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Effect of Chickpea Substitute in the Quality Characteristics of Biscuits and Cake

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Abstract:
Background: Chickpea (Cicer arietinum L.) is considered the fifth valuable legume in terms of worldwide economic stand point. It is planted in southern and western area of Asia and Mediterranean. **Aim:** This study was undertaken to study the effect of supplementation of wheat flour with different percentages of chickpea (5, 10, 15, 20, 30 %) on the chemical composition, physical and organoleptic properties of biscuits and cakes. **Methods:** Cake and biscuits were prepared using different percentage of chickpea flour. Substitute the wheat flour in their formula. Chemical composition, physical measurements as well as sensory evaluation were carried out on the tested samples. **Results:** The results showed that chickpea flour is a good source of protein (22.82%), crude fiber **(**2.90%) and ash (3.33%). Also, chickpea is rich in potassium, magnesium and iron. Supplementation of wheat flour with chickpea flours in biscuits results in increasing protein, lipid, fiber and ash. The specific volume were in the range of (38.83 – 44.13cc/gm), specific lightness were in the range of (41-25 cc/gm.) and spread factor ranged between (100-114.21%) for control samples and biscuits that contain 30 % of the chick pea flour. This biscuit which contain chickpea flour at all the supplement ratio were accepted by the panelist. The cake prepared with supplementation of wheat flour with chickpea flours at different percentage (5, 10, 15, 20, 30%) had a higher protein, lipid, crude fiber and ash content with less percentage of carbohydrates. Increasing the ratio of chickpea flours in cake has led to a slight increase in volume and specific gravity. Sensory evaluation of the cake was accepted at all the different supplementation ratios of chickpea with the higher score for the cake samples that contain chickpea flours at ratio 10 -15%. **Conclusion:** Generally prepared cake and biscuits samples with chickpea flour as a supplement to wheat flour in their formula lead to increasing protein, crude fiber and mineral content with improving the physical properties and organoleptic characteristics.

Key words: Chickpea, Physical properties, Sensory Evaluation, Chemical Composition, Biscuits, Cake

INTRODUCTION

Chickpea (Cicer arietinum L.) is one of the oldest and most widely grown grains, crops in the Middle and East, and it was grown in the Nile Valley of Egypt, since pharonic new Kingdom.[1,2] Chickpeas are mainly used for human consumption since they contain high amounts of good quality proteins. Also chickpeas are consumed in India in various forms, roasted beans, processed and cooked paste. The seeds are sometimes ground into

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flour or meal which is frequently mixed with wheat flours or used in the preparation of various confectionaries. It is believed that inclusion of chickpea in the human diet improves health conditions, and this is probably due to the presence of growth promoting substance in the grain of chickpea grains [3,4].

Chickpea is a very good source of carbohydrates and proteins, which together constitute about 80% of the total dry seed weight.[5]

Moreover, Fahmy et al,[6] mentioned that legumes have a high protein that is twice greater than cereals, ranging from 17% to 25% on dry weight basis.[2] Crude fiber of whole chickpea seeds varied from 2.3% to 3.8%.[7] In addition chickpea is considered as a good source of calorie, phosphorus and iron.[8] Krivelevich et al, [9] reported that the lipids of chickpea had high content of polyunsaturated fatty acids especially linoleic acid (26.9 – 62.4%).[9]

The Egyptian chickpea seeds were analyzed for iron, calcium, phosphorus and magnesium by Moustsfa, [10] who found that the seeds contained 6.31; 73.73; 36.00 and 60 mg/ 100 gm. of iron, calcium and phosphorous on dry weight respectively.

Biscuit are the main food products for much of people, especially for children, anytime of biscuits found in the market contained nearly between 5 – 9 % proteins which are low to fulfill the protein requirements of the children.[11] Bedei et al [12], found that increasing the addition level of low fat peanut flour more than 15%, produce high protein product.

Abd El-Hady, [13] studied the technological characteristics of madrina cake made from blends of wheat flour and 15- 20% of high protein rice flour. the results indicated that incorporating 15% of HPRC in the ingredients resulted in a slightly decrease in each of the specific gravity and average weight, while the other measurements including volume, height, width increased remarkably compared with the control.

Effect of supplementation of wheat flour with different percentage of chickpea and peanut flour, on the technological composition, technological and organoleptic properties of biscuits were studied by.[14]

The aim of the present research was to study the chemical composition of chickpea flour and the effect of adding chickpea flour to wheat flour on the chemical composition, physical properties and organoleptic properties of biscuit and cake.

MATERIALS AND METHODS

Wheat flour (72% extraction) was purchased from local market at Alexandria city. The dehulled chickpea was purchased also from the same market beside the other ingredients, butter, white sugar, egg, baking powder and vanilla extract. The replacement ratios were (5, 10, 15, 20 and 30%) of wheat flour with chickpea flour after the chickpea was ground in brown grinder.

Methods

Preparation of biscuit sample

The technique used in the study is described in Nicola and Osman.[15] The ingredient used in biscuit preparations are shown in table 1.

Table 1: Formulation of biscuit

Ingredient	Amount in gm
Flour	250 gm
Butter	125 gm
White sugar	125 gm
Whole egg	50 gm
Baking powder	6 gm
Vanilla extract	3 gm

Cake preparation

The cake was prepared according to the method of Rosenthal.[16] The ingredients used in cake preparation are shown in table 2.

Table 2: formulation of cake

Ingredient	Amount in gm.
Wheat flour	140 gm
Powdered sugar	70 gm
Shortening	70 gm
Whole egg	120 gm
Baking powder	7 gm
Vanilla extract	0.2 gm

Chemical composition

Protein and fat in the experimental samples were measured according to Association of Official Analytical Chemists (A.O.A.C).[17]

Moisture content of samples was determined by drying at 105 °C to a constant weight according to A.O.A.C.[17]

Crude fiber content was determined according to the method described in A.O.A.C., [17] by extraction with petroleum ether, digestion with 1.25 % H_2SO_4, filtration and ashing for 30 min at 600 °C

Ash and mineral elements were determined as follows: samples were ashed at 550 °C until a grey ash was obtained and the percentage of ash was calculated according to A.O.A.C. The ash was dissolved in 5 ml of 3 N HCL; the volume was completed to 100 ml in a volumetric glass. Minerals were determined using Atomic Absorption Spectrophotometer according to A.O.A.C.[17]

Physical measurement

Biscuit measurements

The average volume of seven biscuits was measured by the displacements of rape seeds as described by A. A. C. C.[18] Thickness was as follows:

$$\text{Specific lightness (cc/gm.)} = \frac{\text{Volume of 7 biscuits}}{\text{Baked weight of 7 biscuits}}$$

$$\text{Specific volume (cc/gm.)} = \frac{\text{Volume of 7 biscuits}}{\text{Dough weight of 7 biscuits}}$$

$$\text{Spread factor} = \frac{U \times 100}{C}$$

$$U = \frac{W_1}{T_1} = \frac{\text{Average diameter of 7 biscuits}}{\text{Average thickness of 7 biscuits}}$$

$$C = \frac{W_2}{T_2} = \frac{\text{Average diameter of 7 biscuits from control biscuits}}{\text{Average thickness of 7 biscuits from control biscuits}}$$

Cake measurements

$$\text{Specific Volume (cc/gm.)} = \frac{\text{Volume of the cake}}{\text{Dough weight of the cake}}$$

Sensory Evaluation

The sensory characterizes of the baked cakes and cookies were estimated using a numerical outline by a rating of 1- 10 (optimum = 10, very poor=1) according to Goryczka, G. C. and Zabik., E. M. [19]

Statistical analysis

Statistical analyses were done by L.S.D procedure available within MSTATC software package (ver. 12, 1991). Analyses of variance of different experiments were performed (1980).[20]

Results

Chemical Composition of Chickpea

The data in table (3) represent the chemical composition of chickpea. Moisture content of chickpea is 9.22%. Chickpea is considered as a good source of protein since the protein content is 22.82%, while crude fats are 7.03%. Also chickpea is a good source of ash 3.33% and crude fiber (2.95%).

Mineral content of chickpea

Chickpea is a source of minerals as

shown in table (4), chickpea flour contain a remarkable amount of phosphorus, sodium, potassium, magnesium, and iron (325, 64, 82.5, 15.8 and 4.65 mg/ 100 gm., respectively)

Table (3): Chemical composition of chickpea flours

Compound	Amount %
Moisture	9.22
Crude protein	22.82
Crude lipid	7.03
Ash	3.33
Crude fiber	2.95
*Carbohydrates	54.65

*carbohydrate content was calculated by difference

Table (4): Mineral content of chickpea flours

Mineral	Mg/ 100gm
Sodium	64
Calcium	36
Magnesium	15.8
Iron	4.65
Potassium	82.5
Zinc	2.69
Phosphorus	325

Chemical composition and mineral content of biscuits supplemented with chickpea flour

The proximate analyses of biscuits supplemented with different concentration of chickpea flour are shown in table (5). Increasing the ratio of chickpea flour from 5%-30% lead to remarkable reduction in moisture content and carbohydrate content, while the opposite was noted in both of crude protein, crude lipid content of biscuits which were increased remarkably as the ratio of chickpea flour increased. The same trend was observed in the case of crude fiber and ash content.

Mineral content of biscuit samples that contain different percentage of chickpea flour was determined and the data are shown in table (6). Addition of chickpea flour to biscuit formula as supplement

caused a remarkable increment in sodium, calcium, magnesium and iron from (51.9 – 58.05 mg/100 gm.), (25.91 -31.95 mg/100gm), (11.80 – 17.05 mg/100gm) and (1.25 – 4.21 mg/100gm) for the above mentioned minerals, respectively. The same trend was observed for potassium, phosphorous, since they increased gradually with increasing the percentage of chickpea flours in biscuit formula.

Table (5): Chemical composition of biscuits supplemented with different concentration of chickpea flour

Treatment % chickpea	Moisture %	Crude protein %	Lipid %	Crude fiber %	Ash %	*Carbohydrates %
0	6.12	7.85	19.35	0.53	0.87	65.29
5	6.02	8.03	19.39	0.63	0.37	64.26
10	5.83	8.65	19.89	1.02	1.43	62.62
15	5.81	8.99	20.25	1.25	1.60	61.63
20	4.92	9.35	20.25	1.25	16.2	61.59
30	4.75	10.04	21.15	1.49	1.97	60.62

*carbohydrate content was calculated by difference

Table (6) Mineral content (mg/100gm) of biscuits formula with different percentage of chick pea flour

Sample percentage of chickpea flour%	Mineral (mg/ 100gm)						
	Sodium	Calcium	Magnesium	Iron	Potassium	Zinc	Phosphorous
Control (0%)	51.9	25.91	11.80	1.25	82.85	0.16	292
5%	52.23	26.05	11.95	1.84	91.93	0.18	298
10%	53.99	26.95	13.02	1.98	92.05	0.192	302
15%	55.03	28.15	14.87	2.09	93.12	0.199	321
20%	56.12	29.21	15.32	2.88	93.97	0.20	326
30%	58.05	31.85	17.05	4.21	95.05	0.23	332

Physical properties of biscuit supplemented with chickpea flour

Physical properties of biscuit supplemented with chickpea flour are shown in table (7) the data showed that the specific volume and specific lightness increased gradually as the percentage of chickpea flour in the biscuits formula was increased. Also, a remarkable increment was noticed for spread factor with increasing the chickpea flour ratio in the biscuits.

Table (7): **Physical properties of biscuits supplemented with chickpea flour**

Sample % of chickpea flour	Specific volume cc/gm.	Specific lightness cc/gm.	Spread factor %
control	38.85	41.25	100
5	40.23	43.81	105.50
10	41.35	45.35	106.12
15	42.05	46.83	109.00
20	42.95	48.22	111.10
30	44.13	49.98	114.21

Sensory Evaluation of the biscuits supplemented with chickpea flour

The results of the taste panel testing of biscuits supplemented with chickpea are shown in table (8), increasing the ratio of chickpea in the biscuits formula increased slightly the color and flavor score while the opposite was observed in case of texture scores. The overall acceptability score showed that the samples contain 10 to 20 % chickpea flour have the highest overall acceptability.

Table (8): Organoleptic properties of biscuits supplemented with chickpea

Treatment % chickpea	Color (10)	Flavor (10)	Texture (10)	Overall Acceptability (30)
0	8.2±0.92 *	8.1±1.38*	8.5±1.00*	24.8±1.21*
5	8.2±0.95*	8.3±1.25*	8.1±1.21*	24.6±1.92*
10	8.4±1.21*	8.4±1.20*	8.1±0.95*	24.9±1.81*
15	8.5±1.23*	8.6±1.29*	7.7±1.12*	24.8±1.21*
20	8.6±2.12*	8.6±1.62*	7.6±1.31*	24.8±1.31*
30	8.6±2.24*	8.7±1.96*	7.6±1.32*	24.9±1.32*

*M±SD= Mean ± Standard Deviation

Chemical composition of cakes supplemented with chickpea flour

The chemical analysis of cakes made from wheat flour supplemented by different ratios (5%, 10%, 15%, 20%, 30%) of chickpea flour is illustrated in table (9). The results revealed increment increase in crude protein, fat, crude fiber and ash content with a gradual decrement in moisture and carbohydrate content with increasing the ratio of chickpea flours in the prepared cakes.

Table (9): Chemical composition of cakes supplemented with different concentration of chickpea

Treatment % chickpea	Moisture %	Crude protein %	Lipid %	Crude fiber %	Ash %	*Carbohydrates %
0	6.21	6.29	17.81	0.87	0.95	67.87
5	6.01	6.92	18.12	1.01	1.31	66.63
10	5.92	7.25	18.53	1.32	1.59	65.39
15	5.19	7.95	19.03	1.51	1.78	64.54
20	4.98	8.43	19.53	1.65	1.93	63.48
30	4.82	9.05	20.39	1.91	2.05	61.78

***carbohydrate content was calculated by difference**

Mineral content of cake formula prepared with different percentage of chickpea flour (mg/100gm) were determined. The data shown in table (10) show that increasing the percentage of chickpea flour as a supplement in cake formula resulted in a gradual and remarkable increment in the determined mineral. Calcium increased from 26.69 mg/10 gm. in control to 30.96 mg/100 gm. in cake samples that contain chickpea flour at percentage of 30%. Similarly iron increased from 1.21 mg/10 gm. in control to 2.92 mg/ 100 gm. for cake samples that contain 30% chickpea flour.

Also chickpea considered as a good source of potassium, sodium and phosphorus, since increasing the ratio of supplementation of wheat flour with chickpea flour lead to a gradual increment of potassium, sodium and phosphorus. The same trend was observed for magnesium and zinc content of biscuit samples which contain chickpea flour at different ratios.

Table (10) Mineral content (mg/100gm) of cakes formula with different percentage of chick pea flour

Sample percentage of chickpea flour%	Mineral (mg/ 100gm)						
	Sodium	Calcium	Magnesium	Iron	Potassium	Zinc	Phosphorous
Control (0%)	52.05	26.89	11.35	1.21	79.14	0.13	282
5%	52.87	26.75	11.93	1.69	80.21	0.15	289
10%	53.91	27.81	12.34	1.89	80.69	0.16	290
15%	54.35	28.33	13.05	2.11	81.25	0.18	293
20%	55.01	29.05	13.89	2.34	81.77	0.19	294
30%	56.79	30.96	14.55	2.92	82.39	0.21	299

Physical properties of cake supplement with chickpea flour

The volume, weight, specific gravity and porosity of the cake are given in table (9). A slight change in all the previous mentioned values was observed. However specific gravity of cakes contains 5% chickpea flours had the highest specific gravity among the other samples.

Porosity of cake increased remarkably as a result of increasing the ratio of supplementation of wheat flour with chickpea flour. Porosity of biscuit was 43.61 for control and became 47.44 for cake samples that contain chickpea flour at ratio of 30%. The opposite trend was observed for weight (gm.), since it was 163.9 gm. for control to 160.2 gm. for the cake that contain 30% chickpea. However the specific volume of cake samples increased gradually with increasing the replacement ratio of chick pea flour in the cake formula.

Table (11): **Physical properties of cakes supplemented with chickpea flour**

Treatment % of chickpea flour	Volume cm. s	Weight Gm.	Specific volume cc/gm.	Porosity
control	1.63	163.9	37.2	43.61
5	1.61	162.5	37.9	44.32
10	1.62	164.2	39.1	45.15
15	1.62	164.1	42.8	45.98
20	1.63	160.1	43.1	46.25
30	1.69	160.2	43.3	47.44

Sensory Evaluation of cake supplemented with chickpea flour

Sensory evaluation of the cakes:

The sensory quality of the studied cake samples as influenced by the incorporation of different ratio of chickpea replacing wheat flour is shown in table (12).

Adding chickpea flour at increasing percentage lead to a significant increment in both of color and flavor scores until the ratio of 15% of chickpea flour in the cake formula. The opposite was observed for the texture score, overall acceptability score showed that the cake samples that contain 15% of chickpea flour as supplementary to wheat flour were the most preferable samples by the panelist.

Table (12): Organoleptic properties of cakes supplemented with chickpea

Treatment % chickpea	Color (10)	Flavor (10)	Texture (10)	Overall Acceptability (30)
0	8.31 ±0.99*	8.24±1.05*	8.70±0.99*	25.25±1.02*
5	8.55±0.89*	8.55±1.21*	8.50±1.11*	25.50±1.21*
10	8.75±1.21*	8.70±1.21*	8.50±1.25*	25.88±1.23*
15	8.90±0.11*	8.95±0.98*	8.50±1.12*	25.88±1.15*
20	8.65±0.12*	8.95±1.12*	8.41±0.99*	25.55±1.15*
30	8.55±0.132*	9.1±1.32*	7.35±1.05*	24.85±0.98*

*M±SD= Mean ± Standard Deviation

DISCUSSION

Chemical Composition of Chickpea

Chickpea is a very good source of carbohydrates and proteins which together constitute about 80% of the total dry seeds weight.[21]

Moisture content of chickpea is 9.22%. Chickpea is considered as a good source of protein since the protein content is 22.82%, while crude fats are 7.03%. Also chickpea is a good source of ash 3.33% and crude fiber (2.95%). These results are in a good agreement with those of Kaur. and Singh, [21] who stated that chickpea proteins are better appreciated compared to the protein from Pygmalion pea, black gram and green gram. The same authors reported also that chickpea stood out the highest in

lipid content and the lowest in fiber.

Mineral content of chickpea

Chickpea is a source of minerals, chickpea flour contain a remarkable amount of magnesium, potassium, phosphorus and iron. Chickpea is generally consumed as a seed food being a good source of dietary macronutrients (Ca, Mg, K, P) and micronutrient mineral (Fe, ZN, MN). Ensminger et al,[8] stated that chickpea is a good source of phosphorus and iron. Also according to Rao and Deasthale [22], chickpea is a rich source of minerals.

Chemical composition and mineral content of biscuits supplemented with chickpea flour

Increasing the ratio of chickpea flour from 5%-30% lead to remarkable reduction in moisture content and carbohydrate content, while the opposite was noted in both of crude protein, crude lipid content of biscuits which were increased remarkably as the ratio of chickpea flour increased. The same trend was observed in the case of crude fiber and ash content. These results are of a good accordance with these of Malak [14], who reported that as the ratio of chickpea increased the protein, ash and fiber concentration were increased, while carbohydrate content was decreased. Also these results are in agreement with that stated by El-Gommal [23], for wheat/chickpea cookies.

Mineral content of biscuit samples that contain different percentage of chickpea flour was determined and the data are shown in table (6). Addition of chickpea flour to biscuit formula as supplement caused a remarkable increment in sodium, calcium, magnesium and iron from (51.9 – 58.05 mg/100 gm), (25.91 -31.95 mg/100gm), (11.80 – 17.05 mg/100gm) and (1.25 – 4.21 mg/100gm) for the above mentioned minerals, respectively. The same trend was observed for potassium, phosphorous, since they increased

gradually with increasing the percentage of chickpea flours in biscuit formula.

Physical properties of biscuit supplemented with chickpea flour

The specific volume and specific lightness increased gradually as the percentage of chickpea flour in the biscuits formula was increased. Also, a remarkable increment was noticed for spread factor with increasing the chickpea flour ratio in the biscuits. The same trend was reported by Malak.[14] The highest specific volume, specific lightness and spread factor were noticed for biscuit samples that contain 30% of wheat flour in the formula was replaced with chickpea flour.

Sensory Evaluation of the biscuits supplemented with chickpea flour

In the taste panel testing of biscuits supplemented with chickpea, increasing the ratio of chickpea in the biscuits formula increased slightly the color and flavor score while the opposite was observed in case of texture scores. The overall acceptability score showed that the samples contain 10 to 20 % chickpea flour have the highest overall acceptability.

The organoleptic scores suggested that the panelists in this study found all the samples to be acceptable. These results are in a good agreement with those of El-Sherif and Kenawi.[24]

Chemical composition of cakes supplemented with chickpea flour

In the chemical analysis of cakes made from wheat flour supplemented by different ratios (5%, 10%, 15%, 20%, and 30%) of chickpea flour, revealed increment increase in crude protein, fat, crude fiber and ash content with a gradual decrement in moisture and carbohydrate content with increasing the ratio of chickpea flours in the prepared cakes. The obtained results proved that the addition of chickpea flour improve the nutritive value of the resulted cakes. These results are in a good accordance with that reported by El-Gommal.[23] Also El-Sherif and Kenawi, [24] stated that protein content, fat, crude fiber and ash content of cakes samples contain different

ratio of chickpea flour, increased significantly with increasing the ratio of the chickpea flour.

Mineral content of cake formula prepared with different percentage of chickpea flour (mg/100gm) were determined, show that increasing the percentage of chickpea flour as a supplement in cake formula resulted in a gradual and remarkable increment in the determined mineral. Calcium increased from 26.69 mg/10 gm. in control to 30.96 mg/100 gm. in cake samples that contain chickpea flour at percentage of 30%. Similarly iron increased from 1.21 mg/10 gm. in control to 2.92 mg/ 100 gm. for cake samples that contain 30% chickpea flour. These data are in a good agreement with those of El-Nagar.[25]

Also chickpea considered as a good source of potassium, sodium and phosphorus, since increasing the ratio of supplementation of wheat flour with chickpea flour lead to a gradual increment of potassium, sodium and phosphorus. The same trend was observed for magnesium and zinc content of biscuit samples which contain chickpea flour at different ratios.

Physical properties of cake supplement with chickpea flour

The volume, weight, specific gravity and porosity of the cake showed, a slight change in all the previous mentioned values was observed. However specific gravity of cakes contains 5% chickpea flours had the highest specific gravity among the other samples.

The same trend was reported by El-Shimy.[11]

Porosity of cake increased remarkably as a result of increasing the ratio of supplementation of wheat flour with chickpea flour. Porosity of biscuit was 43.61 for control and became 47.44 for cake samples that contain chickpea flour at ratio of 30%. The opposite trend was observed for weight (gm), since it was 163.9 gm. for control to 160.2 gm. for the cake that contain 30% chickpea. However the specific volume of cake samples increased gradually with increasing the replacement ratio of chick pea flour in the cake formula.

Sensory Evaluation of cake

supplemented with chickpea flour

Sensory evaluation of the cakes:

The sensory quality of the studied cake samples as influenced by the incorporation of different ratio of chickpea replacing wheat flour. Adding chickpea flour at increasing percentage lead to a significant increment in both of color and flavor scores until the ratio of 15% of chickpea flour in the cake formula is reached. The opposite was observed for the texture score, overall acceptability score showed that the cake samples that contain 15% of chickpea flour as supplementary to wheat flour were the most preferable samples by the panelist. Generally the samples are acceptable to the panelist.

CONCLUSION AND RECOMMENDATIONS

The present study proved that chickpea is of highly nutritive value. Adding of chickpea flour as a supplement to wheat flour in both of biscuit and cake formula resulted in increasing protein, crude fiber and mineral content with improving the physical properties and organoleptic characteristic. It is therefore recommended to add chickpea flour to wheat flour in baked products, pastries and desserts in restaurants, hotels, plants of bakery products and confectionery.

الملخص العربي

يعتبر الحمص (Cicer arietinum L.) خامس محصول بقولي من ناحية الاستخدام و الناحية الإقتصادية. يزرع الحمص في المناطق الغربية من آسيا و البحر المتوسط . و قد أجريت هذه الدراسة بهدف دراسة تأثير استبدال دقيق القمح بدقيق الحمص عند نسب استبدال مختلفة (5% - 10%-15% - 20%- 30%) و تأثير ذلك علي الخواص الكيميائية و الطبيعية و التقييم العضوي الحسي لكل من الكيك و بسكويت المصنع حيث تم تجهيز عينات من الكيك و البسكويت باستخدام نسب مختلفة من دقيق الحمص كنسب استبدال لدقيق القمح في الخلطة الأساسية . تم تقدير كل من التركيب الكيماوي و الخواص الفيزيائية و أيضاً التقييم الحسي للعينات المختبرة . و قد أوضحت النتائج أن الحمص يعتبر مصدر جيد للبروتين (22.82 %) ، الألياف الخام (2.95 %) ، الرماد 3.33 %) . أيضاً يعتبر الحمص مصدر جيد للبوتاسيوم ، الماغنسيوم ، الحديد. استبدال دقيق القمح بدقيق بدقيق الحمص في خلطة البسكويت أدت إلي زيادة المحتوي من البروتين ، الدهون ، الألياف الخام ، الرماد. كذلك زيادة المحتوي من المعادن الهامة (صوديوم ، بوتاسيوم ، كالسيوم ، حديد ، ماغنسيوم ، زنك ، فوسفور) ، كما زاد أيضاً كل من الحجم النوعي (38.83 – 44.13 سم ^{3} / مم) ، معامل الإنتشار (100 – 114.21 %) ، والإضاءة النوعية (25 -41 سم ^{3} / مم) للعينات الضابطة و البسكويت المحتوي على 30% دقيق حمص استبدال. وقد تقبل المحكمين كل عينات البسكويت المجهزة باستبدال دقيق القمح بدقيق الحمص و عند كل نسب الاستبدال . و قد اوضحت ايضا النتائج أن الكيك المجهز باستبدال دقيق القمح بدقيق الحمص عند نسب استبدال مختلفة (5% ، 10% ، 15% ، 20 % ، 30 %) كان عالي في المحتوي من البروتين ، الدهون ، الألياف الخام ، الرماد مع محتوي أقل من الكربوهيدرات. أيضاً أدت عملية الإستبدال إلي زيادة محتوي الكيك من كل من الصوديوم ، البوتاسيوم ، الكالسيوم ، الحديد ، الماغنسيوم ، الزنك ، الفوسفور) و عند كل نسب الإستبدال المستخدمة من دقيق الحمص. زيادة نسب الإستبدال أدت إلي زيادة طفيفة في الحجم و الحجم النوعي. كما كانت هناك درجة تقبل عالية بواسطة المحكمين لكل عينات البسكويت المجهزة بنسب استبدال لدقيق القمح بدقيق الحمص عند كل نسب الإستبدال بينما كانت العينتين المحتويتين على 10% ، 15% من دقيق الحمص هما الأعلي من حيث تقبل المحكمين. بصفة عامة يمكن القول أن عينات الكيك

و البسكويت الناتجة باستبدال نسب من دقيق القمح في الخلطة بنسب من دقيق الحمص ، أدت إلي زيادة في المحتوي من البروتين و الألياف الخام و المعادن مع تحسين في الخواص الطبيعية و الخواص العضوية الحسية.

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