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Effect Of Raw And Germinated Egyptian Clover Seeds (Trifolium Alexandrinum) On Pasta Quality

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Abstract : Pasta is a staple food in many countries and pasta products are well accepted worldwide because of their low cost, easy of preparation, versatility sensory attributes and long shelf-life. Pasta samples were made from different additives of Egyptian clover seeds (raw Egyptian clover seeds RECS and germinated Egyptian clover seeds GECS) mixed with wheat flour (72% extraction) at different ratios : 5 , 10 , 15 and 20% for both of them. Pasta produced from wheat flour 72% substitution with (RECS) up to level 15% and GECS until level 10% had good overall acceptability, so these levels of replacement were selected with their control to investigat. The results cleared that pasta sample made from 15% RECS was contained the highest value of protein , fat ,fiber , ash and minerals contents before and after cooking followed by pasta processed from 10% GECS . The highest total antioxidant content was achieved by adding 15% RECS to wheat flour 72% extraction and the order of antioxidant activity was 15% RECS > 10% GECS and control which recorded 55.2, 53.04 and 43.2% and 51.8, 51.22 and 35.04% before and after cooking , respectively. Pasta substitution with 15% RECS had the higher increase in weight and volume compared to control, while pasta made from 10% GECS had the lowest value in cooking loss (8.5%).It was concluded that the addition of raw and germinated Egyptian clover seeds to wheat flour for making pasta could improve the chemical composition, quality characteristics and total antioxidant contents. It could be recommended that raw and germinated Egyptian clover seeds as a natural nutritional additives should be added to pasta industry to improve the quality product and increase the nutritional value.

Keywords: Egyptian clover seeds, germination, pasta, cooking quality and antioxidant.

Introduction

Oxidative and free radical-mediated reactions are implicated in degenerative processes (DNA mutations, macromolecule and cell membrane damage) related to aging, neurodegenerative disorders, coronary heart disease and cancer. Plant-based antioxidants have been shown to play a significant role in scavenging free radicals and inhibiting oxidative mechanisms. In recent years, considerable interest has been focused on the antioxidant potential (including antiradical activity) of 'functional foods'. This in turn is contributing to increase worldwide interest in the use of plant antioxidants derived from various food crops, as well as from preparations in the form of alimentary supplements. Much of the antiradical scavenging potential in foods is derived from flavonoids and other phenolic compounds **(Rice-Evans and Miller, 1996; Malesˇev and Kuntic´, 2007).**

Clovers (family: *Fabaceae*; *Trifolium sp.*) have been known for many centuries as important forage plants and valuable herbs in folk medicine, their phytochemical characteristics and biological activity remain only partly established. The best known clover– *Trifolium pratense L.* (red clover)–is used for the production of herbal medicines, an alternative to the conventional hormonal replacement therapy. The biological activity and potential therapeutic effects of other *Trifolium* species have gained a considerable scientific interest. The extracts obtained from various clovers have been shown to possess antioxidative and anti-inflammatory activities, inhibiting angiogenesis and displaying anti-cancer properties **(Kolodziejczyk-Czepas ,2012)**. The chemical profile of clovers is partly recognized. It is known that besides isoflavones, *Trifolium* plants synthesize a wide range of phenolic and polyphenolic compounds such as flavonoids, saponins, clovamides (caffeic acid esters), phenolic acids and other substances **(Oleszek and Stochmal, 2002; Oleszek, 2007)**.

This group of plant phenolics (flavonoids), therapeutically belonging to the class of phytoestrogens, had been the subject of considerable scientific research in recent years, especially in relation to soy isoflavones. Nowadays, besides the health benefits related to menopausal problems, there is an interest in the possible preventive role of these compounds as regards to breast and prostate cancer, osteoporosis, as well as cardiovascular disease, combined with atheromatosis **(Beck et al., 2005; Occhiuto *et al.*, 2007; Imhof et al., 2006; Atkinson *et al.*, 2004 and Clifton-Bligh *et al*., 2001)**.

Trifolium repens L. decoctions have been applied as anti-diarrhoeal remedy **(Mustafa *et al.*, 2012)**. Native Americans have been used *Trifolium pratense L.* to cure external skin problems, lung illnesses, as well as some disorders of nervous and reproductive system **(Sabudak and Guler, 2009)**.

Sprouts are believed to be rich in health-promoting phytochemicals compared with their mature counterparts. Germination (sprouting) has been suggested as an inexpensive and effective way to improve the quality of legumes. Sprouting mobilizes polymerized forms, such as concentrated starch and protein, into carbohydrates and free amino acids, respectively. This significantly improves the nutritional value of sprouts, which can be readily used by the human body **(Randhir and *et al.*, 2004)**. Thus, germination can lead to the development of such functional foods that have a positive effect on the human organism and that help in maintaining the health **(Sangronis and Machado, 2007)**.

Pasta is a staple food in many countries and its products are well accepted worldwide because of their low cost, ease of preparation, versatility sensory attributes and long shelf-life **(Bergman *et al.*, 1994)**. It is mainly used as an energy source due to its high content of carbohydrates. Pasta products have been fortified to enhance their nutritional properties with supplements from various high-protein sources, such as soy flours, soy isolates, milk and milk products, cotton seed meal, egg albumin, whey proteins, yeast protein concentrates and germinated pigeon pea **(Nielsen *et al.*, 1980).**

The aim of this work was a trial to enrich pasta during processing with raw and germinated Egyptian clover seeds and study the effect of these substitutions on pasta quality, organoleptic properties and antioxidant content of pasta made from wheat flour and additives.

Materials And Methods

Materials:

wheat flour (72% extraction) was obtained from South Cairo Mills Company, Giza, Egypt.

Egyptian clover seeds (*Trifolium alexandrinum*) were purchaserd from Medicine plants and Agricultural Seeds Haraz Company, Cairo, Egypt.

Methods:

Preparation of plant materials: Egyptian clover seeds were washed with tap water and divided into two parts: l ; leave it in the sun to dry and ground to fine powder, 2 ; soaked in water for 3 days at room temperature until they germinate, then drying in air forced oven dryer at 50℃ for 6h and ground to fine powder.

Flour mixing: Wheat flour 72% extraction was replaced with raw and germinated Egyptian clover seeds at ratios 5 %, 10%, 15% and 20 % , respectively.

Pasta preparation: The pasta dough strips dried at 50℃ for 6h, then packed.

-The following pasta products, with different levels of raw Egyptian clover seeds (RECS) and germinated Egyptian clover seeds (GECS) were prepared.

- wheat flour 100% (control)
- wheat flour: RECS (95:5)
- wheat flour: RECS (90:10)
- wheat flour: RECS (85:15)
- wheat flour: RECS (80:20)
- wheat flour: GECS (95:5)
- wheat flour: GECS (90:10)
- wheat flour: GECS (85:15)
- wheat flour: GECS (80:20)

Pasta products were prepared as follows:

Homogenized flours were mixed with water to a moisture content of 31.5% and the mix were blended for 2 min and stood for 15 min. Following this , dough was stretched and extruded **[De Maco semi scale laboratory extruder (De Francies Machine Corporation)]** and pasta dough strips was formed (on laboratory scale) ,pre- dried at room temperature for 1h and then dried in convection forced air oven at 50℃ for 6 h . Dry pasta was kept in polyethylene bags and stored at room temperature untill used **(Torres *et al.,* 2007)**. Other sets of pasta batches using wheat flour were replaced with raw and germinated Egyptian clover seeds at ratios 5 %, 10%, 15% and 20%, respectively.

Chemical analysis: The seeds and samples of pasta before and after cooking were analyzed for moisture, ash, total protein and crude fiber according to the methods described in the **A.O.A.C. (2000)**. Total carbohydrates were calculated by difference .Total phenolic was determined according to **Singleton, *et al.,* (1999)**, total flavonoids were measured according to **Kumar *et al* .(2008)** using the aluminum chloride colorimetric assay, and total antioxidant activity was determined DPPH assay. The method is based upon the ability of test sample to scavenge the free radical 1,1 – diphenyl-2-picrylhydrazyl (DPPH) , mentioned by **Joyeux *et al*.,(1995)** .

Cooking quality of pasta :The cooking quality of pasta samples including the increase in weight , volume and cooking loss (%) were measured using the methods described by **Lorenz *et al* .,(1979).**

Organleptic evaluation : pasta products were cooked in boiling water for 10 min without addition of salt, drained and kept in warm condition prior to testing. A panel consisting of ten members from Food Technology Research Institute evaluated the pasta samples for different sensory attributes such as appearance, color, flavor, tenderness and stickness according to the methods described by **Matez (1969)**.

Statistical analysis:

The obtained data from chemical analysis and sensory evaluations were exposed to analysis of variance. Duncan's multiple range tests at ($p \leq 0.05$) level was used to compare between means. The analysis was carried out using the PRO ANOVA Procedure of Statistical Analysis System **(SAS, 1996)**.

Rusults And Discussion

1-Chemical composition of raw materials:

Data presented in Table (1), show the chemical composition of materials used for the preparation of pasta. It could be demonstrated that germinated Egyptian clover seeds contained the highest values in protein, crude fiber and ash were 39.43, 12.22 and 3.99% followed by raw Egyptian clover seeds were 36.6, 9.77 and 3.88% , respectively. Whereas it had the lowest value in total carbohydrate , 36.1%. On the other hand wheat flour 72% extraction contained the highest value in total carbohydrate , 87.5%. These results are in agreement with those obtained by **Abd El-Hamid *et al*., (1986); Mohamed (1998) ;Anon (2005); Farvili *et al*., (1997); and Lovis (2003)**. Also, results were agreement with those obtained by **Torres *et al*., (2007)** who reported that the sprout cowpeas seeds have high level of protein, starch and dietary fiber.

Table (1): Chemical composition of raw materials used for the preparation of pasta (%on dry weight basis).

Samples	Moisture	Protein	Fat	Crud fiber	Ash	*Carbo hydrats
RECS	18.26^{b} ± 0.21	36.6^{b} ± 0.49	9.34^{a} ± 0.03	9.77^{b} ±0.28	3.88^{a} ± 0.01	40.4^{b} ± 0.23
GECS	19.87^{a} ±0.20	39.43^{a} ±0.47	8.25^{b} ± 0.17	12.22^{a} ±0.24	3.99^{a} ± 0.058	36.1^{c} ± 0.46
Wheat flour (72%)	12^{c} ±0.17	10.87^{c} ± 0.59	0.8^{c} ± 0.06	0.33^{c} ± 0.03	0.46^{b} ±0.03	87.5^{a} ±0.63

Data are expressed as mean values ± SE.

RECS = raw Egyptian clover seeds, GECS = germinated Egyptian clover seeds.

*calculated by difference.

The results presented in Table (2) show the mineral contents of raw materials ,it could be noticed that the mineral contents of germinated Egyptian clover seeds (GECS) had the highest content in Fe and Zn ranged from 17.16 and 9.67 mg/100g ,respectively followed by raw Egyptian clover seeds (RECS) 16.77 and 9.27 mg/100g ,respectively. Whereas the wheat flour 72% extraction had the lowest content in Fe , Zn and Ca ranged from 2.1 ,0.85 and 21.5 mg/100g ,respectively . These results are in agreement with those reported by **Anon (2005) and shahine (2009).**

Table (2): Mineral content of raw materials used for the preparation of pasta (mg/100g).

samples	Fe	Zn	Ca
RECS	16.77[a]± 0.44	9.27[a]± 0.20	631.4[a]± 34.76
GECS	17.16[a]± 0.27	9.67[a]± 0.15	526.7[a]± 18.68
Wheat flour (72%)	2.1[b]± 0.088	0.85[b]± 0.029	21.5[b]± 0.29

Data are expressed as mean values ± SE.

Table(3): Antioxidant activity of raw materials used for the preparation of pasta (%on dry weight basis).

Samples	*DPPH	Total phenols	Flavonoids
RECS	76.35[a]± 0.61	1.17[b]± 0.03	0.67[a]± 0.03
GECS	74.4[a]± 1.3	2.29[a]± 0.05	0.49[b]± 0.07
Wheat flour(72%)	45.2[b]± 1.7	0.027[c]±0.003	0.06[c]±0.005

Data are expressed as mean values ± SE. *DPPH = total antioxidant activity assay.

The antioxidant activity of raw materials under investigation are presented in Table (3). It was noticed that both of RECS and GECS had the highest antioxidant activity which recorded 76.3 and74.4%, respectively compared to wheat flour 72% , 45.2%. Germinated Egyptian clover seeds had the highest value of total phenols (2.29%) while RECS had the highest value of flavonoids (0.67%). The results are in harmony to those of **Oleszek and Stochmal (2002), Severino *et al.*, (2007), Zinca , Thanaa *et al.*, (2009) and Vizireanu (2013) .**

2-Organoleptic evaluation of pasta samples:

From the results presented in Table(4) it could be noticed that pasta produced from wheat flour (72%) extraction substituation with RECS until level 5% was characterized by the highest acceptability compared to the control and other treatments , this may be due to the colloidal nature of the Egyptian clover seeds. And the total acceptability of cooked pasta samples in general, was decreased with increasing levels of addition of different additives to wheat flour as 5%, 10%, 15% and 20%, respectively. Also, it was noticed that pasta produced from wheat flour (72%) extraction was substituation with raw RECS until level 15% and GECS until level 10% have good overall acceptability , so the levels of 15% for RECS and 10% of GECS were selected with their control to continue the investigation. In order to study their physical properties , chemical composition and antioxidant activity. These results were in a good agreement with **Abd-El Rahman (1994) and Feillet and Dexter (1996)**, who reported that protein content is the primary factor influencing in pasta quality and the gluten strength is an important secondary factor.

Table (4): Organoleptic evaluation of cooked pasta samples .

Treatment	Appearance (20)	Color (20)	Flavor (20)	Tenderness (25)	Stickness (15)	Total score (100)
Control100% wheat flour	17.33^{ab}±0.33	18.33^{a} ±0.33	18.33^{ab} ±0.33	21.33^{abc}±1.20	12.3^{bc} ±0.66	87.62^{ab}±2.02
5%RECS +95%wheat flour	18^{a}±1.0	18.47^{a} ±0.290	18.5^{a} ±0.288	23.43^{a}±0.29	14^{a}±0.57	92.4^{a}±1.44
10%RECS +90%wheat flour	17^{ab}±0.57	17^{ab} ±1.15	17^{bcd} ±1.0	22^{ab}±1.15	13^{ab}±1.15	86^{bc}±4.04
15%RECS +85%wheat flour	16.3^{bc}±0.65	17.3^{a} ±0.33	17.33^{abc} ±0.33	20.8^{bc}±0.611	12.17^{bc} ±0.600	83.9^{bc}±1.15
20%RECS +80%wheat flour	14.73^{cd}±0.266	15.6^{bc} ±0.305	15.47^{e} ±0.29	19.2^{cd}±0.200	10.87^{c} ±0.52	75.87^{d}±0.52
5%GECS +95%wheat flour)	16^{bcd}±0.00	18^{a} ±0.57	16de ±0.00	21^{bc}±0.57	13^{ab} ±0.57	84^{bc}±0.57
10%GECS +90%wheat flour)	15.93^{bcd}±0.5 8	17a^{b} ±0.577	15.73^{de} ±0.266	20.87^{bc}±0.59	12^{bc} ±0.57	81.53^{c}±1.24
15%GECS +85% wheat flour	14.53^{d}±0.29	14.4^{c} ±0.296	13.3^{f} ±0.650	17.13^{de}±0.59 2	12.6^{ab} ±0.305	71.96^{d}±1.00
20%GECS +80% wheat flour	12.93^{e}±0.520	12.8^{d} ±0.416	12.6^{f} ±0.305	15.2^{e}±0.757	12.2^{bc} ±0.416	65.73^{e} ±1.507

Data are expressed as mean values ± SE

Table (5): Chemical composition of pasta samples (% on dry weight basis).

Treatment	Before cooking			After cooking		
	Control	15% RECS	10% GECS	Control	15% RECS	10% GECS
Moisture	8.66[c] ± 0.25	5.8[d] ± 0.03	6.06[d] ±0.03	10.4[b] ±0.02	8.79[c] ±0.49	11.62[a] ±0.63
Protein	11.5[c] ±0.15	15.24[a] ±0.2	14.46[b] ±0.3	9.5[d] ±0.27	14.49[b] ±0.12	14.0[b] ±0.05
Fat	0.85[d] ±0.02	2.73[a] ±0.14	1.81[b] ±0.02	0.71[d] ±0.05	1.73[b] ±0.01	1.17[c] ±0.003
Crude fiber	0.57[c] ±0.08	1.69[a] ±0.18	1.6[a] ±0.08	0.47[c] ±0.08	1.48[ab] ±0.08	1.23[b] ±0.12
Ash	0.51[c] ±0.05	1.13[a] ±0.02	0.99[ab] ±0.01	0.56[c] ±0.06	0.86[b] ±0.05	0.83[b] ±0.01
*Carbohydrates	86.5[b] ± 0.23	79.2[e] ±0.29	81.14[d] ±0.27	88.7[a] ±0.21	81.44[c] ±0.75	82.7[c] ±0.62

Data are expressed as mean values ± SE.

*calculated by difference.

3-Gross chemical composition of pasta samples before and after cooking :

Data given in Table (5) illustrate the effect of adding different substitution on the chemical composition of pasta made from wheat flour 72% before and after cooking. The moisture content before cooking decreased in all pasta samples of 15%RECS and 10%GECS compared with control pasta made from 100% wheat flour , the moisture content slightly decreased with increasing the percentage of substitution . This was due to different moisture contents of the substitution used in pasta mixtures, the moisture content in all samples after cooking was relatively higher than that before cooking because boiling pasta in water during cooking process increased its water content. Regarding protein, fat, fiber and ash contents increased as the levels of substitution increased, while carbohydrates contents decreased as the levels of substitution increased.

Concerning chemical composition of pasta samples before and after cooking it could be observed from Table (5) that , pasta sample made from 15% RECS contained the highest protein , fat ,fiber and ash contents before and after cooking (15.24, 2.73, 1.69 and 1.13 %) (14.49, 1.73, 1.48 and 0.86%) ,respectively. While the substitution of different concentrations 15% RECS and 10% GECS caused a decrease in carbohydrates in both raw and cooked pasta samples (79.21% and 81.14%) (81.44% and 82.77%) ,respectively . Data are on line with those of **Tarzi *et al.*, 2012**, who found that the percentage of protein,crude oil and ash in control pasta (100% wheat flour) were 11.41,0.51 and 0.68%,respectively.

Table (6) : Minerals content of pasta samples (mg/100g).

Treatment	Before cooking			After cooking		
	Control	15% RECS	10% GECS	Control	15% RECS	10% GECS
Fe	2.95[c] ±0.18	5.54[a] ±0.13	4.66[b] ± 0.22	3.19[c] ±0.45	4.49[b] ± 0.24	4.03[b] ±0.08
Zn	0.96[d] ±0.21	2.22[a] ±0.01	1.71[bc] ±0.13	1.14[d] ± 0.01	1.79[b] ±0.11	1.33[cd] ±0.05
Ca	20.8[e] ±0.41	112.6[a] ±0.88	67.17[c] ±1.07	21.3[e] ± 0.33	102[b] ±0.33	61.67[d] ±1.0

Data are expressed as mean values ± SE.

Results mentioned in Table (6) show the minerals contents of pasta samples before and after cooking ,it could be observed that the pasta product of 15%RECS had the highest content in Fe, Zn and Ca before and after cooking (5.54, 2.22 and 112.63 mg/100g) (4.49, 1.79 and 102 mg/100g) before and after cooking ,respectively followed by pasta product of 10%GECS (4.6, 1.7 and 67.17 mg/100g) (4.03, 1.33 and 61.67 mg/100g) before and after cooking) ,respectively when compared with control pasta (2.95, 0.96 and 20.8 mg/100g) (3.19, 1.14 and 21.3 mg/100g) before and after cooking ,respectively. Hence, pasta containing Egyptian clover seeds are favorable than control pasta because of their high content of important minerals.

Table (7): Antioxidant activity of pasta samples (% on dry weight basis).

Treatment	Before cooking			After cooking		
	Control	15% RECS	10% GECS	Control	15% RECS	10% GECS
*DPPH	43.2[b] ±0.72	55.2[a] ±0.17	53.0[a] ±0.72	35.04[a] ±1.4	51.8[a] ±0.2	51.22[a] ±0.057
Total phenols	0.06[e] ±0.005	0.18[cd] ±0.01	0.23[bc] ±0.01	0.07[ed] ±0.003	0.82[a] ±0.02	0.30[b] ±0.05
Flavonoids	0.04[d] ± 0.00	0.16[a] ±0.0003	0.08[c] ±0.01	0.03[d] ±0.001	0.13[b] ±0.003	0.08[c] ±0.003

Data are expressed as mean values± SE. * DPPH = total antioxidant activity assay

Data presented in Table (7) show antioxidant activity of pasta samples before and after cooking (DPPH, Total phenols and flavonoids) as % on dry weight basis .It could be observed that the antioxidant activity of pasta samples before and after cooking were higher in both of all samples with different substitution compared with pasta made from 100% wheat flour (control sample) .Adding different Egyptian clover seeds(raw and germinated) to wheat flour 72% extraction caused an increase in total antioxidant content . The highest total antioxidant content was achieved by adding 15% RECS to wheat flour 72% extraction . The order of antioxidant activity was 15% RECS > 10%GECS > control .The present results reported that the increase in total phenols content was observed after cooking, these data are in harmony to those of **Gallegos-Infant *et al.*, (2010)** who found that temperature affects on the total phenolic content positively in spaghetti pasta , higher temperatures, higher phenolic contents were observed.

Table (8): Cooking qualities of cooked pasta samples (%) .

Treatment	Initial weight (gm)	Weight after cooking (gm)	Increase in weight (%)	Initial volume (cm)3	Volume after cooking (cm)3	Increae in volume %	Cooking loss (%)
Control	10	19.2[a]±0.23	92[a]±2.3	7	14[b]±0.00	100[b]±0.00	16.8[a] ±0.11
15%RECS	10	20.6[a]± 1.15	106[a]±11.8	7	18[a]±0.57	157.1[a] ±8.24	9.9[b] ± 0.05
10%GECS	10	20.5[a]±0.57	105[a]±5.7	7	17.5[a]±0.28	150[a] ±4.12	8.5[c] ±0.11

Data are expressed as mean values ± SE.

4- Cooking qualities of cooked pasta samples:

Results in Table (8) illustrate the effects of different substitution at different levels to wheat flour (72%) on cooking quality of pasta samples (increase in weight, increase in volume, and cooking loss) during cooking process. The results show that both of all the substitution used caused a gradual increase in weight and volume of cooked pasta. Cooking of control pasta sample made from 100% Wheat flour caused 92% Increase in weight and 100% Increase in volume ,while the pasta substitution with (15% RECS) had the higher increase in weight and volume compared with control were 106%and 157.1% ,respectively followed by pasta substitution with (10% GECS) of wheat flour were 105% and 150% ,respectively. It was observed that the increase in weight appeared to be correlated with that in volume because the Increase in weight in grams could be considered at the same time as an Increase in volume.

Cooking loss is the percentage of cooked residue in water, which was a measure of dissolved solids and could be taken as an indicator of the disintegration degree during the cooking process. Results in Table (8) showed that pasta samples substitution with (10% GECS) had the lowest value in cooking loss (8.5%) followed by pasta samples pasta substitution with (15% RECS) were 9.9% compared with control was 16.8 % .These results were in accordance with the results mentioned by **Grzybowski and Donnelly (1979)** ,who found that protein quantity and quality were also significant factors affecting cooking quality particularly with respect to the maintenance of firmness and cooking stability .

Conclusion:

The results indicate that raw and germinated Egyptian clover seeds as a natural nutritional additives should be added to pasta industry to improve the quality product and increase the nutritional value.

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تأثير إضافة بذور البرسيم المصرى الخام و المنبتة على جودة المكرونة.

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تعتبر المكرونة هى الغذاء الرئيسى فى العديد من دول العالم و ذلك لانها منخفضة التكلفة و سهلة التحضير ولها فترة صلاحية طويله . ولذالك تم عمل عينات من المكرونة بإضافة بذور البرسيم المصرى الخام و المنبتة و خلطها مع دقيق القمح(72%) بنسب استبدال مختلفة 5 ، 10، 15، 20 % لكل من بذور البرسيم المصرى الخام و المنبتة على التوالى وذلك للوصول لافضل عينات مكرونة من ناحية التقيم الحسى ،و لقد اوضحت النتائج ان منتجات المكرونة المصنعة بإضافة 15% من بذور البرسيم المصرى الخام و المصنعة من 10% بذور البرسيم المصرى المنبتة قد أعطيتا قبول جيد فى التقيم الحسى ، لذلك تم اختيار هذه التركيزات مع الكنترول لتكملة الاختبارات عليها .

و لقد اوضحت نتائج الدراسة أن المكرونة المصنعة من15 % من بذور البرسيم المصرى الخام أحتوت على أعلى نسبة من البروتين و الدهون والألياف و الرماد و أيضا المحتوى من العناصرالمعدنية و ذلك قبل و بعد الطبخ يتبعها منتجات المكرونة المصنعة من 10% بذور البرسيم المصرى المنبتة .

كما وجد أن أعلى محتوى لمضادات الاكسدة الكلية كان فى منتجات المكرونة المصنعة من 15 % من بذور البرسيم المصرى الخام وكان ترتيب النشاط المضاد الاكسدة كالاتى 15 % من بذور البرسيم المصرى الخام ثم 10% بذور البرسيم المصرى المنبتة ثم العينة الضابطة (55.2 ،53.04 ، 43.2 ٪) ، (51.8، 51.22، 35.2 %) قبل و بعد الطبخ على التوالى ، المكرونة المدعمة ب 15% بذور برسيم خام أظهرت أعلى زيادة فى الوزن و الحجم بعد الطبخ مقارنا بالكنترول و كانت المكرونة المدعمة ب 10% بذور البرسيم المصرى المنبتة أقل معدل للفقد أثناء الطبخ8.5%.

كما خلصت الدراسة إلى أن إضافة بذور البرسيم الخام و المنبتة إلى دقيق القمح لعمل المكرونة يمكن أن يحسن من التركيب الكيماوى، خواص جودة المكرونة ، التقيم الحسى و المحتوى الكلى من مضادات الاكسدة لعينات المكرونة الناتجة ، لذا يمكن التوصية بأن بذور البرسيم الخام و المنبتة كإضافات غذائية طبيعية و ذات قيمة غذائية عالية يجب أن تضاف لصناعة المكرونة لتحسين جودة المنتج النهائى وزيادة قيمته الغذائية.