٩٨٦) . Ten experienced judges from the staff of the Nutrition and Food Science, Department , Faculty of Specific Education ,Assiut University , Egypt and Ten consumers.

Statistical Analysis

Data were analyzed by applying T- test using SPSS program version ١٦ and the data analyzed with was analysis of variance (ANOVA) procedures by using the (MSTAT- C,١٩٨٣) statistical software package Russell (١٩٨٣). Where the F-test showed signification differences among the means (Duncan ,١٩٩٥) a multiple range test performed at the ٠,٠٥ level .

Table(٢a): chemical composition of wheat toast bread and toast bread fortified with psyllium husks (٥٪,١٠٪and١٥٪)on(W.W) and(D.W)(g/١٠٠)

Samples	Moisture %	Ash%	Protein%		Crud fiber%	
			W.W	D.W	W.W	D.W
Wheat toast bread ٧٢٪ extraction (control)	٣٤,٢٦^{D} ±١,١٢	٩,٨٥^{C} ±٠,٦٢	١٢,١٥^{D} ±٠,١١	١٨,٤٨^{D} ±٠,٩٨	٠,٧٩^{D} ±٠,٠٢	١,٢٠^{D} ±٠,٠٣
Toast bread with ٥٪ psyllium husks	٤٠,٤٦^{C} ±١,٣٧	١٠,٣٣ ^{C} ±٠,٤٣	١٢,٩٩^{C} ±٠,١٤	٢١,٨٢^{C} ±١,٢١	١,١٥^{C} ±٠,٠٤	١,٩٣^{C} ±٠,٠٤
Toast bread with ١٠٪ psyllium husks	٤٨,٥٩^{B} ±١,٧٨	١١,٦٥ ^{B} ±٠,٤١	١٤,٠١^{B} ±٠,٤١	٢٧,٢٥^{B} ±١,٣٥	٢,٥٧^{B} ±٠,٠٥	٤,٩٩^{B} ±٠,١٢
Toast bread with ١٥٪ psyllium husks	٥٢,١٢^{A} ±٢,٢	١٣,٠٥ ^{A} ±٠,٨٦	١٥,٢٢^{A} ±٠,٣٢	٣١,٧٩^{A} ±٢,١٤	٣,٥١^{A} ±٠,٠٦	٧,٣٣^{A} ±٠,٣١
F-Test	٣٩,٧٩ **	١١,١٤ **	٤٣,١٢ **	٢٨,٦٩ **	٧١,٣٦ **	٦٣,١٥ **

-Mean of three replicates .

-N.S(The difference non significant)

-(D.W) = dry weight basis

-(W.W)= wet weight basis

**Highly significant (p≤٠,٠١)

Table(٢b): chemical composition of wheat toast bread and toast bread fortified with psyllium husks (٥٪,١٠٪and١٥٪) on(W.W) and (D.W)(g/١٠٠)

Samples	Crud fat		Total Carbohydrates (g)		Caloric Value (K.cal/١٠٠)	
	W.W	D.W	W.W	D.W	W.W	D.W
Wheat toast bread ٧٢٪ extraction (control)	٠,٥١^{A} ±٠,٠١	٠,٧٧^{A} ±٠,٠٣	٤٢,٤٤ A ±١,٦٣	٦٤,٥٥^{A} ±٢,٦٤	٣٣٩,١٤ A ±٤,١٢	٢٢٢,٩٥ A ±٣,٧٤
Toast bread with ٥٪ psyllium husks	٠,٤٠^{B} ±٠,٠١	٠,٦٧^{B} ±٠,٠٢	٥٨,٢٣ B ±٢,٥١	٣٤,٦٧^{B} ±١,٢٤	٣٢٦,٢٣ B ±٣,٦٥	١٩٤,٢٤ B ±٢,٧٩
Toast bread with ١٠٪ psyllium husks	٠,٣١^{C} ±٠,٠٢	٠,٦٠^{C} ±٠,٠٢	٤٤,٤٩ C ±١,٦٤	٢٢,٨٧^{C} ±٠,٩٦	٢٩٢,٣٨ C ±٢.٩٨	١٥٠,٣١ C ±٢,٦٤
Toast bread with ١٥٪ psyllium husks	٠,٢٢^{D} ±٠,٠٢	٠,٤٦^{D} ±٠,٠١	٣٣,١٧ D ±١,٤٥	١٥,٨٨^{D} ±٠,٨٤	٢٦٣,٩٥ D ±٢,٧٦	١٢٦,٣٨ D ±١,٦٥
F-Test	٢١,٧٨ **	١٤,٩٦**	١٦,٨٨ **	٥١.٢٧ **	٣١,٧٤ **	٤٧,٨٥ **

-Mean of three replicates . -N.S(The difference non significant)

-(D.W) = dry weight basis -(W.W)= wet weight basis

**Highly significant (p≤٠,٠١)

The data on the gross chemical composition of wheat toast bread and fortified toast bread with the psyllium husks are presented in Table(٢). Results revealed that on a wet weight basis and a dry weight basis the gross chemical composition of toast bread fortified with different levels of psyllium husks recorded the highest ratios in protein and crude fiber (١٥,٢٢٪,٣١,٧٩٪ and ٣,٥١٪,٧,٣٣٪) ;respectively .For toast bread with ١٥٪ psyllium husk when compared with wheat toasted bread (control) . On the other hand the lower values were (٠,٢٢٪ ,٠,٤٦٪ ;١٥,٨٨٪,٣٣,١٧٪ and ١٢٦,٣٨٪ ,٢٦٣,٩٥٪) in crude fat ,total carbohydrates and caloric value; respectively . These results were in agreement with EL-Hadide,(٢٠٢٠) & Maria and Manuel,(٢٠٢٢) ,They reported that the toast bread of psyllium husks was high in protein ,crud fiber, moisture, ash and the lowest in total carbohydrates and caloric values due to the nutritional value of psyllium husks.

Table (٣): Minerals content of wheat toast bread and fortified toast bread with (٥٪,١٠٪and١٥٪) psyllium husks (mg/١٠٠g)

Samples	Na	Ca	Fe
Wheat toast bread ٧٢٪ extraction (control)	٢٦,٤٨^{C} ±٠,٨٦	١٩,٩٤^{D} ±٠,٧١	٠,٩٣^{C} ±٠,٠١١
Toast bread with ٥٪ psyllium husks	٢٧,٠١^{C} ±٠,٧٦	٢٥,٤٤^{C} ±٠,٦٥	١,١٠^{C} ±٠,٠٢١
Toast bread with ١٠٪ psyllium husks	٢٩,٠٢^{B} ±٠,٦٢	٣٢,٧٧^{B} ±٠,٣٧	١,٣٠^{B} ±٠,٠٣٢
Toast bread with ١٥٪ psyllium husks	٣١,١١^{A} ±٠,٨٦	٤٠,٤٣^{A} ±٠,٤١	٢,٢٣^{A} ±٠,٠٤١
F-Tast	١٣,١٤**	٢١,٧٨**	١٢,٩٨**

Mean of three replicates

****Highly significant (p≤٠,٠١)**

The minerals content of wheat flour bread and fortified bread with psyllium husks (٥٪,١٠٪ and١٥٪) was recorded in Tabel(٣).These data recorded highly significant difference at (p ≤٠,٠١) between control and fortified toast bread with psyllium husks (٥٪,١٠٪ and١٥٪) in Na ,Ca and Fe contents recorded (٣١,١١ , ٤٠,٤٣ and ٢,٢٣ mg/١٠٠g); respectively in toast bread fortified with ١٥٪ psyllium husks . These results agreed with *EL-Hadidy (٢٠٢٠)* who reported that the pan bread enriched with PSH increased the content of Fe, Ca and Na compared with the control pan bread prepared from wheat flour. These results due to PSH are comparatively rich sources of indispensable minerals.

Table(٤) Physical characteristics of wheat toast bread and fortified toast bread with (٥٪,١٠٪ and١٥٪) psyllium husks

Samples	Physical characteristics		
	Weight(g)	Volume(ml)	S.L.V
Wheat toast bread ٧٢٪ extraction (control)	١٣٨,٣٧^{CD} ±١,٧١	٢٩٢,٢٦^{C} ±٢,١٢	٢,١١^{A} ±٠,٠٣
Toast bread with ٥٪ psyllium husks	١٣٥,٥٥^{C} ±١,٣٤	٣٠٠,٤١^{B} ±٢,١٨	٢,٢١^{A} ±٠,٠٢
Toast bread with ١٠٪ psyllium husks	١٦٦,٠٦^{B} ±١,٨٤	٣٠١.٨٩^{B} ±٢,٣٤	١,٨١^{B} ±٠,٠١
Toast bread with ١٥٪ psyllium husks	١٩٩,٢٣^{A} ±١,٩٢	٣٣٢,٤٠^{A} ±٢,٧٦	١,٦٦^{C} ±٠,٠٢
F-Test	٢٤,٦٨**	٢١,٨٩**	١١,٣٤**

±SD . deviation (p≤٠,٠١) ****Highly significant at (p≤٠,٠١)**

−S .L.V= $\frac{\text{Volume (ml)}}{\text{Weight (g)}}$

The impact of toast bread fortification with PSH on weight (g), volume (ml) and specific volume (S.L.V) revealed that toast bread enriched with PSH had higher values in weight and volume when compared with the control. These results disagree with Simona *et al.*,(٢٠١٧) who explained that the volume of the toast bread reduced as the extent of PSH increased due to interactions among dietary fiber components, gluten and water.

Table (٥a) :Sensory evaluation of wheat toast bread and fortified toast bread with(٥٪,١٠٪ and١٥٪) psyllium husks

Samples	Sensory characteristics			
	Crust Color	Crumb Color	Graining	Texture
	١٠	١٠	١٠	١٠
Wheat toast bread ٧٢٪ extraction (control)	٩,٦٩^{A} ±٠,٥٤	٩,٧٥^{A} ±٠,٣٦	٩,٦٣^{A} ±٠,٤٢	٩,٥٠^{A} ±٠,٣٩
Toast bread with ٥٪ psyllium husks	٩,٣٨^{B} ±٠,٤٢	٨,٥٦^{B} ±٠,٤١	٩,٣١^{B} ±٠,٦٢	٩,٤٤^{A} ±٠,٣٧
Toast bread with ١٠٪ psyllium husks	٨,٢٥^{C} ±٠,٣٧	٨,٣٨^{B} ±٠,٢٧	٨,٣١^{C} ±٠,٣٧	٨,٥٠^{B} ±٠,٢٤
Toast bread with ١٥٪ psyllium husks	٧,٤٤^{D} ±٠,٤٥	٧,٣٨^{C} ±٠,٥٤	٧,٧٥^{D} ±٠,٢٩	٧,٥٦^{C} ±٠,١٩
F-Test	١٣,٦٤**	١٤,١١**	١٢,٨٩**	١٠,٧٦**

****Highly significant(p≤٠,٠١)**

Table (٥b) :Sensory evaluation of wheat toast bread and fortified toast bread with(٥٪,١٠٪ and١٥٪) psyllium husks

Samples	Sensory characteristics		
	Taste	Odor	Overall acceptability
	١٠	١٠	١٠
Wheat toast bread ٧٢٪ extraction (control)	٩,٥٦^{A} ±٠.٢٤	٩,٥٦^{A} ±٠,٣٧	٩,٧٥^{A} ±٠,٣١
Toast bread with ٥٪ psyllium husks	٨,١٦^{C} ±٠,٣١	٩,٥٠^{A} ±٠,٤٢	٩,٦٣^{A} ±٠,٤٤
Toast bread with ١٠٪ psyllium husks	٨,٦٣^{B} ±٠,٤١	٨,٧٥^{B} ±٠,٢٧	٨,٥٠^{B} ±٠,٢٧
Toast bread with ١٥٪ psyllium husks	٧,٦٣^{D} ±٠,٣٤	٧,٢٥^{C} ±٠,١٩	٧,٣١^{C} ±٠,١٣
F-Test	١١,٦٤**	١٠,٩٧**	١١,٠٣**

****Highly significant(p≤٠,٠١)**

Table (٥) shows the sensory evaluation of wheat toast bread and fortified toast bread with (٥٪,١٠٪and١٥٪) psyllium husks. The scores for sensory attributes such as color (crust and crumb), graining , texture , taste , odor and overall acceptability of toast bread differed highly significantly(p≤٠,٠١) between samples.

These variations are related to the amount of psyllium husk added. As shown in Table (٥)the toast bread fortified with ٥٪ psyllium husks ,recorded a higher texture with scores of ٩,٤٤ .The differences in the color of toast bread enriched with PSH resulted from two reasons. The first and dominant was the color of the PSH, which was characterized by a greyish shade and strongly affected the overall color of the dough and bread. The panelists also noticed this. On the contrary, the chemical composition of wheat toast bread fortified with different levels of psyllium husks, The increased amount PSH reduced the swelling of gluten in the toast bread due to the limited volume according to Krystyjan *et al.* ,(٢٠١٨) .

Fig(١): Wheat toast bread٧٢٪extraction(control)

Fig(٢):Toast bread with ٥٪psyllium husks

Fig (٣): Toast bread with ١٠٪ psyllium husks

Fig(٤):Toast bread with ١٥٪pysllium husks

Conclusions

Results revealed that the psyllium husks mixture blended with toast bread had improved nutrients composition and sensory properties. Therefore, it can be fortified successfully into food products to enhance the nutrient content and this will beneficial a wide variety of food applications such as functional and therapeutic food products.

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التركيب الفيزيائي والمحتوي المعدني والتقييم الحسي لقشور السيليوم لخبز التوست

مستخلص البحث

تحتوي قشور السيليوم علي قيمه غذائية عاليه من الالياف والبروتين لذلك تهدف الدراسه الحاليه الي دراسه التركيب الكيميائي والمحتوي المعدني والتقييم الفيزيائي والحسي لخبز التوست المدعم بنسب مختلفه من قشور السيليوم (PSH) (٥٪،١٠٪،١٥٪) .أظهرت النتائج ان التركيب الكيميائي الاجمالي لخبز التوست المدعم ١٥%قشور السيليوم سجل نسب عاليه من البروتين والالياف (١٥,٢٢%،٣١,٧٩%: ٣,٥١%،٧,٣٣%) علي التوالي علي اساس الوزن الرطب والوزن الجاف. في حين أن خبز التوست المدعم ب١٥%قشور السيليوم سجل قيم أقل في محتوي الدهون الخام والكربوهيدرات الكليه و قيمه السعرات الحراريه (٠,٢٢%،٠,٤٦٥%:١٥,٨٨%،٣٣,١٧%:١٢٦,٣٦% ٢٦٣,٩، ٥%) علي التوالي علي اساس الوزن الرطب والوزن الجاف أشارت النتائج أيضا الي وجود فروق معنويه أكبر في المحتوي المعدني بين خبز التوست المدعم بقشور السيليوم وخبز التوست (الكنترول). سجل خبز التوست المدعم ب ١٥%قشور السيليوم أعلي قيم في الصوديوم والكالسيوم والحديد (٣١,١١ , ٤٠,٤٣ ,٢,٢٣) ملجم١٠٠جم علي التوالي . أظهر التقيم الحسي أيضا أن عينه خبز التوست المدعم بقشور السيليوم بنسبه٥% كانت الاكثر قبولا بين اعضاء لجنه التحكيم من حيث: القوام والطعم والتحبب مقارنه بنسب خبز التوست المدعم بقشور السيليوم الاخري. الخصائص الفيزيائيه لخبز التوست الذي يحتوي علي ١٥%قشور السيليوم فقد سجل أعلي قيمه من حيث الوزن (١٩٩,٢٣g) والحجم (٣٣٢,٤٠ml)ولذلك يوصي باستخدام قشور السيليوم كمصدر للالياف لرفع القيمه الغذائيه للمنتجات.

الكلمات المفتاحيه:

قشور السيليوم ،التركيب الكيميائي ، المحتوي المعدني ،خبز التوست