

QUALITY ATTRIBUTES OF CARROT JAM SUPPLEMENTED WITH PROTEIN CONCENTRATE OF LOOFA SEEDS

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ABSTRACT

Protein concentrate was prepared from loofa seeds and used with levels of 5,10,15,20 and 25 % to supplement carrot jams with protein to increase the nutritional value.

The chemical composition of loofa seeds and its protein concentrate were evaluated. The obtained results indicated that the loofa seeds and its protein concentrate contained high amounts of protein , which were 32.06 and 74.83 % (on DWB), respectively. The essential amino acids index (EAAI), biological value (BV) and protein efficiency ratio (PER) were calculated and compared with FAO/WHO/UNU (1985) pattern. Functional properties of protein in loofa seeds protein concentrate (L.S.P.C) were evaluated. The chemical composition of prepared carrot jam was studied. The contents of protein and energy values (K. cal./100 g sample) were increased due to increasing of (L.S.P.C) levels. Meanwhile, fat and carbohydrates were decreased.

Increasing the level of protein concentrate from loofa seeds at levels 5 -25 % caused to increase the essential amino acids, especially sulphur amino acids.

Sensory evaluation of tested carrot jam enriched with different levels of (L.S.P.C) showed greater sensory quality and preference.

Keywords: loofa (*Luffa aegyptiaca*) seeds, protein concentrate, chemical composition, amino acids and supplementation.

INTRODUCTION

There are a promising increase in plantation of loofa (*Luffa aegyptiaca*) in Egypt because of its profitable over run from the sponge and the seeds which showed higher protein content.

The total yield production from loofa fruits and seeds in Egypt are shown in Table (1).The data indicate that the total annual production of loofa fruit was about 18000 loofa produced from feddan (Ministry of Agriculture and Land Reclamation, 2010).

Table 1: Total area and yield of loofa fruit in Egypt

Items	Data
Total area (feddans)	109000
Yield (loofa fruit/feddan)	18000
Yield of seeds (g/loofa)	20 - 30
Weight of seeds (g/loofa)	13.95
Percentage of hulls (%)	30.30
Percentage of kernel (%)	69.70

The previous research showed considerable amount of protein isolate and protein concentrate of loofa seeds , which may substitute the animal protein, which cannot full fill the requirements of protein needed due to population expansion.

The yield of seeds from the fruit was 33.5 %, while the kernel was found to possess 50% of the seed weight. The protein and fat contents of the kernel were 39 % and 44 %, respectively (Kamel and Blackman , 1982).

Novel sources of protein such as cereals, vegetables, legumes and microorganisms, should be systematically evaluated for their potential as food nutrients (Mona *et al.*, 1991). Adequate amounts of protein are also vital for adolescents and adults (Whitney *et al.*, 1998). Yang and Tsao (1981), reported that the seeds of loofa *cylindrica* contain 76% protein , 1.5 % sugar and 15.8 % lipid.

Jaiswal *et al.* , (1984), stated that all seeds were rich in essential amino acids and no toxic or unusual amino acid was detected.

On the other hand, Saad (1998), reported that the loofa seeds were free from any type of toxic , but, the alkali solution at 4% was used to remove the bitter taste from protein concentrate produced from the loofa seeds.

Accordingly to the same author, loofa seeds retain a suitably high protein content of relatively good quality. 90% of protein content (isolate and concentrate) may offers an excellent supplement for many foods. The seeds of this plant may be adequately available in Egypt ; since the fruit is widely used for basing (as a sponge) contains a great number of seeds, which should be removed before selling.

The objective of this study is to evaluate loofa seeds and its protein concentrate and the effect of substitution with loofa seeds protein concentrate (L.S.P.C) on quality attribute, nutritive value and sensory acceptability for carrot jam.

MATERIALS AND METHODS

Materials

loofa (*Luffa aegyptiaca*) seeds were obtained from the Crops Institute Research, Agriculture Research Center, Ministry of Agriculture and Reclamation, Giza, Egypt.

Technological methods

Preparation of loofa seeds

The fruits of loofa were opened and the seeds were cleaned and the hulls were removed manually , and floating the remainder hulls in water followed by air drying, then packaged in polyethylene bags and maintain at room temperature till used.

Preparation of loofa seeds protein concentrate (L.S.P.C)

Whole Loofa seeds (ground meal) were soaked in hexane (1: 1.5 meal: solvent w/v) for 24 hr at room temperature. After defatted meal was prepared according to the method described by Baker *et al.*, (1979) , about 80 % protein was successive extractions.

Preparation of carrot jam

Carrot jam was prepared according to the method described by El-Gindy (1982), removing the green parts of carrots, cut into small pieces, cooked with part of sugar and sufficient water. Cooking on low flame until sugar was dissolved; then (2 g/ kg carrot) of citric acid was added and heating was continued for inspissations until the T.S.S. level was near 68%. The cooking was stopped when reached 68% (T.S.S.). Loofa seeds protein concentrate (L.S.P.C) was added during jam cooking to replace 5,10,15,20 and 25% levels from carrot fruit.

Analytical methods

Moisture, protein, fat, fiber and ash contents were determined according to the methods described in the AOAC (2003). The carbohydrates were calculated by differences. Caloric values were calculated as sum of multiplying protein and carbohydrates by 4.0 and fat by 9.0 (AOAC, 2003).

Individual amino acids were determined by using (LKB 4151) Amino Acid Analyzer (Alpha plus), according to the method described by Pellett and Young (1980). Tryptophane, was determined colorimetrically after alkaline hydrolysis of loofa seeds and its protein concentrate according to the method of Blauth *et al.*, (1963).

Nutritional value for prepared jam at levels; 5,10,15,20 and 25 % of loofa seeds protein concentrate were evaluated according to (RDA, 1989). Percent satisfaction of the daily requirement of adult man in protein or energy and essential amino acids (EAA) when consuming 150 g of jam products (P.S./150 %) were also calculated.

Amino acids scores (AS) were calculated according to the formula reported by FAO/WHO/UNU (1985) reference protein as follows:

$$A.S = \frac{\text{EAA (g/16g N) of test protein}}{\text{EAA (g/16g N) of the pattern}}$$

Essential amino acid index (EAAI) and biological value (B.V.) were calculated according to Oser (1995). Also, protein efficiency ratios (PER) were calculated using by three equations as described by Alsmeyer *et al.*, (1974) as follows:

$$\text{PER 1} = 0.684 + 0.456 (\text{Leucine}) - 0.047 (\text{Proline}).$$

$$\text{PER 2} = 0.468 + 0.454 (\text{Leucine}) - 0.150 (\text{Tyrrosine}).$$

$$\text{PER 3} = 1.816 + 0.435 (\text{Methionine}) - 0.780 (\text{Leucine}) + 0.211 (\text{Histidine}) - 0.944 (\text{Tyrrosine}).$$

The functional properties of the loofa seeds protein concentrate (L.S.P.C) were studied. In this concern nitrogen solubility index (NSI) of (LSPC) was determined according to the method described by Thompson *et al.* (1982), whereas emulsion capacity (EC) and emulsion stability (ES) were determined according to the method of Marshall *et al.*, (1975), foaming capacity (FC) and foaming stability (FS) were determined by Dipak and Mukherjee (1986) method. Water and oil absorption (WOA) and water oil absorption index (WOAI) were determined according to the method of Beuchat (1977).

Sensory evaluation

Sensory was applied organoleptically by ten well-trained panelists, according to Watts *et al.*, (1989). Analysis of variance were conducted in accordance with procedures described by Steel and Torrie (1980).

Signification differences between treatments means were determined using Duncan's (1985).

RESULTS AND DISCUSSION

Chemical composition of loofa seeds and its protein concentrate

Results in Table (2) shows the change in chemical composition in loofa seeds and its protein concentrate.

Results revealed that the contents of protein , fat , ash, crude fiber and carbohydrates were 32.06,14.77,1.85, 0.94 and 50.38 % and 74.83, 0.87,1.85,0.63 and 21.82% (DWB) in loofa seeds and its protein concentrate, respectively.

Results, also indicate that , loofa seeds contain higher amounts of fat , fiber and carbohydrates than protein concentrate. These results showed higher energy value in loofa seeds compared with its protein concentrate, which were 420.21 and 367.41 k.cal./100g, respectively. This can be explained by the higher fat and carbohydrates.

The nutritional evaluation (GDR= grams consumed to meet the daily requirements of adult man in protein or energy) and (P.S./150 = percent satisfaction of the daily needs of adult man in protein or energy when consuming 150 g of the product.) for protein values consumed by adult man were 216 g ,69% and 90 g and 166% for loofa seeds and its protein concentrate, respectively.

Table 2: Proximate composition of loofa seeds and its protein concentrate

Constituents (%)		Loofa seeds	Protein concentrate of loofa seeds
Moisture	WW	9.18	6.85
	DW	----	----
Protein	WW	29.12	69.70
	DW	32.06	74.83
Fat	WW	13.41	0.81
	DW	14.77	0.87
Ash	WW	1.68	1.72
	DW	1.85	1.85
Fiber	WW	0.85	0.59
	DW	0.94	0.63
Carbohydrates	WW	45.76	20.33
	DW	50.38	21.82
Energy value (k.cal./100 g)	WW	420.21	367.41
	DW	----	----
GDR for protein (g)	WW	216	90
	DW	----	----
GDR for energy (g)	WW	690	789
	DW	----	----
P.S./ 150 for protein (%)	WW	69	166
	DW	----	----
P.S./150 for energy (%)	WW	22	19
	DW	----	----

W.W.: Wet weight basis. D.W.: Dry weight basis.

G.D.R.: grams consumed to meet the daily requirement of adult man in protein or energy.

P.S./150 : percent satisfaction of the daily needs of adult man in protein or energy when consuming 150 g of the product.

Amino acid composition of loofa seeds and its protein concentrate:

Results of the amino acids for loofa seeds and its protein concentrate are found in Tables (3 and 4), There were no noticeable changes found, since histidine recorded the lowest amino acid score (A.S) compared to other essential amino acids (E.A.A).

However, histidine content was higher with about 2 times more than in case of FAO/WHO/UNU (1985) reference. (A.S.) values were 1.49 and 1.48 for protein of loofa seeds and its protein concentrate, respectively, but were rich in phenylalanine+ tyrosine (A.S. = 3.98 and 3.85) , respectively.

Anyhow, the loss of protein quality during preparation of protein concentrates as indicated by (B.V.) calculation. (B.V.) for proteins of loofa seeds and its protein concentrate were 70.52 and 62.65 % , respectively. Also, it could be observed that the (EAAI) and (BV) for loofa seeds protein concentrate were decreased compared with loofa seeds, due to expected damage occurred in the essential amino acids during preparation.

Results in Table (4) indicated the amino acids content of loofa seeds and its protein concentrate as (g /100 g sample). Also, in this table, GDR values for EAA were calculated. Thus, the protein concentrate caused to increase the nutritional value.

Table 3: Amino acids content of loofa seeds and its protein concentrate

Amino acids content	FAO/WHO/UNU (1985) reference g / 16 g N	Loofa seeds		Protein concentrate of loofa seeds	
		g /16 g N	A.S	g /16g N	AS
Leucine	1.9	6.50	3.42	5.97	3.14
Isoleucine	1.3	4.09	3.15	4.05	3.12
Lysine	1.6	3.86	2.41	3.61	2.26
Methionine		1.82		1.73	
Cystine		1.43		1.38	
Phenylalanine		4.90		4.74	
Tyrosine		2.67		2.58	
Threonine	0.9	3.19	3.54	3.02	3.36
Tryptophan	0.5	1.55	3.10	1.50	3.00
Valine	1.3	4.59	3.53	4.51	3.47
Arginine		19.10		18.85	
Histidine	1.6	2.38	1.49	2.37	1.48
Alanine		4.56		4.03	
Glutamic		17.21		15.39	
Glycine		5.43		5.32	
Aspartic		8.32		8.13	
Proline		5.45		5.09	
Hydroxyproline		0.43		0.40	
Serine		4.35		4.29	
Methionine + cystine	1.7	4.25	2.50	3.11	1.83
Phenylalanine+ tyrosine	1.9	7.57	3.98	7.32	3.85
EAAI		75.46		68.24	
B.V. %		70.52		62.65	
PER ₁		2.06		1.84	
PER ₂		2.20		1.97	
PER ₃		2.03		1.66	

A.S = amino acid scores.

B.V. = biological value.

E.A.A.I.= essential amino acid index.

P.E.R 1,2,3 = protein efficiency ratios.

Table 4: Amino acids content of loofa seeds and its protein concentrate (g /100 g sample).

Amino acids content	Daily requirement of man in (g)	Loofa seeds		Protein concentrate of loofa seeds	
		g / 100 g sample	G.D.R.* (g)	g / 100 g sample	G.D.R (g)
Leucine	1.197	1.89	63	4.16	29
Isoleucine	0.819	1.19	69	2.82	29
Lysine	1.008	1.12	90	2.52	40
Methionine		0.53		1.21	
Cystine		0.42		0.96	
Phenylalanine		1.43		3.30	
Tyrosine		0.78		1.80	
Threonine	0.567	0.93	61	2.10	27
Tryptophan	0.315	0.45	70	1.05	30
Valine	0.819	1.34	61	3.14	26
Arginine		5.56		13.14	
Histidine	1.008	0.69	146	1.65	61
Alanine		1.33		2.81	
Glutamic		5.01		10.73	
Glycine		1.58		3.71	
Aspartic		2.42		5.67	
Proline		1.59		3.55	
Hydroxyproline		0.13		0.28	
Serine		1.27		2.99	
Methionine + cystine	1.071	0.95	113	2.17	49
Phenylalanine + tyrosine	1.197	2.30	52	5.10	23

*G.D.R.: grams consumed to meet the daily requirements of adult man in individual essential amino acids.

Also, the results showed that the (G.D.R) values were extremely less showing higher nutritional value of protein concentrate compared to that of seeds (Table 4). From these results , it could be noticed that highest G.D.R. was found for histidine (146 g) for loofa seeds , while the lowest value was found for phenylalanine + tyrosine (52 g). Also, from the same table , the G.D.R. for loofa seeds protein concentrate were decreased compared with loofa seeds.

Functional properties of protein in loofa seeds protein concentrate

The data of nitrogen solubility index (NSI) of the loofa seeds protein concentrate (L.S.P.C) as a function of pH are presented in Table (5). When the pH value moved away from the iso-electric point at both sides, nitrogen solubility was increased. Results showed that a minimum solubility at pH 4.5 which might be the iso-electric point of protein in the loofa seeds protein concentrate (L.S.P.C). The solubility of protein was increased by rising or decreasing the pH value. The higher solubility of protein was noticed at pH 1.5 (27.98) and at pH 9.0 was (39.09). These results are similar with Hussein (1997), who found that at the same pH (9.0), fish wastes protein solubility was higher.

Results presented in Table (5) indicated that, the water absorption (WA), oil absorption (OA) by 100g of (LSPC) , as well as, the calculated water/oil absorption index (WOAI) for loofa seeds protein concentrate (L.S.P.C). It could be observed that WA, OA and WOAI for (LSPC) were 298.23, 90.56 g/100g dry sample and 3.29 g water/ml oil , respectively.

The results in Table (6) show the emulsion capacity (EC) and emulsion stability (ES) of the loofa seeds protein concentrate (L.S.P.C) as function of pH. The emulsion capacity ranged from (65 – 78 ml oil/g protein) at pH 4.5 and 9.0, respectively. The lowest (EC) was found at pH 4.5 ,while , the higher value was recorded at pH (9.0). Also, least (ES) was found at pH (4.5), while, higher ES value was found at pH (9.0).

Foaming capacity (FC) and foaming stability (FS) as function of pH presented in Table (7). The results indicated that the (FC) value was higher at pH 1.5, while, it was lower at pH 4.5. Also, foam stability (FS) of the loofa seeds protein concentrate (L.S.P.C) was lower at pH 4.5 recorded and highest values at pH 9.0.

Table 5: Some physical characteristics of protein concentrate from loofa seeds (L.S.P.C.)

Indices	pH values					
	1.5	3.0	4.5	6.0	7.5	9.0
(N.S.I.)*	27.98	26.20	22.71	23.59	24.08	39.09
Treatments	Water absorption (g H ₂ O/100 g dry sample)		Oil absorption (ml oil /100 g dry sample)		WOAI ** (g water/ml oil)	
(L.S.P.C.)	298.23		90.56		3.29	

(N.S.I.): nitrogen solubility index

**WOAI =water /oil absorption index.

Table 6: Emulsion capacity (EC) and emulsion stability (ES) as a function of pH dispersed in 1 % of protein concentrate from loofa seeds (L.S.P.C.)

Values (pH)	(EC) (ml oil / g protein)	(Emulsion stability, ES)							
		Aqueous phase (cm ³) separated at room temperature (18°C) after time (hr)							
		0	0.25	0.50	1.0	2.0	3.0	24.0	48.0
1.5	75	0	0	0	0	10	15	35	30
3.0	74	0	0	0	0	10	10	25	25
4.5	65	0	0	0	0	9	9	10	20
6.0	67	0	0	0	0	10	15	15	25
7.5	72	0	8	8	16	18	18	23	61
9.0	78	0	8	12	13	18	20	25	65

Table 7: Foam capacity (FC) and foam stability (FS) as a function of pH dispersed in 1 % of protein concentrate from loofa seeds (L.S.P.C.).

Values (pH)	(FC) volume inc. %	Foam stability (%) at room temperature after time (min.)										
		0	5	10	20	30	40	50	60	70	90	120
1.5	568	79	65	52	44	42	42	31	25	25	25	25
3.0	213	68	62	53	51	51	50	50	48	45	45	45
4.5	123	58	47	36	36	36	27	21	19	19	17	17
6.0	153	60	49	47	46	46	38	38	36	36	36	36
7.5	248	78	71	68	65	63	60	56	56	56	56	56
9.0	358	92	80	75	73	73	69	66	66	65	63	62

These results of functional properties for protein were in agreement with Hussein (1994), for tomato seeds protein.

Chemical composition of carrot jam enriched with different levels of protein concentrate from loofa seeds

The chemical composition of carrot jam enriched with different levels of loofa seeds protein concentrate (L.S.P.C) were shown in Table (8). Results indicated that levels of loofa seeds protein concentrate (L.S.P.C) caused to increase the protein and decreased other constituents.

The moisture content decreased slightly in carrot jam due to the increasing level of loofa seeds protein concentrate (L.S.P.C). The initial protein content in control jam was 5.37 % (DWB) , which increased to 14.53 and 16.02 % (DWB) at level of 20 and 25 % loofa seeds protein concentrate (L.S.P.C), respectively.

Results in Table (8), also showed that the fat content slightly decreased from 3.15 to 2.46 % (DWB), whereas, energy values (k.cal./100g) increased from 283.71 to 301.69 k.cal./100g for control and enriched jam with 25 % of loofa seeds protein concentrate , respectively.

Also, from the same Table (8) ,it could be seen that by increasing the P.S./150 g for protein , the increment was 29 % at 25% loofa seeds protein concentrate (L.S.P.C) comparing with 9% for control sample. On contrary, GDR value for protein decreased from 1645 to 512 g , respectively.

Table 8: Proximate chemical composition of carrot jam enriched with different levels of protein concentrate from loofa seeds (L.S.P.C.).

Samples (level of L.S.P.C)	Chemical composition											
	Moisture %	Protein %	Fat %	Ash %	Fibers %	Carbohydrates %	Energy value (k.cal. / 100 gm)	GDR for protein g	GDR for energy g	P.S./150 for protein %	P.S./150 for energy %	
Control	WW	28.64	3.83	2.25	2.63	1.11	61.54	283.71	1645	1022	9	14.67
	DW	----	5.37	3.15	3.69	1.56	86.23	----	----	----	----	----
5 %	WW	27.57	5.12	2.18	2.67	1.08	61.38	285.62	1230	1015	12	14.77
	DW	----	7.07	3.01	3.69	1.49	84.74	----	----	----	----	----
10 %	WW	26.48	7.42	2.11	2.64	1.06	60.29	289.83	849	1001	18	14.99
	DW	----	10.09	2.87	3.59	1.44	82.01	----	----	----	----	----
15 %	WW	25.39	9.71	2.03	2.69	1.03	59.15	293.71	649	987	23	15.19
	DW	----	13.01	2.72	3.61	1.38	79.28	----	----	----	----	----
20 %	WW	24.30	11.00	1.96	2.72	1.01	59.01	297.68	573	974	26	15.40
	DW	----	14.53	2.59	3.59	1.33	77.96	----	----	----	----	----
25 %	WW	23.21	12.30	1.89	2.75	0.98	58.87	301.69	512	961	29	15.60
	DW	----	16.02	2.46	3.58	1.28	76.66	----	----	----	----	----

W.W.: Wet weight basis.

D.W.: Dry weight basis.

G.D.R.: grams consumed to meet the daily requirement of adult man in protein or energy.

P.S./150 :percent satisfaction of the daily needs of adult man in protein or energy when consuming 150 g of the product.

Amino acids content in carrot jam enriched with different levels of protein concentrate from loofa seeds

Table (9) show that with increasing levels of loofa seeds protein concentrate (L.S.P.C) in jam , amino acids such as, leucine, isoleucine, lysine, phenylalanine, tyrosine, therionine, tryptophane, valine and arginine were increased , while, the sulpher amino acids were low in loofa seeds protein concentrate (L.S.P.C),which caused decrease in some amino acids owing to different levels, such as, alanine, glutamic acid, glycine and aspartic acid. From these results, it could be observed that hydroxyproline was present in protein concentrate carrot jam samples ,while, it was absent in control sample, this because the connective tissue protein (of loofa seeds) is usually contained a little amount in hydroxyproline (and rich in proline), which was also reported by Askar *et al.* (1982).

Values of amino acids score(A.S.) were less than two in control jam expressed as histidine and sulpher amino acids, this indicating that the jam less protein content than the amino acids in protein of FAO/WHO/UNU (1985), reference. But ,the adding different levels of loofa seeds protein concentrate (L.S.P.C),(A.S) of protein was increased in carrot jam, except for tryptophane. On the other hand, calculated EAAI,BV and PER values were increased progressively with increasing the levels of loofa seeds protein concentrate as seen in Table (9). Nevertheless, EAAI and BV in jam contained loofa seeds protein concentrate (L.S.P.C) were considerably higher than that in control sample (55.89 and 49.19%), respectively. Thus, our results indicated that the improvement of protein quality was occurred due to adding different levels of loofa seeds protein concentrate (L.S.P.C) ,which caused increasing for both EAAI and BV values.Also, from the results given in Table(10) show the amino acids composition of jams as (g/100g sample), it could be noticed that the percentage of loofa seeds protein concentrate (L.S.P.C) increased the essential amino acids content in prepared jams.

In addition, the results in Table (10) indicated that adding loofa seeds protein concentrate (L.S.P.C) increased nutritional value. Results also indicated that the daily requirements of histidine seems to be low in jams contained loofa seeds protein concentrate (L.S.P.C) compared with other essential amino acids. Also, it could be cleared that the P.S./150 values were low for control jam (10 – 27%), while, it was higher (42 – 99%) for jams supplemented with 25% of loofa seeds protein concentrate (L.S.P.C).

Conclusively, adding different levels of loofa seeds protein concentrate (L.S.P.C) to carrot jam caused to improve the nutritional and biological values of jams.

Organoleptic evaluation of prepared carrot jam

Data presented in Table (11) shows the average scores for aroma, taste, color, texture and overall acceptability. It is evident that the jam contained 25% (L.S.P.C) recorded the lowest scores of overall acceptability. Also ,the lowest score of color and texture was recorded in jam contained 25%. On the other hand, a very good score for all characteristics were noticed in jam enriched with 5,10 and 15% loofa seeds protein concentrate (L.S.P.C).

Therefore, jams enriched with 5,10 and 15% of loofa seeds protein concentrate(L.S.P.C) added food quality attributes.

Conclusively, enriched carrot jam up to 15 % loofa seeds protein concentrate(L.S.P.C) was suitable for production of jams contained high amount of protein.

Table 11: Organoleptic evaluation of carrot jam enriched with protein concentrate from loofa seeds (L.S.P.C.).

Characteristics	Level of L.S.P.C. (%)					
	Control	5 %	10 %	15 %	20 %	25 %
Aroma	9 ^a	9 ^a	9 ^a	9 ^a	9 ^a	9 ^a
Taste	9 ^a	9 ^a	9 ^a	9 ^a	9 ^a	9 ^a
Color	9 ^a	9 ^a	9 ^a	9 ^a	8 ^{ab}	7 ^b
Texture	9 ^a	9 ^a	9 ^a	9 ^a	8 ^{ab}	7 ^b
Overall acceptability	9 ^a	9 ^a	9 ^a	9 ^a	9 ^a	8 ^a

Means under the same line bearing different superscript letters are different significantly (P < 0.05).

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خصائص الجودة لمربي الجزر المدعمة بمركز بروتين بذور اللوف
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تم تجهيز مركز بروتين من بذور اللوف واستخدامه بنسب ٥ ، ١٠ ، ١٥ ، ٢٠ ، ٢٥ % لتدعيم مربي الجزر المصنعة بهدف إنتاج مربي غنية بالبروتين وعالية القيمة الغذائية. ولذلك فقد تم دراسة التركيب الكيميائي لبذور اللوف والمركز البروتيني منها. وأوضحت النتائج المتحصل عليها أن بذور اللوف والمركز البروتيني منها احتوت علي كميات كبيرة من البروتين حيث كانت ٣٢,٠٦ و ٧٤,٨٣ % (علي أساس الوزن الجاف) , علي التوالي. بالإضافة إلى ذلك تم حساب كل من دليل الأحماض الأمينية الأساسية والقيمة البيولوجية للبروتين وكفاءة الاستفادة من البروتين ومقارنتهما بالاحتياجات الدولية من قبل منظمة الصحة العالمية ومنظمة الأغذية والزراعة (١٩٨٥). كذلك تم تقييم الخواص الوظيفية للبروتين في مركز بروتين بذور اللوف. وأيضا تم دراسة التركيب الكيميائي لعينات المربي التي تم إعدادها ,حيث أظهرت النتائج انه بزيادة نسبة الإحلال بمركز بروتين بذور اللوف أدى إلى زيادة نسبة البروتين , بينما انخفضت نسب كل من الدهون والكاربوهيدرات , مع ملاحظة ارتفاع في مقدار الطاقة الحرارية (ك. كالورى /١٠٠ جرام) . هذا وقد وجد أنه بزيادة نسب إضافة المركز البروتيني لبذور اللوف من ٥ - ٢٥ % قد أدى إلى زيادة تركيز الأحماض الأمينية الأساسية وخاصة الأحماض الأمينية الكبريتية. وأوضحت نتائج التقييم الحسي للمربي المدعمة بمستويات مختلفة من مركز بروتين بذور اللوف حصولها على معدلات عالية للتقييم الحسي من حيث خصائص الجودة ودرجة التفضيل العالية.

قام بتحكيم البحث

كلية الزراعة - جامعة المنصورة
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Table 10: Amino acids content of carrot jam (g/100g sample) enriched with different levels of protein concentrate from loofa seeds (L.S.P.C).

Amino acids content	Daily requirement of man in g	level of L.S.P.C. (%)																	
		Control			5%			10%			15%			20%			25%		
		g/100 g sample	GDR	P.S./150	g/100 g sample	GDR	P.S./150	g/100 g sample	GDR	P.S./150	g/100 g sample	GDR	P.S./150	g/100 g sample	GDR	P.S./150	g/100 g sample	GDR	P.S./150
Leucine	1.197	0.18	665	23	0.28	428	35	0.41	292	51	0.55	218	69	0.63	190	79	0.72	166	90
Isoleucine	0.819	0.15	546	27	0.20	410	37	0.30	273	55	0.39	210	71	0.44	186	81	0.50	164	92
Lysine	1.008	0.11	916	16	0.17	593	25	0.25	403	37	0.34	296	51	0.38	265	57	0.43	234	64
Methionine		0.06			0.08			0.12			0.16			0.19			0.21		
Cystine		0.05			0.07			0.10			0.13			0.15			0.17		
Phenylalanine		0.14			0.21			0.32			0.43			0.50			0.56		
Tyrosine		0.07			0.11			0.18			0.24			0.27			0.31		
Threonine	0.567	0.10	567	26	0.15	378	40	0.22	258	58	0.29	196	77	0.33	172	87	0.37	153	98
Tryptophan	0.315	0.04	788	19	0.06	525	29	0.10	315	48	0.14	225	67	0.16	197	76	0.18	175	86
Valine	0.819	0.15	546	27	0.21	390	38	0.32	256	59	0.42	195	77	0.48	171	88	0.54	152	99
Arginine		0.30			0.68			1.13			1.57			1.86			1.76		
Histidine	1.008	0.07	1440	10	0.11	916	16	0.16	630	24	0.22	458	33	0.25	403	37	0.28	360	42
Alanine		0.28			0.29			0.53			0.47			0.51			0.55		
Glutamic		0.96			1.04			1.38			1.72			1.88			2.06		
Glycine		0.26			0.31			0.43			0.55			0.61			0.68		
Aspartic		0.58			0.60			0.97			0.95			1.03			1.12		
Proline		0.14			0.22			0.34			0.46			0.53			0.60		
Hydroxyproline		----			0.002			0.004			0.006			0.009			0.01		
Serine		0.16			0.22			0.32			0.41			0.47			0.53		
Methionine + cystine	1.071	0.11	974	15	0.15	714	21	0.22	487	31	0.29	369	41	0.34	315	48	0.38	282	53
Phenylalanine+ tyrosine	1.197	0.21	570	26	0.33	363	41	0.50	239	63	0.67	179	84	0.77	155	96	0.87	138	109

G.D.R.: grams consumed to meet the daily requirement of adult man in individual essential amino acids..

P.S./150 :percent satisfaction of the daily needs of adult man in individual essential amino acids when consuming 150 g of the product.

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Table 9 : Amino acids content of carrot jam enriched with different levels of protein concentrate from loofa seeds (L.S.P.C.).

Amino acids content	FAO/WHO/ UNU (1985) reference g / 16 g N	level of L.S.P.C. (%)											
		Control		5%		10%		15%		20%		25%	
		g/16 g N	A.S.	g/16 g N	A.S.	g/16 g N	A.S.	g/16 g N	A.S.	g/16 g N	A.S.	g/16 g N	A.S.
Leucine	1.9	4.79	2.52	5.37	2.83	5.58	2.94	5.69	2.99	5.76	3.03	5.81	3.06
Isoleucine	1.3	3.93	3.02	3.99	3.07	4.01	3.08	4.02	3.09	4.03	3.10	4.03	3.10
Lysine	1.6	2.96	1.85	3.28	2.05	3.40	2.13	3.45	2.16	3.49	2.18	3.52	2.20
Methionine		1.45		1.59		1.64		1.66		1.68		1.69	
Cystine		1.20		1.29		1.32		1.34		1.35		1.36	
Phenylalanine		3.57		4.14		4.35		4.46		4.53		4.58	
Tyrosine		1.90		2.23		2.36		2.42		2.46		2.49	
Threonine	0.9	2.72	3.02	2.87	3.19	2.92	3.24	2.95	3.28	2.97	3.30	2.98	3.31
Tryptophan	0.5	1.03	2.06	1.26	2.52	1.35	2.70	1.39	2.78	1.42	2.84	1.43	2.86
Valine	1.3	3.79	2.92	4.14	3.18	4.27	3.28	4.34	3.34	4.38	3.37	4.41	3.39
Arginine		7.81		13.22		15.21		16.20		16.86		17.30	
Histidine	1.6	1.86	1.16	2.11	1.32	2.20	1.38	2.25	1.41	2.28	1.43	2.30	1.44
Alanine		7.20		5.65		7.08		4.79		4.60		4.47	
Glutamic		25.03		20.31		18.57		17.70		17.13		16.74	
Glycine		6.72		6.03		5.78		5.66		5.57		5.52	
Aspartic		15.10		11.68		13.11		9.80		9.38		9.11	
Proline		3.72		4.39		4.64		4.76		4.84		4.90	
Hydroxproline		----		0.03		0.05		0.06		0.08		0.11	
Serine		4.14		4.21		4.24		4.25		4.26		4.27	
Methionine + cystine	1.7	2.65	1.56	2.88	1.69	2.96	1.74	3.00	1.76	3.03	1.78	3.05	1.79
Phenylalanine + tyrosine	1.9	5.47	2.88	6.38	3.36	6.71	3.53	6.88	3.62	6.99	3.68	7.06	3.72
EAAI			55.89		62.04		64.26		65.36		66.11		66.55
B.V. %			49.19		55.89		58.31		59.51		60.33		60.81
PER ₁			1.36		1.59		1.68		1.72		1.75		1.77
PER ₂			1.51		1.74		1.82		1.86		1.89		1.91
PER ₃			1.15		1.40		1.49		1.53		1.57		1.59

A.S = amino acid scores. E.A.A.I.= essential amino acid index.
B.V. = biological value. P.E.R 1,2,3 = protein efficiency ratios.

