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NUTRITIONAL EVALUATION OF LEAF PROTEIN CONCENTRATE AND ISOLATE FROM SWEET POTATO

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ABSTRACT

Sweet potato is one of the most important vegetable crop in Egypt. Leaves of these plants are rich sources of proteins, fibers and pigments. A special interest was given to plant protein as hypocholesterolemic agent. They are also used for nutrition and food additives. Leaf protein concentrate (LPC) was prepared by using HCl 1.0 N. In addition, leaf protein isolate (LPI) was extracted by using sodium hydroxide. The percentage of protein in LPC was 40.53%. While in LPI, it amounted to 86.63 %. The amino acids content of LPI was determined using amino acid analyzer. The first limiting amino acids were cysteine and methionine. Methionine:glycine ratio and arginine:lysine ratio are important for their hypocholesterolemic effect. In LPI; methionine: glycine ratio was low (0.29) compared with casein (1.57), while arginine: lysine ratios was high (1.30) compared with casein (0.46). Phenolic compounds and tannins were also determined in LPC, LPI and fibrous residues.

The present study was carried out on rats in order to evaluate the biological value of (LPC) and (LPI) from sweet potato. Casein (10%) in basal diet was replaced by the same amount of protein found in LPC and LPI. Albino rats (18) were fed on diet containing LPC and LPI, in order to determine the gain in body weight, food efficiency ratio, protein efficiency ratio and biological value. The lipid fractions (total lipids, cholesterol and triglycerides) were determined in serum and liver of rats fed on LPC and LPI compared with casein. In rats fed diets containing LPC, the total lipids in serum decreased from 405.6 to 291.41, total cholesterol from 126.32 to 91.21 and triglycerides from 147.92 to 113.45 mg/dl. In case of LPI, the total lipids in serum decreased from 405.6 to 344.5, total cholesterol from 126.32 to 105.98 and triglycerides from 147.92 to 125.7 mg/dl. LPC and LPI decreased lipid fractions in liver. Low methionine:glycine ratio and high arginine:lysine ratio were found to lower cholesterol. The effect of LPC and LPI on transaminase enzymes, protein and urea in serum were determined. No deleterious effect on liver or kidney could be detected.

INTRODUCTION

Leaf protein is one of several novel sources of protein, which could be effectively used to combat protein malnutrition. The recent technological advance made it possible to separate the protein from green leaves (Igarashi *et al.,* 1997).

The fibrous residues remaining after LPI can be used for feeding ruminant animals and the whey is potentially useful fermentation medium (El-Baz *et al.,* 1988 and Kuldip *et al.,* 1996).

Atta *et al.,* (1988) mentioned that LPI from Egyptian sweet potato (% on dry weight) contained 5.6 ash 0.0 ether extract, 92.0 protein, 0.8 crude fiber, 1.6 carbohydrates and 0.2 chlorophyll. One third of chlorophyll percent in leaves was removed as a result of protein isolation process. The amino acids content of sweet potato LPI (g/100g protein) was 4.53 Thr, 5.08 Val, 2.61 Met, 4.53 Ile, 5.15 Leu, 0.47 Cys, 4.02 Tyr, 4.34 Phe, 5.58 Lys, 1.82 Try, 12.1

Asp, 10.39 Glu, 5.6 Ser, 5.76 Gly, 6.43 Ala, 3.46 His and 8.09 Arg. These results showed that LPI was rich in all essential and non-essential amino acids.Ghosh *et al.,* (1988) mentioned that 100g of vines (the green tops) of sweet potato contained 87.1g moisture, 0.57g nitrogen, 0.67g ether extract, 12.4g crude fiber, 3.61mg carotene, 0.06mg thiamin and 2.5mg vitamin-C.
El-Baz *et al.,* (1988) reported that fibrous residue in 9 vegetable wastes had 9-18% protein and could be used as feed for ruminants.

The chemical structure of proteins and presence of some antinutritional factors reduced the nitrogen utilization and would affect general protein metabolism (Rubio *et al.,* 1995). Ghanem, (1986) noticed that tannins content of LPC from sweet potato was 5.86%. Atta *et al.,* (1988) reported that oxalate, cyanogenetic glucoside and tannins in LPI of sweet potato were: 0.6, 0.0 and 0.5%, respectively. Metwalli *et al.,* (1988) found oxalate 1.3%, cyanogenetic glycosides 0.1% and tannins 0.8% in sweet potato leaves. Different interactions have been described between either tannins and dietary protein or tannins and digestive enzymes (Jansman *et al.,* 1994).

Plant protein has received much attention because it generally exerts of hypocholesterolemic effect compared with animal protein. Some of amino acids especially argnine, lysine and methionine play an important role in the process of lipogensis (Moundras *et al.,* 1995).
Significant drop in total lipids and triglycerides occurred in all groups of rats fed on different source of plant protein. The value of triglycerides in both serum and liver tended to be lower at the high level of plant protein intake.The serum phospholipid content was decreased with increasing the level of proteins. There was a marked reduction in serum LDL values in all groups of animal. On the other hand, HDL-fraction showed marked elevation (. Mikhail *et al.,* 1996).

The ratio of arginine: lysine might be the major factor responsible for causing a change in plasma cholesterol of rabbits given different dietary protein (Kritchevsky *et al.,* 1982).

The Arg:Lys ratio was very effective in regulating the triacylglyceride levels in plasma. Indeed, rats fed the legume seeds and the protein isolates showed higher serum Arg:Lys ratios than those offered casein diets (Rahman *et al.,* 1996).

The hypocholesterolemic effect of plant protein may also be due to the presence of saponins and tannins (Gamal, 1991). Saponins bind bile acids, it has been reported that saponins in the diet lower cholesterol concentrations (Potter *et al.,* 1993).

Generally, the relationship between the cholesterol-lowering action of vegetable protein concentrate, such as spinach, radish and cabbage has been not yet fully examined.

The aim of this work was to prepare both LPC and LPI from sweet potato leaves. The chemical composition included phenolic compounds and tannins of leaves, LPC, LPI and fibrous residues remaining after LPI extraction were determined.

The biological evaluation was done to determine gain in body weight, feed intake, food efficiency ratio (FER), protein efficiency ratio (PER) and

biological value (BV). Also, serum and liver total lipids, total cholesterol and triglycerides were determined. Moreover, transaminase enzymes activity (sGOT and sGPT or sAST and sALT), serum protein and serum urea were estimated in rats fed on different diets.

MATERIALS AND METHODS

Samples of sweet potato leaves was sorted and washed by tap water. A part of the leaves was dried in an air oven at 60-70 ^{o}C, then milled to pass through 100-mesh screen sieve. Samples of the fine powdered leaves were kept in black bags and used for preparation of leaf protein concentrate and isolate.

LPC and LPI were prepared according to Rhee *et al.,* (1972), as described in scheme 1 and 2.

The chemical analysis such as, moisture, ash, ether extract, crude fiber and crude protein were determined according the procedures described in A.O.A.C.(1990). While, total hydrolyzable carbohydrates were determined as glucose according to Dubois *et al.,* (1956). Holocellulose and hemicellulose were determined according to Smith, (1969). Lignin content was determined according to Martion, (1964). Total pigments (chlorophyll A,B and carotenoids) according to the methods of Westtstian, (1957) . Amino acids were determined using amino acid analyzer according to the method described by Olson *et al.,* (1975). Total phenols were determined colorimetrically as described by Daniel and George (1957) and total tannins (as tannic acid) as described in A.O.A.C, (1990).

Scheme (I): Preparation of Leave protein concentrate (LPC):

Solids/solvent ratio, time of extraction and pH value were applied according to *Rhee, et al., (1972).*

Scheme (II) : Preparation of protein isolate by alkaline extraction

method followed by acid precipitation:

Solids/solvents ratio, time of extraction and pH value were that used by (Rhee, et al., 1972; and Igarashi, et al,1997).

Biological experiment

Male albino rats (18 animals) of 30 days old (28 ± 2g) were provided by the Nutrition Institute, Cairo. Animals were housed in individual cages with screen bottoms and fed on basal diet for one week. It consisted of casein 10%, corn oil 10%, cellulose 5%, salt mixture 4%, vitamin mixture 1% and corn starch 70%. The salt mixture used was that proposed by Hegseted *et al., (*1941), while the vitamin mixture was that of Campbell, (1961).

After feeding on basal diet for one week, rats were divided into three groups. The first group (6rats) was fed on a basal diet for another 5 weeks. The second group (6rats) was fed on diet (I) (Table 1) for five weeks, it contained 20% LPC from sweet potato, which is equivalent to the protein content in casein. The third group (6 rats) was fed on diet (II) for 5 weeks, it consisted of 10% LPI from sweet potato, which is equivalent to the protein content in casein. During the whole experiment, rats were kept separately in well-aerated cages, diets and water were supplied *ad-libtum*. Each rat was weighed every two days and its food consumption was determined.

Table (1): Diets composition (%):

	Basal diet	Diet (I)*	Diet(II)**
Casein	10	-	-
Protein concentrate	-	20	-
Protein isolate	-	-	10
Corn oil	10	10	10
Cellulose	5	5	5
Salt mixture	4	4	4
Vitamin mixture	1	1	1
Starch	70	60	70

***Amount of LPC equivalent to the protein content in 10% casein.**
****Amount of LPI equivalent to the protein content in 10% casein.**

` At the end of experiment periods, the PER was assayed according to the method of Campbell, (1961). While the BV was calculated according to the equation of Mitchell and Block, (1946). Rats were anaesthetized using chloroform and sacrificed. Blood samples were collected from each rat, then centrifuged at 3000 rpm to obtain the serum, which was kept in the deep freezer for analysis of total lipids, total cholesterol, triglycerides, transaminase enzymes (sGOT and sGPT), protein and urea. The liver was removed from each rat, weighted and kept in saline solution into capped tubes in the deep freezer (-20^{o}C) for determination of total lipids, total cholesterol and triglycerides. Extraction of total lipids from liver was carried out according to the methods of Bligh and Dyer, (1959).

Total lipids in serum and liver extract were determined according to the method of Knight *et al.,* (1972). While, total cholesterol by Zak, (1957) method and triglycerides by the method of Lowell *et al.,* (1973).

The biuret method was used for determination of total soluble protein in serum according to Henary, (1964). Serum aspartate transferase (sAST) and serum alanine transferase (sALT) activities were measured colorimetrically according to the methods of Reitman and Frankel, (1957). Urea in serum was determined according to the method of Caraway, (1975).

Statistical analysis of data was tested according to the procedure described by Snedecor and Cochran, (1973) and Waller and Duncan, (1969).

RESULTS AND DISCUSSION

The data regarding chemical composition of sweet potato leaves are reported in table (2). Crude protein of sweet potato dried leaves was 23.14%, ether extract content reached 10.98%. Ash amounted to 14.19% of dry weight.

Regarding total hydrolyzable carbohydrates, it showed a value of 39.15% in sweet potato dried leaves. This include all the hydrolyzable carbohydrates in 1.0N H_2SO_4 after heating on a boiling water bath for 3 hrs. With regard to crude fiber, it amounted to 7.86% of dry weight.

Our results are in agreement with those reported by Takahashi *et al.,* (1996) who found 17.5% crude protein and 10.8% ash in potato leaves. Metwalli *et al.,* (1988) found 29.3% crude protein, 11.5% crude fiber and 44.0% nitrogen free extract in sweet potato leaves. Also, Zhang and Xie, (1990) reported an average value of crude protein 18.5% in 31 varieties of sweet potato leaves.

The fiber fractions, such as cellulose, hemicellulose and lignin could promote certain physiological effects, such as reduction of cholesterol (Kishimoto *et al.,* 1995) and hypoglycemic agent (Anderson *et al.,* 1990).

According to the effects of chlorophyll and carotenoids, as antioxidant decreased risk of chronic heart diseases and anticarcenogenic agent (Gey, 1993). These pigments were also determined (table2).

Table (2): Chemical composition (% of dry weight) of some sweet potato leaves and its fractions.

Constituents	Sweet potato leaves	LPC	LPI	Fibrous residue
Crude protein	23.14	42.03	89.92	3.86
Ether extract	10.98	7.81	1.24	4.22
Ash	14.19	9.15	3.03	13.20
Total hydrolyzable carbohydrates*	39.15	23.68	4.45	50.13
Crude fiber	7.86	11.42	0.66	26.51
Cellulosic matter	2.76	4.18	0.38	15.00
Hemicellulose	1.84	1.65	0.13	5.73
Lignin	1.33	3.17	0.10	3.31
Total chlorophyll(mg/g)	4.48	4.60	0.52	1.34
Chlorophyll-A	2.14	2.99	0.34	0.91
Chlorophyll-B	2.34	1.61	0.18	0.43
Carotenoids(mg/g)	0.39	1.31	0.16	0.68

The moisture in fresh leaves in sweet potato was (86.74%) ; LPC= Leaf protein concentrate; LPI= Leaf protein isolate; *= After hydrolysis on boiling water bath with 1.0N H_2SO_4 for 3 hrs.

Chemical composition of leaf protein concentrate (LPC)

The LPC was subjected to chemical analyses, the results are reported in table (2). The crude protein content increased in the LPC, it amounted to 42.03%, while it was 23.14% in the dried leaves (table 2).
Ghanem, (1986) reported that LPC of sweet potato amounted to 41.13% .

Chemical composition of leaf protein isolate (LPI)

Protein isolate is an important product of plant according to its use as food additive in bakery products and sausage (Khorshid *et al.,*1993 and Metwalli *et al.,*1988). Recently, it has been used as a hypocholesterolemic agent, according to its amino acid content (Kurowska and Carroll, 1994 and

Igarashi *et al.,* 1997). The yield of protein was 17.2% and the extractability was 80.19%.

The chemical composition of LPI is given in table (2). The protein content was 89.92%. It is also, observed that ether extract (1.24%); ash (3.03%) and crude fiber (0.66%) highly decreased as compared with LPC..

These results are in agreement with those reported by Atta, *et al.,* (1988), who found 92.0% crude protein in leaf protein isolate from sweet potato.

Amino acids content of leaf protein isolate (LPI):

In order to obtain more information about the chemical composition of the protein, the amino acids were determined in LPI. The results are reported in table (3) as g/ 100g protein compared with the amino acids composition of casein and FAO/WHO (1990).

It is observed that the protein isolate of sweet potato is highly deficient in cysteine and methionine, and deficient to some extent in lysine and leucine. It is also, worthy to mention that the total non-essential amino acids amounted to 55.04 % of total amino acids. The most predominating non-essential amino acids were aspartic (11.42%) and glutamic acids (14.51%) while, they amounted in casein to 6.18 and 9.00%, respectively. Moreover, glycine and alanine amounted to 4.62 and 6.46% compared with casein 1.65 and 2.61%, respectively. Arginine, also was found in higher amount in LPI (6.30%), while in casein it amounted to 3.22%. According to their importance, the effect of these amino acids while be discussed in the biological part.

The chemical score (CS) in table (4), shows that the most limiting amino acids were cysteine and methionine. While lysine score was 87.82 in LPI, which proved a lysine deficiency as compared with casein (127.09).

Fibrous residues:

The fibrous residue remaining after LPI isolation, was subjected to chemical analysis the results are reported in table (5).

It is clear that it contains higher amount of crude fiber (26.51%) compared to the leaves. It contained 3.86% crude protein and high amount of ash (13.20%) on dry weight.

This high amount of crude fiber and ash may due to removal of protein and some soluble compounds (carbohydrates and other compounds). Therefore fibrous residues may be used for animal feeding (El-Baz *et al.,* 1988 and Kuldip *et al.,* 1996).

Table (3): Amino acids content of leaf protein isolate(LPI) in sweet potato compared to casein and FAO/WHO (1990)

Amino acidsg/100protein	LPI	Casein	FAO/WHO (1990)
Lysine	4.83	6.99	5.50
Threonine	3.74	3.72	4.0
Cystine	0.51	0.33	3.5
Methionine	1.36	2.59	
Valine	4.91	5.70	5.0
Isoleucine	4.50	4.46	4.0
Leucine	5.52	8.27	7.0
Tyrosine	3.01	4.79	6.0
Phe.alanine	4.50	4.47	
Total EAA*	32.88	41.32	
Serine	6.72	5.03	
Proline	1.56	9.32	
Glycine	4.62	1.65	
Alanine	6.46	2.61	
Aspartic acid	11.42	6.18	
Glutamic acid	14.51	9.00	
Histidine	3.45	2.65	
Arginine	6.30	3.22	
Total NEAA**	55.04	39.66	
Arg:Lys ratio	1.30	0.46	
Met:Gly ratio	0.29	1.57	

* **EAA = Essential amino acids.** ** **NEAA = Non essential amino acids.**

Table (4): Chemical score and limiting amino acids of leaf protein isolate compared to casein.

Essential amino acids	Sweet potato	Casein
Lysine	87.82	127.09
Threonine	93.50	93.00
Cystine+Methionine	53.43	83.43
Valine	98.20	114.0
Isoleucine	112.50	111.5
Leucine	78.86	111.8
Tyrosine+ Phe.alanine	125.17	154.33
Limiting amino acids	Cys + Met	Cys + Met

$$\text{Chemical score (CS)} = \frac{\text{EAA\% in protein}}{\text{EAA\% in FAO/WHO}} \times 100$$

Antinutritional factors:

Table (6), shows the content of some antinutritional factors in leaves, LPC, LPI and fibrous residue. Phenolic compounds are amounted to 11.18 mg/g in leaves. As expected they were highly decreased in LPI (3.42 mg/g).

The same trend was also observed in tannins. This results regarding the decrease in phenols and tannins are in agreement with those reported by (Atta *et al.,* 1988 and Ladeji *et al.,* 1995).

Table (5): Chemical composition (% of dry weight) of fibrous residues remaining after protein isolation.

Constituents	Sweet potato
Crude protein	3.86
Ether extract	4.22
Ash	13.20
Total hydrolyzable carbohydrates*	50.13
Crude fiber	26.41
Cellulosic matter*	15.00
Hemicellulose*	5.73
Lignin*	23.31
Total chlorophyll(mg/g)	1.34
Chlorophyll-A	0.91
Chlorophyll-B	0.43
Carotenoids(mg/g)	0.68

After hydrolysis on boiling water bath with 1.0N H_2SO_4 for 3 hrs
*** As fiber fraction**

Table (6): Antinutritional factors in leaves, LPC, LPI and fibrous residue (mg/g).

Samples	Phenols	Tannins
Leaves sweet potato	11.18	6.67
LPC of sweet potato	8.33	4.31
LPI of sweet potato	3.42	1.81
Fibrous residues of sweet potato	8.04	2.64

Biological evaluation of sweet potato proteins.

To study the biological effect of sweet potato proteins, albino rats were fed on diets I and II (see table 1) as reported in the experimental part. The effect of these diets on body weight gain, food intake, feed efficiency and lipid fractions in rats were determined.

Gain in body weight, daily food intake and feed efficiency ratio (FER):

The results concerning the daily gain in body weight, daily food intake and feed efficiency ratio at the end of experiment (5weeks) are recorded in table (7). LPC 20% and LPI 10% were added in the diet because they contained the same amount of true protein recorded in casein (In the present experiment casein contained about 80% true protein).

Table (7) : Means of Gain in body weight, Feed intake and Feed efficiency ratio in rats fed on different experimentaldiets:

Diets	Initial weight	Final weight	Weight gain	Daily wt. gain	Feed intake	Daily food intake	Feed Efficiency	Feed Efficiency

	(g)	(g)	(g)	(g/day)	(g)	(g/day)		ratio(FER)
Control	0.35*	102.17	67.17	1.92	375.0	10.71	0.179	17.93
	±1.69	±2.80	±1.69	±0.09	±9.88	±0.45	±0.003	±0.29
LPC	35.6	86.27	50.67**	1.45**	290.7**	8.31**	0.174	17.45**
	±1.50	±1.64	±0.30	±0.05	±7.07	±0.33	±0.005	±0.47
LPI	36.2	98.03	61.83	1.77	343.3	9.81	0.180	18.04
	±1.96	±3.14	±1.34	±0.11	±8.90	±0.42	±0.006	±0.063

*Means ± standard deviation ** .Significant decrease (P < 0.01)

The results show that in case of LPC, the daily gain in body weight was decreased from 1.92 in control to 1.45g/day, also the daily food intake was decreased from 10.71 to 8.31g/day. This led to a decrease in FER from 17.93 to 17.45. All these changes were significant. This decrease in daily gain in body weight may be partially due to the fact that the starch content of this diet was decreased by 10%. The decrease of daily food intake may be due to the presence of relatively high content of fiber in LPC (6.8%), which led to fill the rats stomach and to reduce the feed intake. Such decrease in gain in body weight was cited in case of feeding LPC of cabbage compared with soy protein isolate (Igarashi, *et al.,* 1997).

In this respect, Morita, *et al.,* (1997) cited that diet containing dietary fiber decreased the daily gain in body weight of rats. The content of tannins (4.3 mg/g) may play a role in decreasing gain in body weight. (Rubio *et al.,* 1995).

In case of LPI, non-significant decrease in daily gain in body weight (from 1.92 to 1.77 g/day) and food intake (from 10.71 to 9.81) were observed. FER was non-significantly affected (17.93 to 18.04), this slight increase may be due to experimental error.

Daily protein intake, protein efficiency ratio (PER) and biological value (BV), and liver/body weight ratio

As observed from table (8), the daily protein intake in LPC was decreased from 1.07 in control to 0.83 g/day, while PER decreased from 1.79 to 1.74. On the other hand, BV was decreased from 68.57 to 66.97. All these changes were significant. In case of LPI, the daily protein intake was decreased from 1.07 to 0.98 g/day, PER decreased from 1.79 to 1.80 and BV from 68.57 to 69.17. All these decreases were insignificant.

Hanczakowski and Makuch*.,* (1981) prepared LPC from potato haulms. They found distinct differences in nutritional value (NV) between potato varieties. The biological value (BV) of proteins of the best preparations was nearly as good as soybean meal, but their digestibility was lower. The same authors, (1981) found that the LPC of potato haulms may be a good protein sources for chicks, provided that no more than 25% is included in their diet. Ghanem, (1986) found that the BV of LPC from sweet potato reached a value of 90%.

It could be concluded that LPI from sweet potato according to its BV and PER was approximately equal to casein in its nutritional value.

Table (8) :Protein intake, protein efficiency ratio, and biological value in rats fed on different experimental diets:

Diets	Protein intake(g)	Daily protein intake(g)	Protein efficiency ratio (PER)	Biological value (BV)
Control	37.50	1.07	1.79	68.57
	±0.99	±0.05	±0.03	±0.31
LPC	29.07*	0.83*	1.74*	66.97*
	±0.71	±0.03	±0.06	±0.58
LPI	34.33	0.98	1.80	69.17
	±0.89	±0.04	±0.06	±0.68

***Significant decrease (P < 0.01.)**

As shown in table (9), the liver weight/body weight ratio was insignificantly affected in rats fed on diet containing LPC and LPI compared with control. This could partially prove that no deleterious compounds were present in LPC and LPI.

Table (9): Means of final body weight, liver weight and Liver/body weight ratio in rats fed on different experimental diets.

Dites	Final body weight (g)	Liver weight (g)	Liver / body weight ratio
Control	102.17 ± 2.80	6.83 ±0.36	0.067 ±0.003
LPC	86.27 ±1.64	6.52 ±0.57	0.075 ±0.007
LPI	98.03 ±3.14	7.53 ±0.69	0.076 ±0.008

Effect of LPC and LPI from sweet potato on serum and liver lipid fractions:

The effect of feeding healthy rats on cholesterol-free diets containing casein or LPC or LPI of sweet potato on lipid fractions is given in table (10). The results showed a decrease in lipid fractions.

In serum, total lipid was decreased significantly from 405.6 to 291.41 and 344.53 (mg/dl), while cholesterol decreased from 126.32 to 91.21 and 105.98 (mg/dl), and triglycerides from 147.92 to 113.45 and 125.7 (mg/dl) in diet containing casein compared with LPC and LPI, respectively. The changes in total lipids, cholesterol and triglycerides in liver are given in the same table. A similar significant decrease was observed under the same conditions. Total lipid was decreased from 3.68 to 2.83 and 3.14 (g/100g), cholesterol from 0.52 to 0.37 and 0.43 (g/100g) and triglycerides from 2.90 to 2.07 and 2.45 (g/100g), in case of casein compared with LPC and LPI, respectively.

In case of LPC, this decrease may be partially due to the fiber content (Kishimoto *et al.,* 1995), the presence of some amino acids (Igarashi *et al.,*1997) and some pigments as carotenoids (Sulli *et al.,*1998).

In case of LPI, the decrease in lipid fraction was less than that observed in LPC, these results are in agreement with Potter *et al.,* (1996). The effect of LPI in decreasing in serum and liver total lipids, cholesterol and triglycerides may be due to the presence of relatively high concentration of

some amino acids like glycine, arginine (Sugiyama *et al.,* 1993) and a low concentration of methionine (Igarashi *et al.,* 1997).

Since glycine, threonine and glutamic acid were considered to lower the serum cholesterol level, and glutamic acid may be easily formed from glutamine *in vivo*. This led to stronger cholesterol lowering activity in rats fed diet containing high amount of these amino acids (Zhang and Beynen, 1993). Also, the Arg:Lys ratio and Met:Gly ratio are of high importance in lowering cholesterol level (Morita *et al.,* 1997). It is observed that the Arg: Lys ratio in LPI amounted to 1.3 compared with casein (0.46), and the Met:Gly ratio in LPI was 0.29 compared with casein (1.57).

Regarding the lowering effect of some amino acids on cholesterol Beynen, (1990) showed that soy protein compared to casein increased fecal excretion of bile acids. The physiological result of this, is an environmental in which cholesterol is being "pulled" from the body.

The net mechanism of some amino acids as hypo-cholesterolemic agent is yet unclear (Morita *et al.,* 1997).

Effect of different diets on serum protein:

Protein was determined in the serum rats. Its level was 7.47 in control, while it amounted from 6.78 and7.14 g/dl in diet containing LPC and LPI from sweet potato, (table 11). These results showed that insignificant changes occurred in diet containing LPC and LPI.

Effect of s.GOT and s.GPT activities:

The enzymes assayed most commonly in liver disfunction are aspartate transaminase (AST) and alanine transaminase (ALT) .

In this experiment after feeding rats on diets I and II, the AST and ALT were determined in blood (table 11). The activity of s.GOT increased non significantly from 18.2 in control to 20.5 and 19.3μ/l in LPC and LPI. While, s.GPT also increased insignificantly from 23.7 in control to 25.2 and 26.0μ/l in LPC and LPI. It could be said that no toxic substances affecting liver may be present in LPC and LPI.

Effect of different diets on serum urea:

Table (11) shows the effect of LPC and LPI from sweet potato on the serum urea as renal function. These results showed that urea was decreased significantly from 18.71 in control to 16.48 mg/dl in LPC diet and decreased insignificantly in LPI (18.02 mg/dl).

These results are in agreement with those of Younes *et al.,* (1996), who showed that decreasing dietary protein and increasing the level of a dietary fiber, blend within nutritionally acceptable ranges. Led to decrease plasma urea and the contribution of the kidney nitrogen excretion would be reduced.

The normal concentration of urea in serum prove that no toxic substance affecting kidney may be present in LPC and LPI from sweet potato.

Table (10): Means of serum and liver total lipids, total cholesterol and riglycerides:

Diets	Total lipids		Total cholesterol		Triglycerides	
	Serum (mg/dl)	Liver (g/100g)	Serum (mg/dl)	Liver (g/100g)	Serum (mg/dl)	Liver (g/100g)
Control	405.60 ± 28.89	3.68 ± 0.43	126.32 ± 18.43	0.52 ± 0.05	147.92 ± 12.74	2.90 ± 0.49
LPC	291.41** ± 23.52	2.83* ± 0.33	91.21* ± 14.47	0.37* ± 0.03	113.45* ± 14.99	2.07* ± 0.21
LPI	344.53* ± 32.68	3.14** ± 0.36	105.98* ± 8.31	0.43* ± 0.05	125.70** ± 15.62	2.45** ± 0.32

*** Significant decrease (P < 0.01). ** Significant decrease (P < 0.05).**

Table (11): Means of transaminase enzymes (s.GOT and s.GPT), serum Protein and urea in rats fed on different diets.

	Liver functions				Kidney functions
Diets	s.GOT (μ/l)	s.GPT (μ/l)	s.GOT/ s.GPT ratio	Serum protein (g/dl)	Serum urea (mg/dl)
Control	18.2 ±1.32	23.7 ± 2.20	0.61 ± 0.03	7.47 ±1.25	18.71 ± 0.93
LPIC	20.5 ±1.39	25.2 ± 2.51	0.81 ± 0.08	6.78 ±0.43	16.48* ± 0.96
PLI	19.3 ± 0.88	26.0 ± 0.74	0.75 ± 0.05	7.14 ±1.18	18.02 ± 1.11

**** Decrease significant (P < 0.01).**

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التقييم الغذائى لمركزات البروتين و البروتين المعزول من اوراق البطاطا.

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يعتبر محصول البطاطا من محاصيل الخضر الهامة التي تزرع في ج0م0ع0 ومخلفات هذه النباتات كالأوراق تنتج بكميات كبيره وتعتبر مصدر غني بالبروتينيات والألياف الطبيعيه والصبغات التي تعتبر ذات أهمية خاصة من الناحية الغذائية والعلاجية عند إضافتها لأغذية الإنسان . لذا تم تقدير التركيب

الكيماوي لأوراق نباتات البطاطا ثم تم استخدام طريقه المعامله بحمض هيدروكلوريك 1 ع للحصول علي عينه البروتين المركز من الأوراق الجافه لهذه النباتات أما بالنسبة لإستخلاص البروتين المعزول فقد تم استخدام طريقة المعامله بالقلوي ثم الترسيب بحامض هيدروكلوريك 1ع وتم تقدير التركيب الكيماوي والفينوليات والتانينات لكل من الأوراق ومركزات البروتين والبروتين المعزول وبقايا الالياف الناتجة بعد فصل البروتين0 كذلك تم تقدير محتوى البروتين المعزول من الاحماض الامينية وحساب الـ Chemical score مقارنة بالكازين0وتم تقييم مركزات البروتين (LPC) و البروتين المعزول (LPI) لاوراق البطاطا بيولوجياً بإستخدام وجبة تحتوي علي كازين (10%) للمقارنة ، مع إستبدال الكازين بنفس كميه البروتين الموجوده فى LPC و LPI حيث تم تغذية 18 فأر (فى ثلاثه مجاميع) علي وجبات تحتوي علي الكازين والـ LPC و LPI وذلك لتقدير الزياده في وزن الفئران ، وكفاءه الاستفاده من الوجبات (FER) المحتوية علي LPC و LPI وكفاءه الاستفادة من بروتين الوجبات (PER) وتقدير القيمة البيولوجية (BV) لتلك الواجبات مقارنتاً بالكازين0 أيضاً تم تقدير المحتوي من المفردات الليبيدية (الليبيدات الكلية والكولسيترول الكلي والجلسريدات الثلاثية) في كلا من السيرم والكبد للفئران المغذاه علي وجبات تحتوي علي LPC و LPI مقارنة بالفئران المغذاة علي الكازين وقد وجد إنخفاض في محتوى تلك المفردات. وأيضا تم دراسة تأثير هذه الوجبات علي نشاط الانزيمات الناقله للاحماض الامينية وكذلك البروتين واليوريا في السيرم وتبين عدم حدوث أي تغير بها مما يؤكد أن هذه البروتينات ليس لها أي تأثير ضار علي كلاً من الكبد والكلي للفئران0