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EFFECT OF COOKING METHODS ON NUTRITIONAL QUALITY OF FABA BEAN

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ABSTRACT

Faba bean products ,i.e., Medammis, Bissara, Nabet soup, Falafel, green faba bean and cooked green faba bean were evaluated for its nutritional value . The obtained results revealed that green faba bean and cooked green faba bean contained the highest amount of tannins and phytic acid followed by dry faba bean , while Falafel and Bissara products showed the lowest contents. Green faba bean and dry faba bean showed the highest contents of trypsin inhibitor followed by cooked green faba bean, while other products showed the lowest contents. The results also indicated that Falafel, Bissara and dry faba bean showed the highest values of essential and non essential amino acids followed by Nabet soup, then Medammis, while cooked and uncooked green faba beans showed the lowest values. Concerning protein utilization, the obtained results indicated that Bissara, Falafel and Nabet soup products showed the highest values of TD, BV and NPU, while cooked green faba bean , green faba bean and Medammis products showed the lowest values . These obtained results revealed that the pretreatments practiced for preparation of these products and cooking method were found to have great effect on antinutrional factors and substantialy on the nutritive value of the products.

INTODUCTION

Faba bean (Vicia faba L) is an important food in many countries such as China, Egypt, Italy, Brazil and Ethiopia. It is known by a variety of common names such as field bean, broad bean, horse bean, tick bean, windsor bean and others. It belongs to the family leguminosae (Fabaceae) (Adsule and Akpapunam, 1996).

Faba bean forms an important part of peoples diet in developing countries. It is consumed in the form of immature tender pods, green mature seed or as dry seeds after cooking. The method of cooking and consumption differ widely according to the geographical location. Some of the popular faba bean dishes in Egypt include Fool Medammis, Taamia or Falafel and Fool Nabet (Askar, 1986).

Faba bean seeds have a relatively high protein content with low nutritional quality (Palmer and Thompson, 1975). Raw faba bean seeds were reported to contain antinutritional factors such as protease inhibitors, tannins, favism – inducing factors, haemagglutinins , flatus producing factors and phytates (Adsule and Akpapunam, 1996).

The present investigation was carried to study the antinutritional factors contents and the biological value of the different faba bean products which are widely consumed in Egypt.

MATERIALS AND METHODS

Materials

Dry and fresh faba beans (Vicia faba) Var. Giza-2- , the most common variety in Egypt, were obtained from the Legume Research Section, Agriculture Research Center , Ministry of Agriculture, Giza Egypt.

Methods

1-Preparation of faba bean products :

Faba bean samples (the whole and dehulled seeds) were subjuted to the following processes:

Soaking and germination processes were carried out as reported by **Ghada Youssef (1999).**

Cooked green faba bean was prepared by blanching the whole green faba bean horns in boiled water at the ratio of 1:1.5 W/V for 75 min with addition of 10 gm salt and 7 gm cumin in an aluminium pan.

Medammis product was prepared according to the method described by **Ghada Youssef (1999).**

Nabet soup, Falafel and Bissara products were prepared according to the method described by **Bakr and Bayomy (1997).**

Faba bean products were dried at 60^{o}C for 18 hours in an electric air draught oven. The dried products were ground to pass through a 70 mesh sieve, packed into air- tight jars and kept at 4 ^{o}C. until analysis.

2-Determination of amino acids contents :

-Amino acid determination except for tyrosine and tryptophan was preformed according to the method of **the Official Journal of the European Communities 19-9-98.**

-The system used for the analysis was high performance Amino Acid Analyzer, Beckman 7300 in Regional Center for Food and Feed, Agriculture Research Center, Cairo, Egypt.

3- Determination of antinutritional factors:

-Tannins contents were determined according to the method of Price *et al.*,(1978).

-Phytic acid contents were determined according to the method of Wheeler and Ferrel(1971).

-Trypsin inhibitor was determined according to the method of Kakada *et al*., (1969).

4- **Biological evaluation:**

Biological evaluation of the processed products and green faba bean was carried out according to the procedures described by Eggum(1973)using adult male albino rats (90 animals) in 18 groups each of 5 rats. The experiment was spread over a period of 9 days. The rats were fed 150 mg N and 10 g dry matter per rat per day. The amount of dry matter was adjusted with N- Free diet supplied with vitamins and minerals. Nitrogen of urine and feces was determined according to the method described in A. O. A.C. (2002). True digestibility (T.D.), Biological value (B.V.) and net protein utilization (NPU) values were calculated according to the following equation:-

$$TD = \frac{\text{N intake} - (\text{Faecal N} - \text{metabolic N})}{\text{N intake}} * 100$$

$$BV = \frac{\text{N intake} - (\text{Faecal N} - \text{metabolic N}) - (\text{urinary N} - \text{endogenous})}{\text{N intake} - (\text{Faecal N} - \text{metabolic N})} * 100$$

$$NPU = \frac{T.D. * B.V.}{100}$$

where:
N=nitrogen

-Statistical analysis of the obtained results was carried out according to the method of Snedecor and Cochran (1980) using SAS program (1987) and IBM PC computer.

RESULTS AND DISCUSSION

1-Amino acids contents of raw materials:

Amino acids content of raw materials under study were determined and the obtained results are presented in Tables (1 and 2) From these results it could be noticed that Falafel, Bissara and dry faba bean showed the highest values for essential amino acids contents followed by Nabet soup then Medammis, while green faba bean and cooked green faba bean showed the lowest values. The same trend was also observed for nonessential amino acids. Youssef *et al.,* (1986) reported that severe heat processing, such as that used in the stewing process for Medammis, drastically lowered some of the essential amino acids. This decline was explained by El-Mahdy(1974) on the basis of the effect of the prolonged heat treatment on the protein and their possible reactions with the reducing components or phenolic compounds of the beans. Youssef *et al.,* (1986) reported also that preparation of Bissara has improved the amino acid pattern, which can be attributed to advantages of the decortication process and addition of other ingredients to formulate Bissara. .Khalil (2001) found that germination of faba beans increased the total essential amino acid. Since tryptophane and tyrosine were not determined in our study, we compared our findings of essential amino acids, excluding the two mentioned amino acids, with FAO provisional pattern 1985. We found that the first limiting amino acid were methionine and cystine which were similar to (Marquardt and Campell, 1975) and El-Shemy (1996) who found that methionine and cystine were the first limiting amino acid in bean proteins. Supplementation of diets of faba bean with sulphur amino acids can improve its nutritional quality.

Table 1: Essential amino acids contents of faba bean products (gm of amino acid per 16gm of protein nitrogen).

Essentialamino acids	dry faba bean	Medammis	Nabet soup	Falafel	Bissara	Green faba bean	Cooked green faba bean
Methionine	0.78	0.82	1.06	0.99	1.26	0.94	0.86
Threionine	3.50	3.56	3.52	4.33	4.29	2.49	2.40
Cystein	1.67	1.29	1.43	1.3	1.3	1.89	1.29
Valine	4.35	4.20	4.38	4.33	4.3	3.30	3.25
Isoleucine	3.77	3.51	3.37	4.39	4.11	2.76	2.53
Leucine	6.90	6.59	6.96	6.98	6.2	4.55	4.42
Phenylalanine	4.22	3.22	3.62	4.09	3.9	2.19	2.07
Lysine	6.08	5.98	6.28	6.47	6.22	4.35	4.03
Total determined essential amino acids	31.27	29.17	30.62	32.88	31.58	22.47	20.85

Table 2:Non essential amino acids contents of faba bean products (gmof amino acid per16 gm of protein nitrogen)

Non essentialamino acids	dry faba bean	Medammis	Nabet soup	Falafel	Bissara	Green faba bean	Cooked green faba bean
Aspartic	10.66	10.06	10.86	10.52	10.15	9.47	9.25
Serine	4.56	4.62	4.66	4.04	4.24	2.80	3.39
Glutamic	18.64	15.68	15.81	18.76	18.77	9.74	9.32
Proline	3.39	3.80	4.44	3.94	3.92	2.83	2.75
Glysine	4.47	4.02	3.66	4.5	4.3	2.73	2.70
Alanine	4.81	4.00	4.17	4.94	4.39	5.73	5.14
Histidine	2.13	2.38	2.20	2.42	2.44	1.69	1.60
Arginine	8.28	7.76	7.76	9.53	9.59	6.03	6.02
Total nonessential amino acids	56.94	52.32	53.56	58.65	57.80	41.02	40.17
total determined	88.21	81.49	84.18	91.53	89.38	63.49	61.02

2- Antinutritional factors of faba bean products

Tannins, phytic acid and trypsin inhibitor, the major antinutritional factors of faba bean were determined and the obtained results are shown in Table (3) on dry weight basis.

Table (3): Antinutrittional factors contents of faba bean products

Products	Total tannins (%)	Phytic acids (%)	Trypsin inhibitor Mg/100g
Dry faba bean	0.89	0.61	350
Medammis	0.55	0.35	50
Nabet Soup	0.48	0.36	42
Falafel	0.33	0.20	34
Bissara	0.33	0.25	40
Green faba bean	1.16	0.99	380
Cooked green faba bean	1.00	0.80	240

From the results presented in Table (3) it could be observed that green faba bean, cooked green faba bean and dry faba bean showed the highest contents for tannins and phytic acid, followed by Medammis and Nabet soup, while Falafel and Bissara showed the lowest contents for the same components. Concerning trypsin inhibitor, green faba bean and dry faba bean showed the highest contents followed by cooked green faba bean. However, Medammis , Nabet soup, Bissara and Falafel showed the lowest contents of

trypsin inhibtor. Thorn *et al*., (1983) found that heat treatment reduced the activity of trypsin inhibitor in legumes by about 97%. Ologhobo and Fetuga (1984) reported that some processes, such as soaking, germination and cooking, were found to be most effective in decreasing phytate content and/or eliminate the phytic acid in legumes. Ziena (1989) found that up to 10% of the total tannins were decomposed by heat treatment during cooking of faba bean. Similar results were also reported by Vijayakumari *et al.,* (1996). They found that autoclaving of faba beans for 45 min lead to reduce tannins and phytic acid contents by about 71% and 44%, respectively. Soaking, germination and dehulling processes were also found to be effective in reducing trypsin inhibitor and phytic acid contents (Shekip et al., (1989) and Sharma and Seghal, (1992).

3-Biological evaluation of different faba bean products :

Growing albino rats were fed on various faba bean products, i.e., Medammis, Falafel, Bissara, Nabet soup, cooked green faba bean and green faba bean in addition to casein diet for comparison. The nutritional quality of these different diets was evaluated and the true digestibility (TD), biological value (BV) and net protein utilization (NPU) values were calculated. The obtained results are shown in Table (4).

Table (4): Biological effect of different faba bean products

Source of protein	True digestibility % (TD)	Biological value % (BV)	Net protein utilization %(NPU)
Medammis	74.16 ^{hi} ± 3.78	61.56 ^{bcdef} ± 7.35	45.76 ^{ef} ± 6.83
Falafel	90.33 ^{bcd} ± 2.52	72.50 ^{ab} ± 15.77	65.58 ^{ab} ± 14.55
Bissara	87.84 ^{def} ± 0.90	65.82 ^{abcde} ± 15.01	57.80 ^{bcd} ± 12.98
Nabet Soup	84.54 ^{f} ± 5.55	64.50 ^{abcde} ± 13.08	54.50 ^{bcde} ± 7.63
Green faba bean	68.79 ^{j} ± 5.39	56.72 ^{cdef} ± 11.40	39.02 ^{f} ± 10.15
Cooked green faba bean	72.12 ^{ij} ± 2.01	53.85 ^{def} ± 5.86	38.82 ^{f} ± 4.45
Casein	97.48 ^{a} ± 0.87	76.68 ^{a} ± 4.79	74.74 ^{a} ±4.59
L.S.D. $_{(0.05)}$	* 4.220	*** 11.663	** 9.851

Each value is the mean of 5 replicates; Means ± Standard error; Means in the same column with the same letter are not significantly different at P< 0.05; **: Highly significant values; *: Low significant values.

From the results presented in Table (4) it could be noticed that TD value of casein was 97.48% followed by Falafel (90.33%) then Bissara (87.84%) and Nabet soup (84.54%). Medammis, cooked green faba bean and green faba bean products showed the lowest TD Values i,e.74.16, 72.12 and 68.79%, respectively. The results of statistical analysis showed that all TD values of faba bean products were significantly different from casein diet . However no significant difference was observed between TD values of Falafel and Bissara products. The same trend was also found for TD values of Nabet soup and Bissara. Concerning BV , the obtained results indicated that Falafel , Bissara and Nabet soup were found to be not significantly different from that of casein diet while Medammis, green faba bean and cooked green faba bean showed significant differences in comparison with casein diet.

The results in the same Table indicated also that NPU of Falafel (65.58%)was not significantly different from that of casein (74.74%), while the

other studied products showed significant differences in compared to casein. However, no significant difference was observed for NPU values of Nabet soup, Falafel and Bissara. The same trend was observed for Medammis, green faba bean and cooked green faba bean. However, these results revealed that cooked green faba bean , green faba bean and Medammis products showed the lowest TD, BV and NPU values compared to other products .This might be due to its higher content of tannins (Table 3). It was reported that higher levels of tannins may have depressed the utilization of dietary protein by interacting with proteins to form indigestible compound, by inactivating proteolytic enzymes, by interference with the epithelial protective mucus of the intestine or by altering the absorption of digested nutrients OH and Hoff (1989). On the other hand , Bissara, Falafel and Nabet soup products showed the highest values of TD,BV and NPU . This could be related to the pretreatments practiced for preparing these products, such as soaking, germination and dehulling which lead to improve the nutritional value and caused a significant decrease in the antinutritional factors (Bakr, 1996).

From the obtained results it could be concluded that pretreatments practiced and cooking methods were found to have great effect on the nutritional quality of faba bean products and the products which were prepared from dehulled, soaked and germinated faba bean might be the best from the nutritional standpoint. The habit of consuming green faba bean should be limited.

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تأثير طرق الطبخ على الجودة الغذائيه لمنتجات الفول البلدى

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تم دراسة القيمه الغذائيه لمنتجات الفول البلدى مثل الفول المدمس والبصارة وشوربة الفول النابت والطعميه والفول الأخضر والفول الأخضر المطبوخ وتبين من النتائج أن الفول الأخضر والفول الأخضر المطبوخ أعلى قيمة فى المحتوى من التانينات وحمض الفيتك يلى ذلك الفول الجاف بينما أظهرت النتائج أن منتجات الطعميه والبصاره أقل قيمه.

كما لوحظ ان الفول الأخضر والفول الجاف أعلى قيمه فى المحتوى من مثبطات التربسين ويلى ذلك الفول الأخضر المطبوخ . بينما لوحظ ان المنتجات الأخرى أظهرت قيما أقل .

المحتوى من الأحماض الأمينيه الأساسيه وغير الأساسيه كان أعلى فى الطعميه والبصارة والفول الجاف عنها فى شوربة الفول النابت والفول المدمس بينما لوحظ أن الفول الأخضر المطبوخ وغير المطبوخ أظهرت قيمة أقل.

أما فيما يخص الإستفاده الفعليه من البروتين فإن النتائج المتحصل عليها أظهرت أن منتجات البصارة والطعميه وشوربة الفول النابت كانت الأعلى فى القيمة الحيويه وكذلك فى البروتين المستفاد والقابلية للهضم بالمقارنة بالفول الأخضر المطبوخ والفول الأخضر والفول المدمس التى أظهرت قيما أقل لهذه المؤشرات.

وأتضح من النتائج المتحصل عليها أن المعاملات الأوليه التى تطبق أثناء إعداد هذه المنتجات وطرق الطبخ المختلفه كان لها تأثير كبير على مضادات التغذيه وبالتالى على القيمه الغذائيه لهذه المنتجات.

Table (5): Effect of potassium nitrate and ammonium sulphate on fruit chemical properties of guava trees.

Treatment	TSS (˚Brix)			Acidity (%)			TSS/Acid ratio			Ascorbic acid (mg/100g)		
	2003	2004	Mean	2003	2004	Mean	2003	2004	Mean	2003	2004	Mean
Potassium nitrate												
2%	10.00 D	10.70 D	10.35	0.46 A	0.47 A	0.47	21.84 D	22.78 D	22.31	94.30 A	105.00 B	99.65
4%	10.20 C	10.50 E	10.35	0.41 B	0.42 AB	0.42	24.88 C	25.01 CD	24.95	110.00 A	111.40 A	110.70
6%	11.00 B	11.27 BC	11.14	0.39 C	0.40 B	0.40	28.20 B	28.55 B	28.38	112.20 A	114.00 A	113.10
Ammonium sulphate												
5%	11.00 B	11.50 A	11.25	0.44 A	0.42 AB	0.43	25.61 C	27.45 BC	26.53	96.90 A	101.20 BC	99.05
10%	11.20 A	11.10 C	11.15	0.37 C	0.39 B	0.38	29.48 B	28.49 B	28.99	97.10 A	103.00 BC	100.05
15%	11.00 B	11.40 AB	11.20	0.29 D	0.30 C	0.30	37.95 A	38.32 A	38.14	110.30 A	110.00 A	110.15
Control	10.30 C	10.50 E	10.40	0.38 C	0.40 B	0.39	25.79 C	25.97 BC	25.88	98.10 A	100.50 C	99.30

Values followed by the same letter(s) within each season are not significantly different at 5 % level.

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4%	10.20 C	10.50 E	10.35	0.41 B	0.42 AB	0.42	24.88 C	25.01 CD	24.95	110.00 A	111.40 A	110.70
6%	11.00 B	11.27 BC	11.14	0.39 C	0.40 B	0.40	28.20 B	28.55 B	28.38	112.20 A	114.00 A	113.10
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10%	11.20 A	11.10 C	11.15	0.37 C	0.39 B	0.38	29.48 B	28.49 B	28.99	97.10 A	103.00 BC	100.05
15%	11.00 B	11.40 AB	11.20	0.29 D	0.30 C	0.30	37.95 A	38.32 A	38.14	110.30 A	110.00 A	110.15
Control	10.30 C	10.50 E	10.40	0.38 C	0.40 B	0.39	25.79 C	25.97 BC	25.88	98.10 A	100.50 C	99.30

Values followed by the same letter(s) within each season are not significantly different at 5 % level.