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USE OF FABA BEAN AND RADISH SEED SPROUTS FOR PRODUCTION OF EGYPTIAN TAAMYAH AS A NEW FUNCTIONAL FOOD

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ABSTRACT

In this study, faba bean and radish seeds were sprouted and used to improve the nutritional properties of Egyptian taamyah. Faba bean sprouts were selected to increase amino acids content and decrease flatulence factors (stacchyose and raffinose) of Egyptian taamyah, while sprouted radish seeds were used as a source of some minerals (Phosphorus, Calcium, Iron and Zinc) to supplement the same product. Initial moisture of faba bean and radish seeds was 9.19±0.17 (%) and 6.20±0.057 (%) reached to 63.61±0.53 (%) and 60.25±0.46 (%) at the sixth day of sprouting, respectively. After four days of sprouting faba bean sprouts recorded high contents of cystein, leucine, aspartic, iso leucine, phenylalanine and proline. Therefore, four days faba bean sprouts were used to substitute zero, 50, 75 and 100% of de-hulled and soaked faba bean in Egyptian taamyah. The highest decrease in stacchyose and raffinose contents was observed in raw Egyptian taamyah prepared from 100% four days faba bean sprouts. The reduction of stacchyose content of raw and fried Egyptian taamyah were 74.86 and 77.16 % at ratio 100% of faba bean sprouts, respectively. On other hand, the reduction of raffinose content of raw and fried Egyptian taamyah was 67.36 and 83.35% at ratio 100% of faba bean sprouts, respectively. Sensorial, no significant differences were observed between the Egyptian taamyah samples containing 75 and 100% of faba bean sprouts but the first one was more preferable for panelists in its odor and overall acceptability. Minerals content was followed during 6 days of sprouting of radish seeds in order to select the suitable sprouting day. The selected sprouting day was found to be 6, 2, 4 and 3 which increased of Phosphorus, Calcium, Iron and Zinc to levels of 0.864%, 1.5%, 139.2 ppm and 43.75 ppm, respectively to supplement the Egyptian taamyah by adding 10, 20, and 30 g of dried radish sprouts. The best supplemented level of dried radish sprouts as a source of Zinc in Egyptian taamyah was 10 g/100 g de-hulled faba bean while it was 30 g as a source of Calcium, Iron and Phosphorous. Sensory evaluation showed that with increasing the sprouting time and levels of dried radish sprouts the acceptability of Egyptian taamyah was increased.

INTRODUCTION

Falafel (taamyah) is one of the most popular foods consumed by majority of the population in Egypt. The main constituent of falafel is faba bean (*Vicia faba L.*) with variable amount of onion, garlic and some vegetables such as Egyptian leek herbs and parsley. The whole mixture is finely ground prior to forming into patties which are finally deep fried **(Youssef *et al* 1986)**

Faba bean (*Vicia faba L.*), broad bean, is a species of bean (*Fabaceace*) native to North Africa and South West Asia. In Egypt faba beans are a common staple food in the Egyptian diet, eaten by rich and poor alike. Egyptians eat faba beans in various ways: they may be shelled, dried and then cooked in water at low heat for several hours. They are primary ingredients in Taamyah (Egyptian Arabic for falafel) **Vered *et al* (1997)**. Broad beans can be eaten in several forms, i.e., stewed (medamis), as bean cakes (taamyah), as a stewed bean paste (bissara) and as a germinated bean soup (foul nabit). These are major forms in which broad beans are consumed by low income populations as a source of protein **(Abdalla *et al* 1988)**.

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Flatulence is one of constrains limiting the consumption of legume seed by human. This phenomenon has been attributed mainly to the α-galactosides, raffinose, stachyose and verbascose. These oligosaccharides are indigestible by human due to the lack of α-galactosidases; rather they are fermented aerobically in the colon by microorganisms to produce carbon dioxide, hydrogen and methane **(Rackis, 1975)**. These gases cause abdominal discomfort due to flutes effect and sometimes result in diarrhea. Essential removal of these compounds would improve the nutritional quality of legumes **(Obendorf, 1997 and Reddy *et al* 1984)**. **Machaiah and Pedenkar, (2002)** reported that during germination of legumes for 0-4 days, raffinose family oligosaccharides such as stachyose and verbascose, which constituted 55-66 % of soluble carbohydrates of legumes were degraded at different rates and reducing sugars were accumulated .Verbascose, stachyose and raffinose are associated with desiccation tolerance and storability of seeds and are also flatulence producing.

The radish (*Raphanus sativus*) is an *edible root vegetable* of the *Brassicaceae* family that was domesticated in *Europe* in pre-*Roman* times. Radishes are grown and consumed throughout the world. They have numerous varieties, varying in size, color and duration of required cultivation time. The seed of radish are edible and are some times used as a crunchy, spicy addition to salads.There are some radishes that are grown for their seeds; oilseed radishes are grown, as the name implies, for oil production **(Daniel and Hopf, 2000)**. Radishes and radish leaves are an excellent source of vitamin C. Globe radishes are a very good source of the trace mineral molybdenum and a good source of folic acid and potassium and Daikons are a very good source of copper and potassium. The Kaiware Daikon radish sprout is a potent source of antioxidants. Radish leaves are a good source of calcium **(Takaya *et al* 2005)**

Seed sprouts have long been used in the diet as health food and recent research shows that in addition to being a good source of basic nutrient, they also have important phytochemicals with disease preventive and health promoting properties **(Randhir *et al* 2004)**. Sprouting is a practice of soaking and leaving seeds until they germinate and begin to sprout. This practice is reported to be associated with improvements in the nutritive value of seeds **(Zanabria *et al* 2006)**. Furthermore, sprouting significantly increases the total content of all enzymes and mobilizes polymerized food forms such as concentrated starch and protein into simpler carbohydrates and free amino acids, respectively. Germination unfolds, and enzymes trigger elaborate biochemical changes such as proteins break into amino acids **(Zielinsk *et al* 2005)**

A multitude of chemical changes occur to mobilize the stored carbohydrate and protein reserve into the growing sprout. Sprouting removes anti-nutrient such as enzyme inhibitors in the seed that make sprouts safe for the diet. Sprouts have substantial nutritional benefits on the human body because of their high concentration of protein and essential nutrients in mobilized form **(Mc Cue and Shetly, 2002)**. **Kim *et al* (2004)** found that free fatty acids content of buckwheat sprouts were markedly increased and almost four times higher than seeds. So, they were considered buckwheat sprouts as a new source of vegetable.

Since the quality and quantity of bioactive compounds are important when the sprouts are considered as a new functional food. The present study was undertaken to improve the nutritional properties of Egyptian taamyah by substitution of de-hulled and soaked faba beans with sprouted faba beans for increasing amino acids and decreasing oligosaccharides (stacchyose and raffinose) contents and also by supplemented Egyptian taamyah with sprouted radish as a source of some minerals (Phosphorus, Calcium, Iron and Zinc).

MATERIALS AND METHODS

1. Materials

Commercial dry faba beans (*Vicia faba L.*), de-hulled Faba bean, onion, garlic, leaf vegetables (coriander, parsley and Egyptian leek) and sunflower oil used to prepare Egyptian taamyah were purchased from local market in Cairo, Egypt. Radish seeds (*Raphanus sativus L.*) were obtained from GAARA establishment for import and export, Cairo, Egypt.

2. Methods

2.1. Sprouting

Faba beans and radish seeds were washed with water after which was sort out any discolored or defective seeds. Faba beans and radish seeds were soaked by submerging in tap water for 12 and 8 h, respectively at room temperature. Sprouting was carried out in dark place; continue to keep seeds sprinkled with tap water at least 2 to 3 times per day. When the sprouts have grown they were moved to sunny spots so the chlorophyll in the leaves can develop. After 6 days sprouts were harvested and faba bean sprouts were washed to remove seed coats and fibrous roots by hand (**Khalil *et al* 2007**). Sprouts were allowed to drip drain until used for analysis and application. Radish sprouts were dried in an air oven at 50°C over night.

2.2. Moisture content and yield of sprouts

Moisture content of different samples was determined according to the methods of **A.O.A.C. (2007)**. Sprouting yield of faba beans and radish seeds were calculated according to (**Khattak *et al* 2007**).

2.3. Preparation of Egyptian taamyah

The method adapted for taamyah preparation is that used in Egyptian homes as presented in **Table (1). and Fig. (1).**

Table1. Recipe of taamyah (g/100 g de-hulled dry faba bean)

Ingredients (g/100 g de-hulled faba bean)						
De-hulled dry faba bean	Onion	Garlic	Parsley	Coriander	Leek	salt
100	15.52	3	3.5	3.5	16.8	1.5

De-hulled dry faba bean
↓
Sorting
↓
Dry cleaning
↓
Wash by water
↓
Soaking in tap water for 12 h at room temperature
↓
Draining
↓
Addition of onion, garlic and leaf vegetable
↓
Mincing twice
↓
Addition of salt
↓
Mixed
↓
Forming into disks
↓
Deep frying in sunflower oil at 175°C for 5 min.

Figure 1. Flow chart for production of Egyptian taamyah

The production of Egyptian taamyah from de-hulled and soaked faba beans and sprouts of faba bean or dry radish seeds were including two batches. The first one was aimed to increase amino acids content and to decrease flatulence factors (stacchyose and raffinose) in de-hulled faba bean taamyah. It was formulated on the basis of substitution of de-hulled and soaked faba bean by zero, 50, 75 and 100% of faba bean sprouts which was taken after four days of sprouting. The second batch was formulated by supplementing Egyptian taamyah with adding 10, 20 and 30 g dried radish sprouts after 6, 2, 4 and 3 days of sprouting, as a sources of Phosphorus, Calcium, Iron and Zinc, respectively in individually treatment.

2.4. Analytical methods

2.4.1. Analysis of amino acids

Analysis of amino acids was carried by GC/MS apparatus according to **Mabbott, (1990)** at Research Institute Agriculture Research Center, Giza. Egypt.

2.4.2. Analysis of Oligosaccharides

Stacchyose and raffinose were accomplished by HPLC apparatus **(Machaiah *et al* 1999)** by National Research Center, Giza .Egypt.

2.4.3. Analysis of minerals

Calcium, Iron and Zinc were determined using atomic absorption spectrophotometer while, Phosphorus was determined by colorimeter method (ammonium molybdate) using spectrophotometer **(Chapman and Pratt, 1961)** at Arid Land Agricultural Research and Services Center Faculty of Agriculture, Ain Shams University.

2.5. Sensory evaluation

About 10 panelists from the staff members of Food Science Department, Faculty of Agriculture, Ain Shams University were asked to evaluate texture, flavor, color and overall acceptability of the processed taamyah **(Ziena *et al* 1988)**.

2.6. Statistical analysis

Data of moisture contents were expressed as the mean ± standard deviation of three replicates. The other experiment data were analyzed using analysis of variance at ($p \leq 0.05$). The data were analyzed according to User' Guide of Statistical Analysis System at computing Center of Faculty of Agriculture, Ain Shams University **(SAS, 2004)**.

RESULTS AND DISCUSSION

1. Sprouting of faba bean

Sprouting is the practice of soaking, draining and then rinsing seeds at regular intervals until they germinate, or sprout. This can be a semi-automated or fully automated process when done on a large scale for commercial use **(Zanabria *et al* 2006)**. It has been widely reported that seed sprouts provide higher nutritive value than raw seeds and their production is simple and inexpensive **(Martinez-villaluenga *et al* 2010)**. Different stages of faba bean sprouting from soaking to sixth day of sprouting were shown in **Fig. (2)**. Faba bean sprouts have a light- yellow colored cotyledon, bright-white colored hypocotyls and light green of two leaves.

1.1. Moisture content and yield of faba bean sprouts

Results regarding the influence of sprouting on moisture content of faba bean are presented in **Table (2)**. Initial moisture of faba bean was 9.19±0.17 (%) and the absorption pattern of seeds was increased with increasing sprouting times reached to 63.61±0.53 (%) at the sixth day of sprouting. **Mao-Jun *et al* (2005)** found that weight increases as the seed absorb water and minerals. The yield of faba bean sprouts was calculated after their hulls completely removed and it was found to be 227.89%.These means that every 100 g of dry faba bean give 227.89 g of sprouts at the fourth day of sprouting.

1.2. Free amino acids content of faba bean sprouts

Free amino acids content (FAA) of faba bean was followed during 6 days of sprouting in order to select the suitable sprouting day to provide the maximum improvements in nutritional properties of Egyptian taamyah. Free amino acids content of faba bean sprouts during 6 days was presented in **Table (3)**. Free amino acids content in faba bean sprouts was increased as sprouting days progressed until the fourth day of sprouting. As sprouting days progressed, most of FAA content in faba bean sprouts was markedly decreased in the fifth day and then a remarkable increase was observed in the sixth day of sprouting.

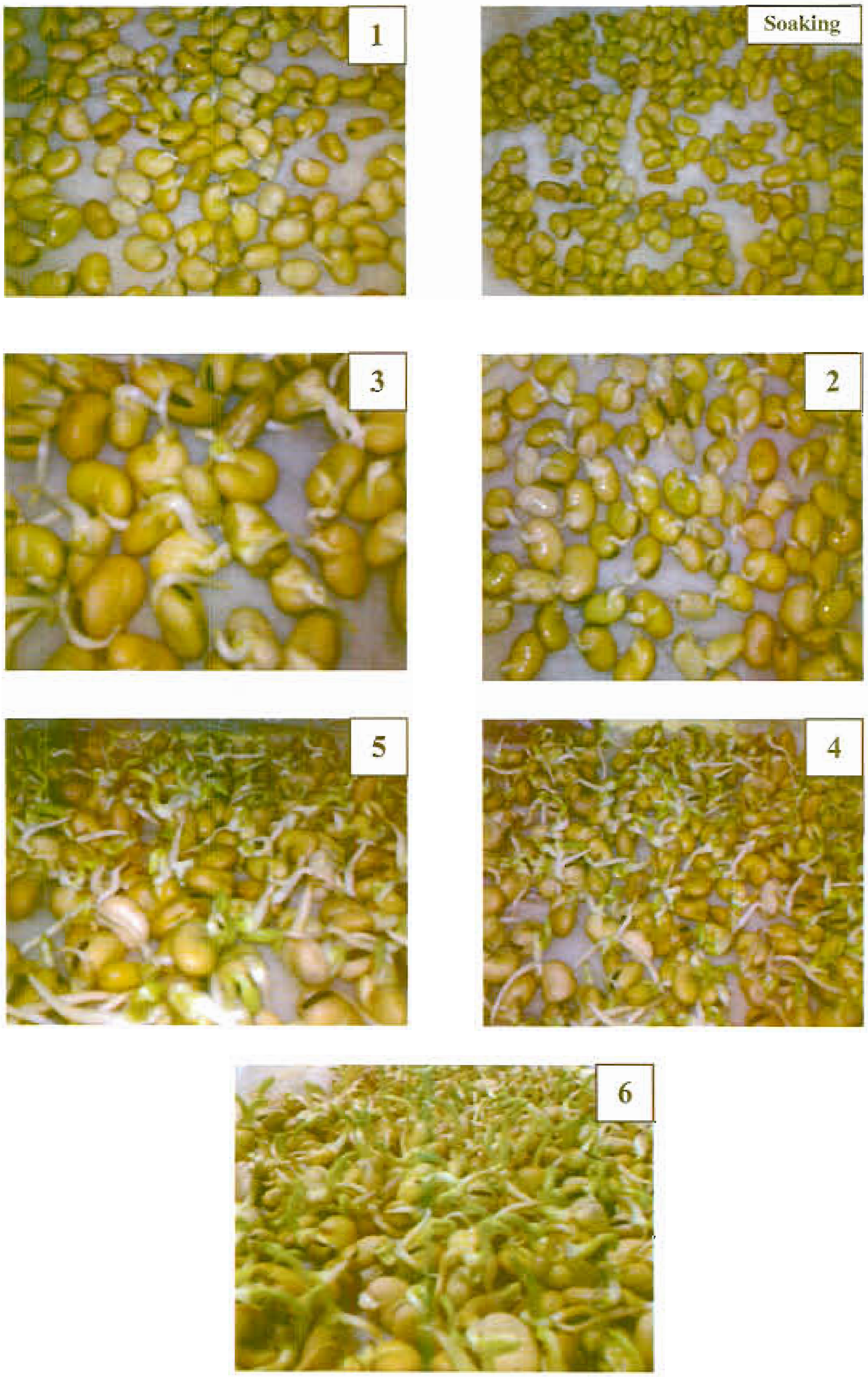

Figure 2. Sprouting days of faba bean

Table 2. Moisture content (%) of faba beans during sprouting

	Dry seed	Soaking seed	Days of sprouting					
			1	2	3	4	5	6
Moisture content (%)	9.16 ±0.17	52.79 ±0.75	54. 21 ±0.67	56.27 ±0.60	62.04 ±0.08	62.9 ±0.07	63.22 ±0.91	63.61 ±0.53

Data expressed as mean of three replicates ± standard deviation.

Table 3. Free amino acids content of faba bean sprouts during sprouting

Amino acids content (mg/100g)	Dry seed	Soaking seed	Days of sprouting					
			1	2	3	4	5	6
Alanine	3.84	14.64	15.52	22.81	22.53	34.34	25.81	31.03
Glycine	14.63	13.74	14.65	16.35	55.78	80.24	57.13	58.31
Therionione	17.16	20.47	35.27	48.62	129.96	164.47	136.45	156.92
Serine	16. 86	16.60	19.41	35.92	61.27	160.80	82.62	146.24
Valine	30.35	7.46	22.08	55.83	142.07	168.71	134.76	146.71
Leucine	41.47	15.01	15.36	46.43	199.32	262.09	153.19	193.67
Iso leucione	30.71	31.42	46.55	70.71	200.00	250.96	211.26	182.90
Cysteine	6.98	3.54	1.97	3.59	27.59	57.90	24.16	31.39
Proline	51.06	50.65	14.34	60.28	180.63	202.94	132.40	149.84
Methionine	4.68	4.71	2.36	11.62	18.49	42.18	16.32	29.88
Aspartic	67.66	63.69	46.93	70.79	211.14	257.22	202.65	191.95
Phynylalanine	23.69	61.27	22.41	116.44	176.38	228.77	180.17	211.10
Arginene	23.29	20.52	14.77	40.01	142.83	119.23	98.36	103.55
Tyrosine	13.48	28.03	13.09	32.18	59.44	124.76	113.23	118.37
Glutamic	27.77	8.37	6.15	16.03	85.30	98.62	51.01	61.12
Histidine	13.65	12.12	11.57	35.14	157.27	107.98	53.90	99.18
Tryptophane	17.91	9.71	5.11	9.24	63.72	115.17	45.04	89.99
Cystein	33.04	47.79	33.871	76.00	233.46	269.96	230.45	186.81

Faba bean sprouts recording high contents of cystein, leucine, aspartic, iso leucine, phenylalanine and proline and their level were 269.96, 262.09, 257.22, 250.96, 228.77 and 202.94 (mg/100g) after 4 days of sprouting, respectively . The maximum content of cystein was observed after 4 days of faba bean sprouting (269.96 mg/100g), meanwhile, the minimum content of free amino acids was observed for alanine (34.34 mg/100g) at the same day of faba bean sprouting. However, therionine, phenylalanine, serine, tyrosine and methionine in faba bean sprouts were almost nine times higher than those of dry faba bean, while glutamic was recorded low value than the previous amino acids which only almost three times higher than those of dry faba bean. **Hammd and Field, (1979)** explained that abundance of lysine, γ-amino-n-butyric acid and sulfur containing amino acids such as cystein, methionine and cystchionine in buckwheat sprouts will provide a high nutritional value. These results are in agreement with the finding obtained by **Kim *et al* (2004).** From the previous results it can be concluded that the best day of sprouting according to the highest content of FAA was the fourth day of faba bean sprouting.

1.3. Stacchyose and raffinose contents of Egyptian taamyah substituted by different ratios of four days faba bean sprouts

Stacchyose and raffinose oligosaccharides are considered the main factor in producing flatulence in human when they have eaten beans. Egyptian taamyah was prepared by substitution of de-hulled faba bean by zero, 50, 75 and 100% of faba bean sprouts which was taken after four days of sprouting. Stacchyose and raffinose contents were determined in different samples of Egyptian taamyah before and after frying and the results are in **Fig. (3)**. Stacchyose and raffinose contents gradually decreased with increasing the level of faba bean sprouts in Egyptian taamyah. The highest decrease in stacchyose and raffinose contents was observed in raw Egyptian taamyah prepared from 100% faba bean sprouts which reached 17.97 and 23.3 mg/100gm samples, respectively compared to 71.5and 71.4 mg/100gm control sample (without Faba bean sprouts), respectively. After frying the stacchyose and raffinose contents in control sample were slightly increased. However, with increase the level of faba bean sprouts in fried Egyptian taamyah the stacchyose content was decreased but their value was higher than before frying. **Bieleck *et al* (2000)** found that the levels of the raffinose family sugars increased during cooking and others observed a decrease of concentration of the raffinose family sugars (raffinose by 87%, stacchyose by 85% and verbascose by 25%) after cooking of soybean for 60 min.

The reduction percent of flatulence factors (stacchyose and raffinose) in Egyptian taamyah supplemented by faba bean sprouts before and after frying is shown in **Fig. (4)**. The reduction in stacchyose content of raw and fried Egyptian taamyah were 54.96 and 50.36% at ratio 50% faba bean sprouts and it reached 74.86 and 77.16 % at ratio 100% faba bean sprouts, respectively. On other hand, the reduction of raffinose content of raw and fried Egyptian taamyah were 54.15 and 62.81% at ratio 50% faba bean sprouts and it reached 67.36 and 83.35% at ratio 100% faba bean sprouts, respectively. From the mentioned results, it can be noticed that, the reduction rate of raffinose after frying of Egyptian taamyah was higher than the reduction rate of stacchyose. Our observation about greater degradation of flatulence factors (stacchyose and raffinose) in faba bean sprouts is due to enhance of the associated degradative enzyme activities during sprouting.

These results proved that faba bean sprouting is effective method for removal the stachyose and raffinose which cause flatulent phenomena in human after ingestion of legumes. Therefore reduction of these components enhances digestibility of legume seeds and sprouting is potentially useful for processing such sugars.

1.4. Sensory evaluation of Egyptian taamyah prepared with sprouted faba bean

Sensory evaluation of Egyptian taamyah prepared by substituting de-hulled faba beans with (zero, 50, 75 and 100 %) faba bean sprouts after four days of sprouting are presented in **Table (4)**. The substitution of de-hulled faba bean in Egyptian taamyah with faba bean sprouts at 75 and 100% ratio showed significantly superior sensory properties than control sample (zero faba bean sprouts). Egyptian taamyah prepared by 75% faba bean sprouts was given the highest scoring in overall acceptability and significantly the best one when compared with control sample in its odor. No significant differences were observed between the Egyptian taamyah prepared by 75 and 100% faba bean sprouts but the first one was more preferable for panelists in its odor and overall acceptability also it was taken the highest score in all properties when compared with all other samples.

2. Sprouting of radish seeds

Minerals are important factors in human nutrition and fulfill many biochemical functions in human metabolism. They are the activation power of several enzymes; stabilize the structure of RNA and DNA (**Scherz and Kirchhoff, 2006**). Different stages of radish seeds sprouting from soaking to sixth day of sprouting were shown in **Fig. (5)**. Radish sprouts have a dark- yellow colored cotyledon, bright-white colored hypocotyls and dark green of two leaves.

2.1. Moisture content and yield of radish sprouts

Results regarding the influence of sprouting on moisture content of radish seeds are presented in **Table (5)**. Initial moisture of radish seeds was 6.203±0.06 (%) and the absorption pattern of seeds was increased with increasing sprouting times reached to 60.25±0.46 (%) at the sixth day of sprouting. The yield of radish sprouts was calculated after 2, 3, 4 and 6 day of sprouting and

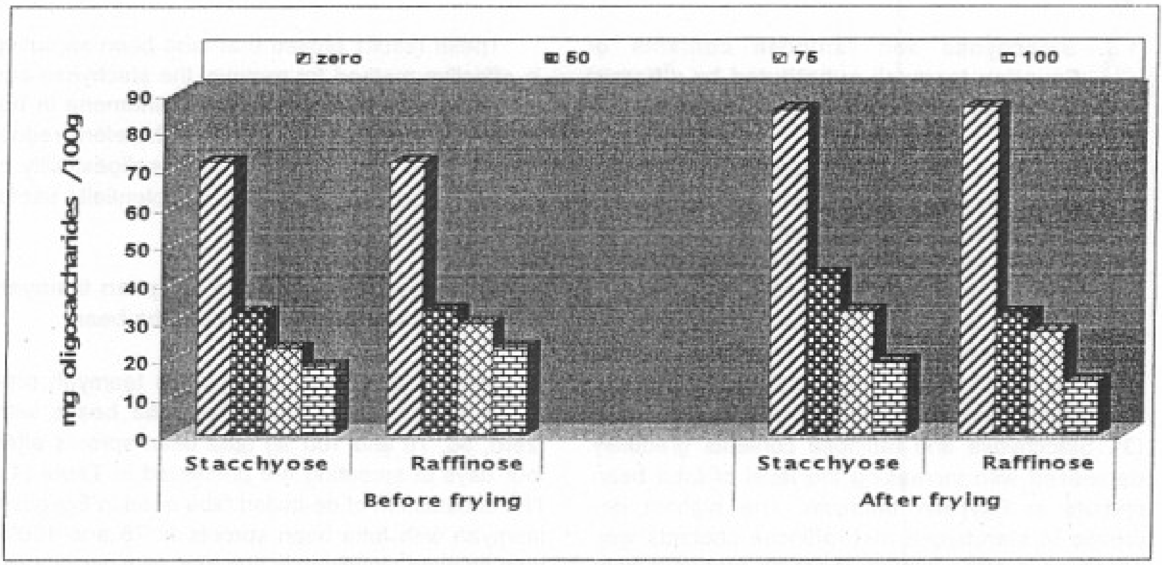

Figure 3. Stacchyose and raffinose contents of Egyptian taamyah substituted by different ratios of four days faba bean sprouts before and after frying

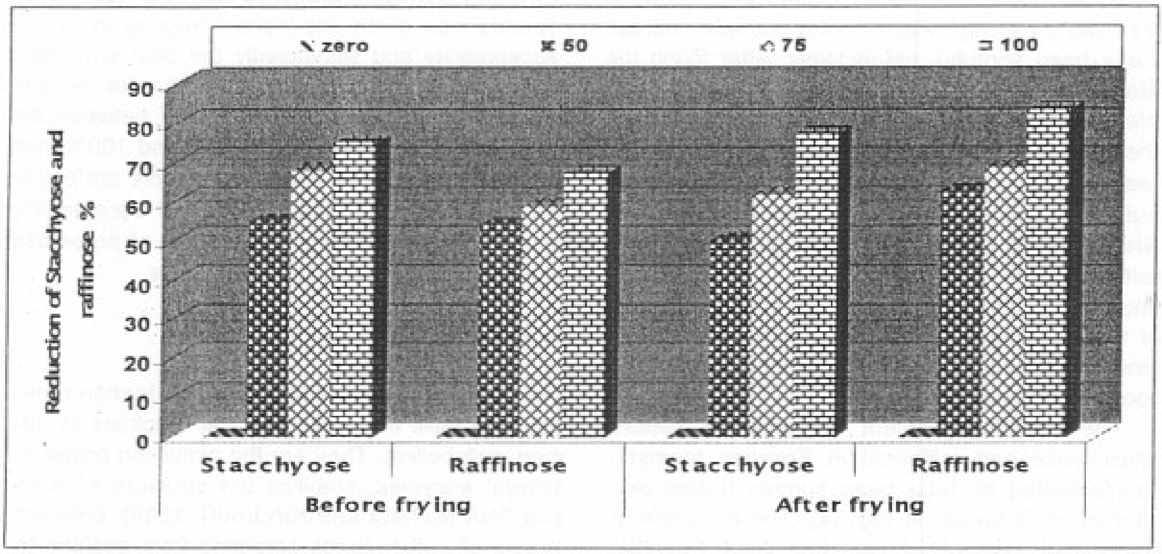

Figure 4. Reduction of stacchyose and raffinose contents in Egyptian taamyah substituted by different ratios of four days faba bean sprouts before and after frying

Table 4. Means value of sensory properties of Egyptian taamyah substituted by different ratios of four days faba bean sprouts

Substituted ratio of faba bean sprouts (%)	Means* value of sensory properties				
	Color	Odor	Taste	Texture	Overall acceptability
Zero (control)	7.6^{B}	8.0^{B}	7.6^{B}	7.7^{B}	7.5^{B}
50	8.5^{A}	8.6^{AB}	7.6^{B}	7.3^{B}	7.7^{B}
75	8.9^{A}	8.8^{A}	8.8^{A}	8.7^{A}	8.9^{A}
100	8.5^{A}	8.6^{AB}	8.5^{A}	8.6^{A}	8.4^{A}

*: Means in a column showing the same letter are not significantly different ($p \geq 0.05$)

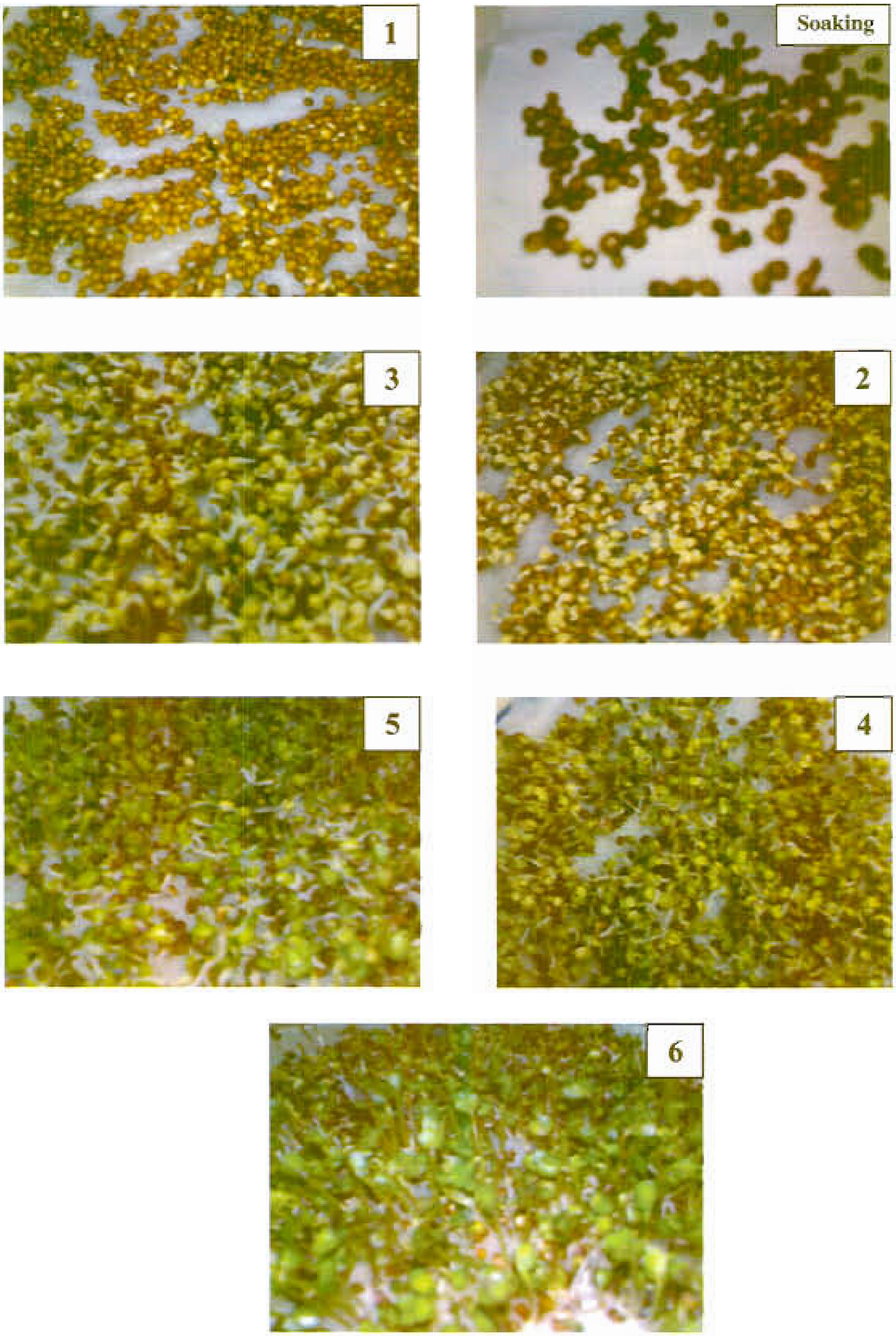

Figure 5. Sprouting days of radish seeds

Table .5 Moisture content (%) of radish seeds during sprouting

	Dry seed	Soaking seed	Days of sprouting					
			1	2	3	4	5	6
Moisture content (%)	6.20 ±0.06	45.29 ±0.30	46.05 ±0.32	50.53 ±0.37	51.65 ±0.34	52.70 ±0.36	57.69 ±0.55	60.25 ±0.46

Data expressed as mean of three replicates ± standard deviation.

it was found to be 103.59, 174.30, 222.82 and 335.65(%), respectively. We can observed that the yield increasing with increase the sprouting days of radish.

2.2. Minerals analysis of radish seed sprouts

Minerals content was followed during 6 days of sprouting of radish seeds in order to select the suitable sprouting days to provide the maximum improvement in Phosphorus, Calcium, Iron and Zinc for supplement Egyptian taamyah. Values of some minerals (Phosphorus, Calcium, Iron and Zinc) in radish seeds during 6 days of sprouting are presented in **Table (6)**. Phosphorus content in radish sprouts was markedly increased as sprouting days progressed. The highest value of Phosphorus content was observed at sixth day of sprouting (0.864%). Therefore 6 days radish sprouts were selected as a source of high Phosphorus content. The maximum content of Calcium was observed in second day of radish seed sprouts and its level was reached 1.5% compared to 0.98% in dry radish seed. However, Calcium contents increased more rapidly as sprouting days progressed until the selected day of sprouting. As sprouting days progressed, Iron and Zinc contents showed relatively moderate increment reaching their maximum (139.2 and 43.75 ppm) after 4 and 3 days of radish seed sprouting, respectively. It could be concluded that radish sprouting for 6, 2, 4 and 3 days can be selected as source of high Phosphorus (0.864%), Calcium (1.5%), Iron (139.2ppm) and Zinc (43.75 ppm) to supplement the Egyptian taamyah. Several nutritive factors such as vitamin concentrations and bioavailability of trace minerals are reported to increase during germination **(EL-Adawy, 2002)**.

2.3. Sensory evaluation of Egyptian taamyah prepared with sprouted radish seeds

The statistical analysis of sensory properties of Egyptian taamyah prepared with sprouted radish seeds supplemented by adding 10, 20 and 30 g of dried radish sprouts/100 g de-hulled faba bean after two, three, four and six days of sprouting as a source of Calcium, Zinc, Iron and Phosphorous were given in **Tables 7, 8 , 9 and 10**, respectively. It's clear from **Table (7)** that there are no significant differences between Egyptian taamyah supplemented by two days 30g dried radish sprouts as a source of calcium and the control sample in all sensory properties except overall acceptability. At the same time the Egyptian taamyah prepared with 10 and 20 g dried radish sprouts had significantly lowered of most sensory properties than control sample. Therefore, the Egyptian taamyah supplemented by 30 g dried radish sprouts is the nearest one to the control sample in its sensory properties Results in **Table (8)** showed that the sensory properties of the Egyptian taamyah supplemented with three days dry radish sprouts as a source of Zinc. There were no significant differences between Egyptian taamyah supplemented by 10g dry radish sprouts and the control sample in all sensory properties and it's the preferable one when compared with the 20 and 30g dried radish sprouts samples in overall acceptability.

Supplementation of Egyptian taamyah with Iron was carried out by adding 10, 20 and 30 g dry radish sprouts from the fourth day of sprouting. As shown in **Table (9)** no significant differences were observed in all sensory properties of control sample and that supplemented with adding 30 g of dried radish sprouts. Egyptian taamyah with 30 g dried radish sprouts was more preferable by panelists in all sensory properties than those prepared

Table 6. Minerals content of dry, soaking seeds and radish sprouts during sprouting and Egyptian taamyha

samples		(%)		(ppm)	
		P	Ca	Fe	Zn
Dry seed		0.486	0.98	59.66	33.46
Soaking seed		0.724	1.44	79.55	7.73
Days of sprouting	1	0.699	0.98	99.43	28.31
	2	0.598	1.50	99.43	33.46
	3	0.694	1.39	99.34	43.75
	4	0.653	1.15	139.2	33.46
	5	0.686	1.12	119.2	33.46
	6	0.864	1.38	59.32	30.88
Egyptian taamyah		0.431	0.83	79.55	7.73

Table 7. Means value of sensory properties of Egyptian taamyah supplemented by different levels of radish sprouts after two days of sprouting (as a source of Calcium)

Supplemented level of dried radish sprouts (%)	Means* value of sensory properties				
	Color	Odor	Taste	Texture	Overall acceptability
Zero(control)	8.9^{A}	9.0^{A}	9.0^{A}	8.8^{A}	9.0^{A}
10	8.8^{A}	7.6^{B}	7.8^{B}	8.6^{A}	8.4^{B}
20	7.9^{B}	7.4^{B}	7.1^{C}	8.4^{B}	7.3^{C}
30	8.4^{AB}	8.7^{A}	8.4^{AB}	8.5^{A}	8.2^{B}

* : Means in a column showing the same letter are not significantly different ($p \geq 0.05$)

Table 8. Means value of sensory properties of Egyptian taamyah supplemented by different levels of radish sprouts after three days of sprouting (as a source of Zinc)

Supplemented level of dried radish sprouts (%)	Means* value of sensory properties				
	Color	Odor	Taste	Texture	Overall acceptability
zero(control)	8.8^{A}	8.6^{A}	8.5^{A}	8.8^{A}	8.8^{A}
10	8.5^{A}	8.7^{A}	8.8^{A}	8.6^{A}	8.8^{A}
20	8.4^{A}	7.0^{B}	6.6^{B}	7.4^{B}	6.7^{C}
30	7.2^{B}	8.7^{A}	8.4^{A}	8.5^{A}	8.2^{B}

* : Means in a column showing the same letter are not significantly different ($p \geq 0.05$)

Table 9. Means value of sensory properties of Egyptian taamyah supplemented by different levels of radish sprouts after four days of sprouting (as a source of Iron)

Supplemented level of dried radish sprouts (%)	Means* value of sensory properties				
	Color	Odor	Taste	Texture	Overall acceptability
zero(control)	8.3^A	8.3^AB	7.9^AB	8.5^A	8.7^A
10	7.7^A	7.9^B	7.4^B	7.7^A	7.8^B
20	5.9^B	5.7^C	5.6^C	6.2^B	5.9^C
30	8.4^A	8.9^A	8.4^A	8.5^A	8.2^AB

*: Means in a column showing the same letter are not significantly different ($p \geq 0.05$)

Table 10. Means value of sensory properties of Egyptian taamyah supplemented by different levels of radish sprouts after six days of sprouting (as a source of Phosphorus)

Supplemented level of dried radish sprouts (%)	Means* value of sensory properties				
	Color	Odor	Taste	Texture	Overall acceptability
zero(control)	8.6^A	8.5^A	8.6^A	8.6^A	8.5^A
10	7.1^B	7.3^B	7.4^B	7.4^B	7.2^B
20	6.6^B	6.3^C	6.2^C	6.5^C	6.2^C
30	8.4^A	8.7^A	8.4^A	8.5^A	8.2^A

*: Means in a column showing the same letter are not significantly different ($p \geq 0.05$)

with 10 and 20 g dried radish sprouts. Similar results were obtained when Egyptian taamyah was supplemented by 6 days sprouts of radish seeds as a source of Phosphorous (**Table 10**).

From the aforementioned results it can be concluded that the best supplemented level of dried radish sprouts as a source of Zinc in Egyptian taamyah was 10 g dried radish sprouts. which, raising Zinc almost two times higher than those of control sample .While the best one as a source of Calcium, Iron or Phosphorous was when adding 30 g dried radish sprouts which, also raising Calcium, Iron or Phosphorous almost two times higher than those of control sample This means that with increasing the sprouting time the acceptability of panelists was increasing to more addition of dried radish sprouts into Egyptian taamyah.

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حوليـات العلـوم الزراعية
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إستخدام نبتات بذور الفول والفجل فى إنتاج الطعمية المصرية كغذاء وظيفى جديد

[١٩]

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الموجــــز

أجريت هذه الدراسة بهدف إستخدام نبتات بـذور الفول والفجل فى تحسين الخصائص التغذوية للطعمية المصرية. حيث تم إختيار نبتات الفول لرفع محتوى الطعمية المصرية من الأحماض الامينية وكذلك تقليل محتواها من العوامل المسببة للانتفـاخ (الاسـتاكيوز والرافينوز) ، بينمـا تـم إستخـدام نبتـات بذورالفجل لتدعيم نفس المنتج بالعناصـر المعدنيـة (الفوسفور والكالسيوم والحديد والزنك). حيث كـان المحتوى الرطوبى المبدئـى لبذور الفـول والفجـل (٪) ٠,١٧ ± ٩,١٩ و (٪) ٠,٠٥٧ ± ٦,٢٠ فـى حين وصل الـى (٪) ٠,٥٣ ± ٦٣,٦١ و (٪) ٠,٤٦ ± ٦٠,٢٥ على التوالى بعد اليـوم السـادس. ولقـد سجلت نبتات الفول أعلى محتـوى مـن الاحمـاض الامينية التالية فى اليوم الرابـع وهـى السيـستتين والليوسين والاسبارتك والايسوليوسين والفنيل الانـين وكذلك البرولين ولذلك تم إستخدام نبتات اليوم الرابع للفول فى تصنيع الطعمية المصرية بإستبدال صـفر، ٥٠، ٧٥و ١٠٠٪ نبتات الفول لليوم الرابع بـدلا من الفول منزوع القشرة (الفول المدشوش) المنقـوع. وقد لوحظ ان الطعمية المصنعة بــ ١٠٠ ٪ مـن نبتات فول اليوم الرابع قد سجلت أعلى إنخفاض فـى تركيز كلا من الاستاكيوز والرافينوز. حيث وصـلت نسبة إختزال الاستاكيوز فى الطعمية المصرية الخام والمقلية عند إستبدال ١٠٠ ٪ الى ٨٦ ، ٧٤ و ١٦ ، ٧٧ ٪ على التوالى ، بينما وصلت نـسبة إختـزال الرافينوز فى الطعمية المصرية الخام والمقلية عنـد إستبدال ١٠٠ ٪ الى٣٦ ، ٦٧ و ٣٥ ، ٨٣ ٪ على التوالى وتبعا للخواص الحسية لم يكن هناك إختلاف معنوى بين الطعمية المستبدلة بنسبة ٧٥ و ١٠٠٪ من نبتات الفول إلا أن الاولى كانـت الأفـضل لـدى المحكمين من حيث الرائحة والقبول العام. ولقـد تـم تتبع محتوى نبتات الفجل من الأملاح المعدنية خـلال ستة أيام من التنبيت وذلك لإختيـار اليـوم الأمثـل لتدعيم الطعمية المصرية فوجد أن اليـوم الـسادس والثانى والرابع بالإضافة الى اليوم الثالث يزيد مـن محتوى نبتات الفجل من الفوسفور والكالسيوم والحديد والزنك حيـث كـان محتواهـا ٠,٨٦٤ ٪ و ١,٥٪ و١٣٩,٢و ٤٣,٧٥ جزء فى المليون علـى التـوالى والتى أستخدمت لتدعيم الطعمية المصرية بإضافة ١٠ و٢٠ و٣٠ جم من نبتات الفجل المجففـة. ووجـدأن التدعيم بـ ١٠جم نبتات فجل مجففة١ ١٠٠ جـم فـول منزوع القشرة كان أفضل مستوى لتـدعيم الطعميـة بالزنك . بينما إضافة ٣٠ جم من نبتات الفجل المجففة كانت الأفضل كمصدرللفوسفور والكالسيوم والحديـد ولقد لوحظ زيادة القبول العام للطعمية المصرية مـع زيادة مدة التنبيت والكمية المضافة للتدعيم بالعناصر المعدنية من نبتات الفجل .

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