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EFFECT OF PROCESSING ON AMINO ACIDS CONTENTS OF FOUR SPECIES OF THE FAMILY CUCURBITACEAE

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ABSTRACT: This study was carried out to evaluate the effect of boiling on amino acids contents of the fruits of four species of the family Cucurbitaceae which were *Cucurbita maxima D*, *Cucurbita pepo L*, *Cucurbita moschata* and *Lagenaria siceraria* variety supreme court. In this study, fresh fruit of the four species were subjected to conventional processing technique which is boiling as well as drying. The dry and boiled fruits were evaluated for essential and nonessential amino acids content as well as total amino acids. Amino acids profile of boiled and dry fruits showed the presence of eight essential and nine non essential amino acids. The four species recorded a considerable amount of proline as follows: *L. s*. uncooked (370 mg/100gm), *C. mo*. uncooked (318 mg/100gm) *L. s*. cooked (258.8 mg/100gm), *C. p*. uncooked (232mg/100gm) and *C. p*. cooked (208mg/100gm). The highest total amount of amino acids of boiled fruits was recorded in *Lagenaria siceraria* (4977.6mg/100gm) followed by *Cucurbita pepo* (2870.1mg/100gm) where as the lowest was recorded in *Cucurbita maxima* (1427mg/100gm). Glutamic acid was the most abundant amino acid in the four species, the highest amount of this amino acid (1367mg/100gm) was recorded by *Cucurbita pepo* untreated fruits. In general all Cucurbita species recorded a decrease in amino acids of treated fruits except proline in *C. ma*. and alanine in *C. p*. whereas in *L. s*. there was an increase in six amino acids which were aspartic acid, threonine, serine, glutamic acid, glycine and lysine.

INTRODUCTION: Family Cucurbitaceae is a wonderful family comprises members in all field of medicine as well as their nutritional value. The usefulness of the most member of Cucurbitaceae is due to the presence of bioactive constituents such as alkaloids, tannins, flavonoids and phenolic compounds. These chemicals are known to carry out vital medicinal roles in human body[1].

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The four studied species are edible species with highly nutritional value represented in good percentages of essential and non essential amino acids, good percentages of macro and micro elements and other nutritional values like vitamins and carotene [1-2].

Three of the studied species which were *Cucurbita maxima*, *Cucurbita pepo*, *Cucurbita moschata* belonging to the genus *Cucurbita* which consists of 15 species whereof 10 are wild species and five cultivated species [3], members of this genus are monoecious annual or perennial scandent herbs [4], the three species are well known in Sudan as edible species; the fruits were cooked in different ways

whereas the seeds were roasted as well as traditionally using in expelling intestinal parasite. *Lagenaria siceraria* belonging to the genus *Lagenaria* which covers five perennial wild species [3]. In Sudan *Lagenaria siceraria* has not been known as a vegetable crop, the existing subspecies has been known as siceraria[3] with a bitter fruit and hard shell used as domestic utensils like bottles, bowls, milk pots and containers of several types made out of the dried shells.

Heating can be both beneficial and detrimental to nutrient content of foods. It generally improves the digestibility of foods, making some nutrients more available. A typical example is the protein in legumes, which is made more digestible by heating because of the inactivation of anti-nutrients such as trypsin inhibitors[5]. The main aim of this study is to find out through scientific bases, the effect of processing on amino acids profile of four species of Cucurbitaceae widely used throughout the world.

MATERIALS AND METHODS:

The fruits of *Cucurbita pepo L, Cucurbita maxima D, Cucurbita moschata* variety butternut and *Lagenaria siceraria* variety superme court were collected between April and August 2008. The fruits of *Cucurbita pepo, Cucurbita maxima* were collected from Khartoum state whereas *Cucurbita moschata* variety butternut and *Lagenaria siceraria* variety superme court were collected from Saudi Arabia. The plants were identified and authenticated by the taxonomists Dr, Abdu Elgabar Nasir Gumaa, Department of Biology, faculty of Education, Khartoum University. The fruit flesh were cut into thin slices and air-dried in a shade with good ventilation and then ground finely using electric machine, In case of processed fruits, they were boiled for 20 minutes then dried in a shade and finely ground using electric machine.

Detection of the amino acids:

The content of amino acids was determined by the techniques of [6]. 200 mg of finely ground fruit was taken in a hydrolysis tube, then 5 ml of 6N HCl was added and the tube was closed tightly. The closed tube was incubated at 110^{o}C for 24 hours. After incubation, the solution was filtered. 200 μL of the filtrate was taken and evaporated at 140^{o} C for about 1 hour.1ml of a sample diluting buffer was added to the dried filtrate. Note that for the exact pH value adjustment, hydrochloric acid has to be dosed individually. The quantity of amino acid in each fraction was estimated using Amino Acid Analyzer (Syknm S 7130 Germany).

RESULTS: From **Table 1** which was represented the essential amino acids while **Table 2** was represented the nonessential amino acids of the fruits of the four species of Cucurbits conducted in mg/100gm dry weight. The highest total amount of essential amino acids of uncooked fruit was recorded in *L. s* (2175 mg/100gm) followed by *C. p.* (1820mg/100gm) and the lowest was in *C. ma* (802 mg/100gm) (chromatograms1&2). Uncooked fruit of *C. p*. recorded highest amount of glutamic acid (1367mg/100gm) (chromatograms3&4) whereas *C. mo*. cooked fruit recorded lowest amount of glutamic acid (335.6 mg/100gm) (chromatograms5&6). The highest amount of arginine was recorded in *L. s*. uncooked fruit (950 mg/100gm) (chromatograms7&8) and the lowest was recorded in *C. ma.* cooked fruit (56.1 mg/100gm) and moderate amount in *Cucurbita pepo* (289 mg/100gm).

The highest total amount of amino acids of cooked fruits was recorded in *L.s*. (4977.6 mg/100gm) whereas the lowest was recorded in *C. ma*. (1427 mg/100gm). *L. s*. cooked fruit recorded the highest amount of glycine (185 mg/100gm) and leucine (382.5 mg/100gm). The four species recorded a considerable amount of proline as follows: *L. s*. uncooked (370 mg/100gm), *C. mo*. uncooked (318 mg/100gm) *L. s*. cooked (258.8 mg/100gm), *C. p*. uncooked (232mg/100gm) and *C. p*. cooked (208mg/100gm).

TABLE 1: ESSENTIAL AMINO ACIDS OF THE FRUITS OF THE FOUR SPECIES OF CUCURBITS CONDUCTED in mg/100gm DRY WEIGHT

Amino acids	Species							
	C.ma. unco.	*C.ma.* co.	*C. p.* unco.	*C. p.* co.	*C.mo.* unco	*C.mo.* co.	*L.s.* unco.	*L. s.* co.
Threonine	67	32.6	160	43.9	54	28.8	195	198.8
Valine	182	-	342	-	286	-	477	336.3
Methionine	18	7.3	43	26.7	71	20.8	61	28.8

Isoleucine	138	113	290	212.1	261	120	372	267.5
Leucine	169	119	346	199.8	243	128.8	520	382.5
Phenylalanine	93	54.4	233	108.4	150	59	266	236.3
Histidine	56	18.6	124	27.6	63	24.6	125	97.5
Lysine	79	26.3	282	47.9	78	37.2	159	276.9
Total	802	371.2	1820	666.4	1206	419.2	2175	1824.6

Unco. = uncooked, co. = cooked; (-)= unread, *C. m.: Cucurbita maxima D, C. p.:Cucurbita pepo L, C. m.: Cucurbita moschata and L. s.: Lagenaria siceraria*

TABLE 2: NONESSENTIAL AMINO ACIDS OF THE FRUITS OF THE FOUR SPECIES OF CUCURBITS CONDUCTEDIN mg/100gm DRY WEIGHT

Amino acids	**Species**							
	***C.ma.* unco.**	***C.ma.* co.**	***C. p.* unco.**	***C. p.* co.**	***C.mo.* unco.**	***C.mo.* co.**	***L.s.* unco.**	***L. s.* co.**
Aspartic acid	286	401.9	966	576,3	566	385.5	491	552.5
Serine	68	44.1	220	57.5	50	33	159	186.3
Glutamic acid	761	202.4	1367	640.9	675	335.6	723	1150
Proline	138	151.1	232	208	318	175.7	370	258.8
Glycine	43.89	8.0	179	7.1	15	4.9	66	185
Alanine	240	172.1	517	521.1	334	165.1	583	282.5
Cystine	9.00	-	24	-	33	-	32	7.9
Tyrosine	39	20.2	150	34.6	102	27.4	139	100
Arginine	126	56.14	289	158.2	896	450.7	950	430
Total	1710.9	1055.9	3944	2203.7	2989	1577.1	3513	3153

Unco. = uncooked, co. = cooked; (-)= unread, *C. m.: Cucurbita maxima D, C. p.:Cucurbita pepo L, C. m.: Cucurbita moschata and L. s.: Lagenaria siceraria*

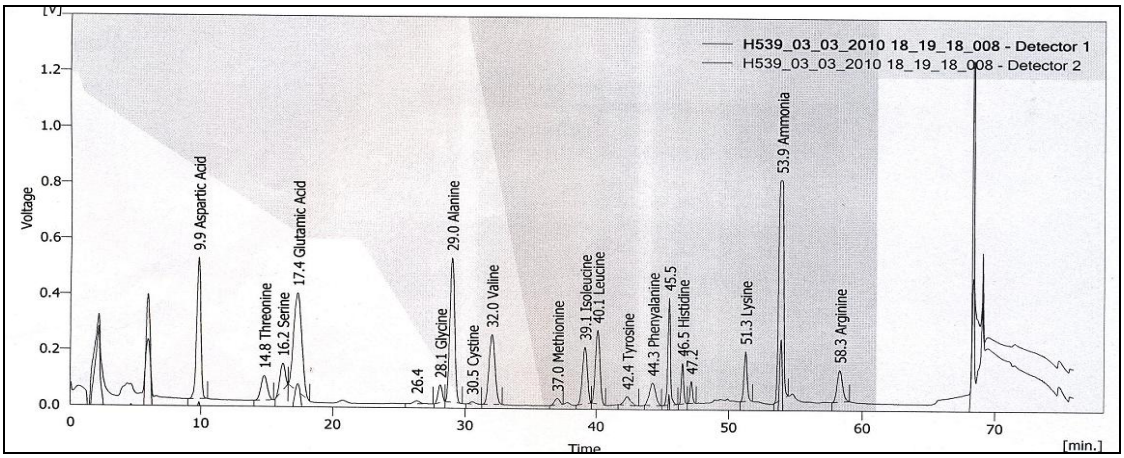

FIG.1: CHROMATOGRAM (1): ESSENTIAL AND NON ESSENTIAL AMINO ACIDS OF *CUCURBITA MAXIMA* UNCOOKED FRUITS

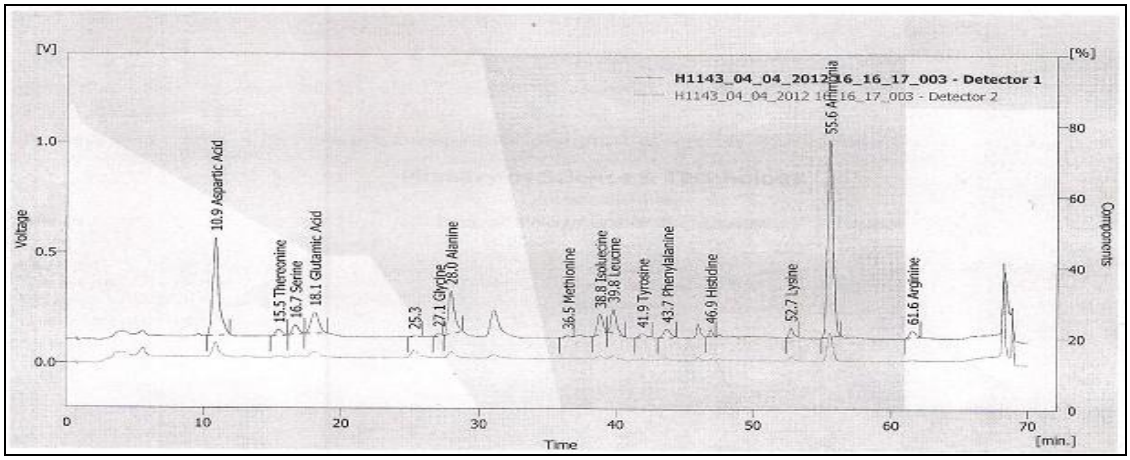

FIG.2: CHROMATOGRAM (2): ESSENTIAL AND NON ESSENTIAL AMINO ACIDS OF *CUCURBITA MAXIMA* COOKED FRUIT

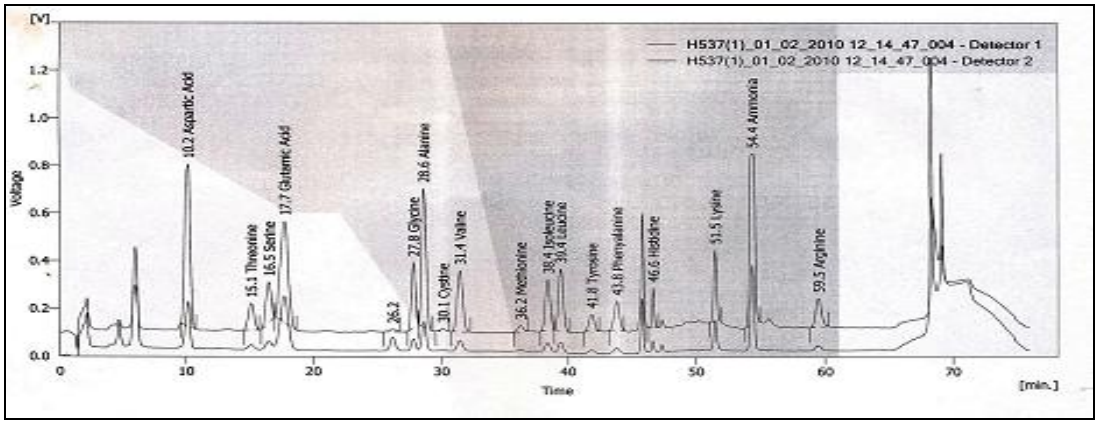

FIG.3: CHROMATOGRAM (3): ESSENTIAL AND NON ESSENTIAL AMINO ACIDS OF *CUCURBITA PEPO* UNCOOKED FRUIT

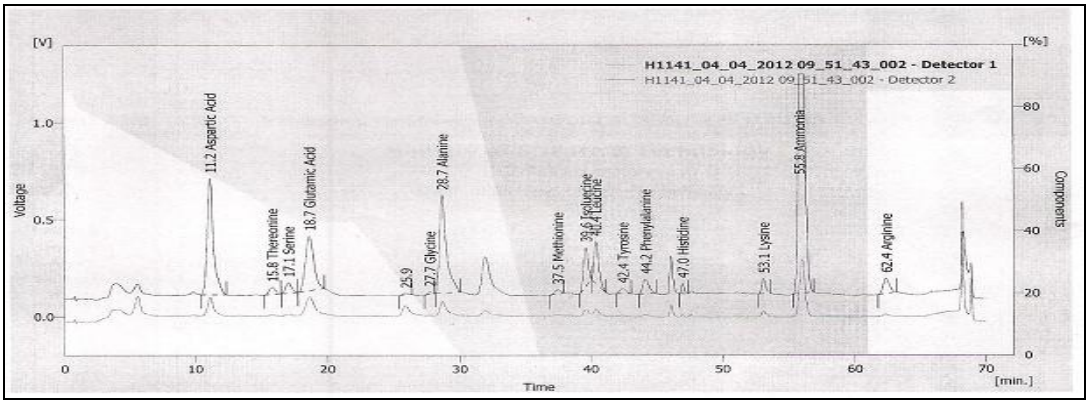

FIG.4: CHROMATOGRAM (4): ESSENTIAL AND NON ESSENTIAL AMINO ACIDS OF *CUCURBITA PEPO* COOKED FRUIT

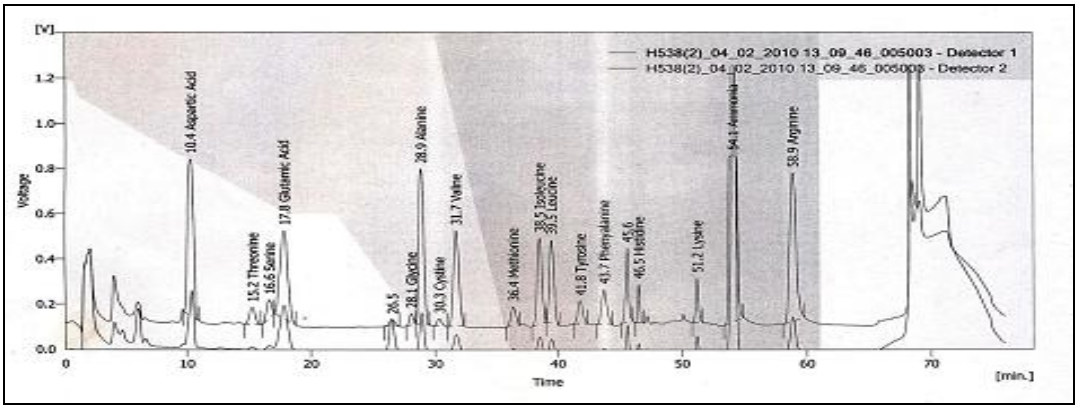

FIG.5: CHROMATOGRAM (5): ESSENTIAL AND NON ESSENTIAL AMINO ACIDS OF *CUCURBITA MOSCHATA* UNCOOKED FRUIT

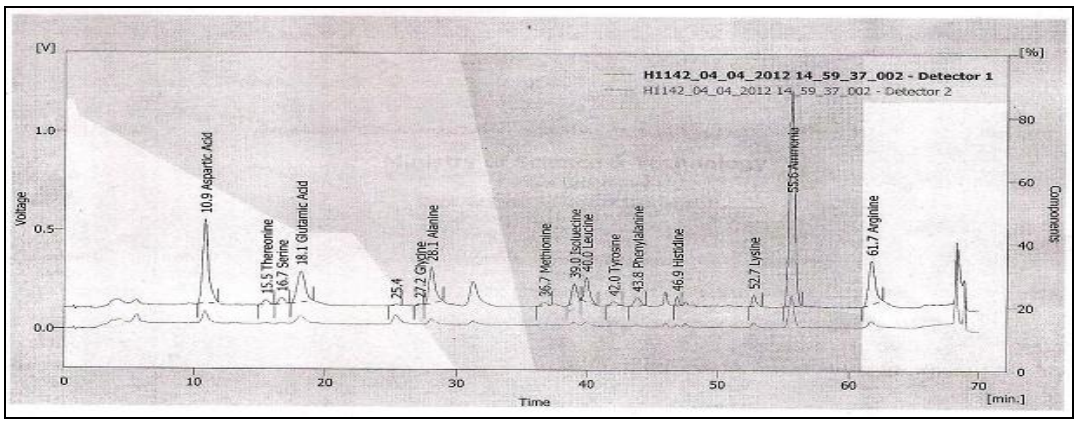

FIG.6: CHROMATOGRAM (6): ESSENTIAL AND NON ESSENTIAL AMINO ACIDS OF *CUCURBITA MOSCHATA* COOKED FRUIT

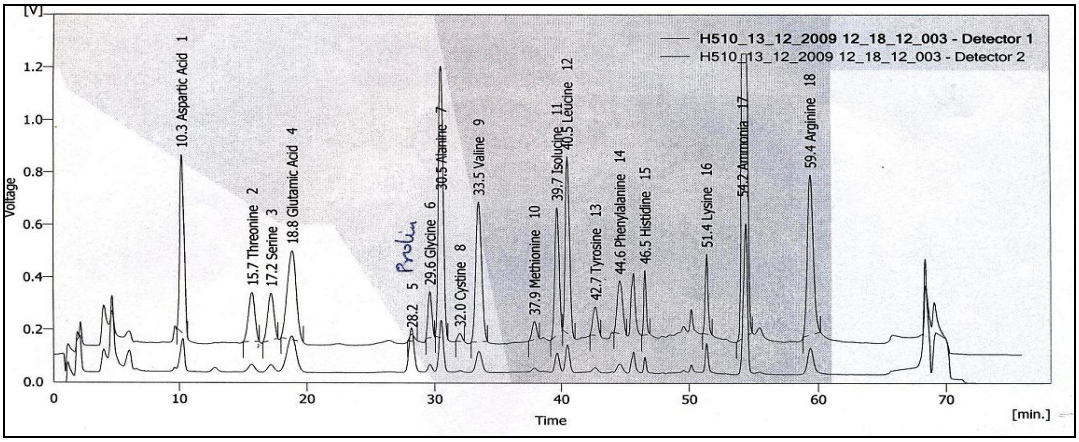

FIG.7: CHROMATOGRAM (7): ESSENTIAL AND NON ESSENTIAL AMINO ACIDS OF *L. S.* UNCOOKED FRUIT

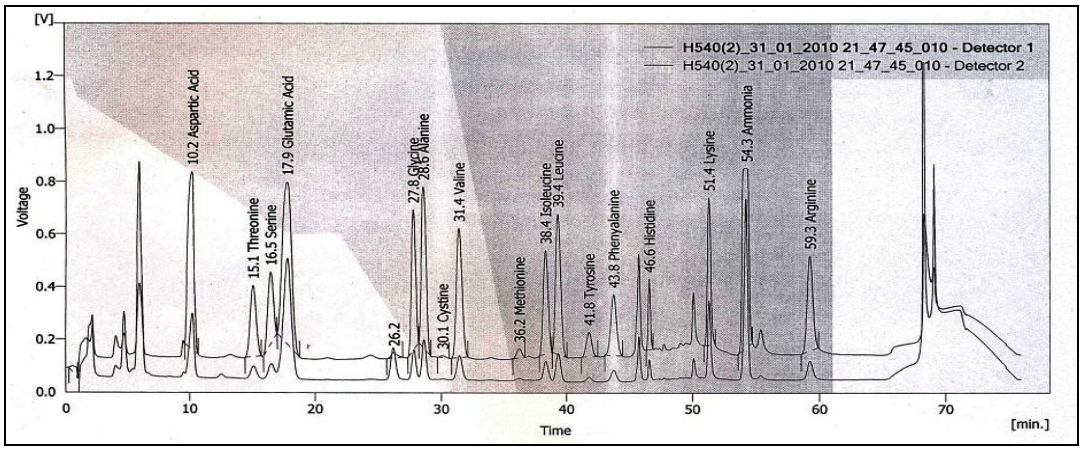

FIG.8: CHROMATOGRAM (8): ESSENTIAL AND NON ESSENTIAL AMINO ACIDS OF *LAGENARIA SICERARIA* COOKED FRUIT

DISCUSSION: The result of an investigation of amino acids of pumpkin pulp (*C. p.*) which was conducted by[4-6] is agree with the results of this study in the highest amount of glutamic acid and proline but disagree with the total amount of amino acids (7.4 g/ kg), also it is compatible with the finding of [8] who investigated amino acids in pumpkin pulp and they found that the highest amounts of the essential amino acids were of leucine 1.09–3.6 and valine 0.90–2.83 g kg-1, and the lowest was of methionine – 0.16–0.94 g kg-1 and of all nonessential amino acids the highest amount was of glutamic acid (4.82–12.96) and aspartic acid (3.7–12.99) g kg^{-1}.

The total amount of amino acids of *C. ma* untreated fruit (2513 mg/100gm) is higher than the finding of [9] who reported that the total amount of amino acids in *C. ma.* D. pumpkin pulp was 4.90 g $100g^{-1}$.

Amino acids of *C. p*. uncooked fruit is higher than that of the USDA National Nutrient Database for Standard Reference in g/ 100 g which are as follows: tryptophan - 0.024, threonine - 0.066, isoleucine - 0.098, leucine - 0.159, lysine - 0.151, methionine - 0.039, cystine - 0.029, phenylalanine - 0.096, tyrosine - 0.073, valine - 0.123, arginine - 0.115, histidine - 0.059, alanine - 0.142, aspartic acid - 0.332, glutamic acid - 0.291, glycine - 0.103, proline - 0.085, serine-0.111.

Regarding *L. s*. the amount of amino acids of the treated and untreated fruits is higher than that which has been recorded by USDA Nutrient Database conducted in g/100g (tryptophan-0.003, threonin-0.018, isoleucine-0.033, leucine-0.036, lysine-0.021, methionine-0.004, phenylalanine-0.015, valine-0.027, arginine-0.14 and histidine-0.004) and much higher than the result of[10] which was recorded as follows: leucines 0.8; phenylalanine 0.9; valine 0.3; tyrosine 0.4; alanine 0.5; threonine 0.2; glutamic acid 0.3; serine 0.6; aspartic acid 1.9; cystine 0.6; cysteine 0.3; arginine 0.4; and proline 0.3mg/g. and [11] who reported amino acids of *L. s.* in gm/100gm as follows: tryptophan-0.003, throenin-0.018, isoleucine-0.033,

leucine-0.036, methionine-0.004, phenylalanine-0.015, valine-0.027, arginine-0.14 and histidine-0.004. The total amino acids of *L. s.* boiled fruits is the highest amount among all boiled fruits of the studied species.

Comparing amino acids in treated and untreated fruits, all Cucurbita species recorded a decrease in amino acids of treated fruits except proline in *C. ma.* and alanine in *C. p.* whereas in *L. s.* there was an increase in six amino acids which were aspartic acid, threonine, serine, glutamic acid, glycine and lysine. The decrease in the amount of proline, isolucine, histidine and tyrosine is agreed with the finding of [2-4, 5b, 12] who investigated effect of cooking method on amino acid composition and nutritional parameters of Persian sturgeon (*Acipenser persicus*). They recorded that the losses of some amino acids such as lysine in grilled and fried samples can be due to the formation of different Millard product during heating. Lysine is the most susceptible amino acid in intact proteins because it has a free amino group at the epsilon carbon unit that is readily available to react with reducing sugars [13, 14]. Free lysine is even more reactive because it has two free amino groups.

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