Minufiya J. Agric. Res. Vol. 40 No. 3(1): 679 – 695 (2015) **"http://www.mujar.net"**

NUTRITIONAL AND BIOCHEMICAL STUDIES ON SUPPLEMENTATION OF CHICKPEA POWDER ON RATS DIETS SUFFERED FROM PROTEIN MALNUTRITION

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(Received: Apr. 19, 2015)

ABSTRACT: *The present study was conducted to investigate the effect of chickpea powder supplementation on rats diet suffered from protein malnutrition in levels of serum blood lipid profile, liver enzymes, renal function, serum proteins and minerals iron and zinc. The current study was performed on a total of forty two normal male albino rats of an average body weight 150±10 g of Sprague Dawley Strain were used. They were obtained from the Laboratory Animal House of Ophthalmic Research Institute, Giza. Animals were acclimatized to laboratory condition before being used, the rats were divided into two main groups as follows:- The first main group (6 rats) was fed on basal diet and kept as a control negative . the second main group (36 rats) subgroup (1): saved as control positive group was fed on a ration only. subgroups were fed(chickpea-cake-cake10%-biscuit-and biscuit 10%).The experiment lasted 4 weeks . Meanwhile , feed intake was calculated every day , while rats weight was recorded weekly . At the end of the experiment , the animals were sacrificed and the blood samples were collected, then centrifuged for 10 minutes at 3000 round per minute " r.p.m " to separate the serum. Also , liver , kidneys , spleen , heart and lung were removed from each rat and cleaned by a saline solution , dried by filter paper and weighed. After that , feed intake , body weight gain , feed efficiency ratio and organs to body weight ratio were calculated .After that, kept Liver and heart in formalin solution for histopathological examination. serum samples were take to determine biochemical analysis the following : serum liver enzymes(ALT, AST, ALP), total protein and albumin, calculated globulin, albumin/globulin (A/G) ratio, total cholesterol, triglycerides, lipoprotein fractions (HDLc, LDLc and VLDLc),. the obtained results concluded that feeding with chickpea –cake supplementation of chickpea and biscuit supplementation of chickpea improved malnutrition of protein and improved level of iron and zink in the blood serum.*

Key words: *Chickpea, cake10% , Chickpea 10% , Iron, Zink, live enzymes, lipidprofile .*

INTRODUCTION

Malnutrition, defined as underweight, is a serious public-health problem that has been linked to a substantial increase in the risk of mortality and morbidity. Women and young children bear the brunt of the disease burden associated with malnutrition. In Africa and south Asia, 27−51% of women of reproductive age are underweight (ACC/SCN, 2000), and it is predicted that about 130 million children will be underweight in 2005 (21% of all children). Many of the 30 million low-birth-weight babies born annually (23.8% of all births) face severe short-term and long-term health consequences (Onis *et al*., 2004).

Malnutrition occurs in people who are either undernourished or over-nourished. Under nutrition is a consequence of consuming too few essential nutrients or using or excreting them more rapidly than they can preplaced. infants, young children, and teenagers need additional nutrients. So do women who are pregnant or breastfeeding. Nutrient loss can be accelerated by diarrhea, excessive sweating, heavy bleeding (hemorrhage), or kidney failure. Nutrient intake can be restricted by age-related illnesses and conditions, excessive dieting, severe injury, serious illness, a lengthy hospitalization, or substance abuse. The leading cause of death in children in developing countries is

protein-energy malnutrition. This type of malnutrition is the result of inadequate intake of calories from proteins, vitamins, and minerals. Children who are already undernourished can suffer from protein-energy malnutrition when rapid growth, infection, or disease increases the need for protein and essential minerals (Onis, Blössner & Villar., 1998).

Chickpea (Cicer arietinum, *L*.) is a major food legume in Southern Europe. North Africa, India and Middle East countries (Viveros *et al*.,2001 and Lqbal *et al*., 2006). It is cultivated mainly in Algeria, Ethiopia, Iran, India Mexico, Morocco, Myanmar, Pakistan, Spain, Syria, Tanzania, Tunisia and Turkey (Nghavi and Jahansouz.,2005).

Chickpea seed contains 29% protein, 59% carbohydrate, 3% fiber, 5% oil and 4% ash. Chickpea protein is rich in lysine and arginine but most deficient in sulphur-containing amino acids methionine and cystine (Lqbal *et al.,*2006). Chickpea is also a good source of absorbable Ca, P, Mg, Fe and K (Chavan *et al*., 1986 and Christodoulou *et al*., 2005).

A chickpea is a good source of zinc, foliate and protein, however, main nutritive value seems to be as protein supplement for poultry. It is an important source of available energy because of its high level starch content and the amount of soluble carbohydrate (Awadhesh Kishore,. 2012).

Chickpea is a good source of micronutrients. Selection of genetic material to enrich micronutrients in conjunction with the choice of growing location may enable development of chickpea-based whole food solutions to global micronutrient malnutrition. (Thavarajah and Thavarajah*.,* 2012).

Pelin *et al*., (2015) Chickpea locally known as garbanzos is a good source of protein, minerals, and trace elements. Based on the results of the nutrient analysis of chickpea flour, it showed that it is high in dietary fiber, protein, potassium, calcium and iron. Chickpea flour is three times higher in dietary fiber than wheat flour and rice. Chickpea flour has low glycemic index, much lower than wheat flour and milled rice. Various products were developed with the supplementation of wheat flour with chickpea flour. Thirty percent (30%) substitution showed acceptable processed chickpea based food products.

Thereupon, Nutritional and Biochemical studies on Supplementation of Chickpea Powder on Rats Diets Suffered from Protein Malnutrition will be study.

MATERIALS AND METHODS

The investigation was carried out in the year 2013-2014 at the Department of Food Science and Technology, Faculty of Home Economics, AlAzhar University, Tanta.

Material:

Chik pea

Commercial Chik pea was obtained from Elfarkh ,Tanta

Cake is supported by 10% of Chikpea

All other materials used in dough preparation for butter caka making i.e. sugar, corn oil, baking power, eggs and vanillin were obtained from local market in Tanta ,Garbia governorate.

Biscuit is supported by 10% of Chikpea

All other materials used in dough preparation for butter biscuit making i.e. sugar, corn oil, baking power, eggs and vanillin were obtained from local market in Tanta ,Garbia governorate

Rats

Total of 42 normal male albino rats of an average body weight 150±10 g of Sprague Dawley Strain were used. They were obtained from the Laboratory Animal House of Ophthalmic Research Institute, Giza. Animals were acclimatized to laboratory condition before used.

Motods:

1- preparation of chick pea, -

Chick pea was milled to a fine powder then sieved on a 0.5mm siev. Packaged into

polyethylene bags and stored in deep freezer (-18ċ) until using.

2-Preparation of Cake:

Cake samples were prepared by following the procedure suggested by singh *et al.;* 200b with slight modification which is shown in table (1) .

Singh *et al*., (2006) for making cake, sugar,oil, were creamed by using a mixing machine for 1 min. Eggs were beaten by whip and vanillin was added to the beaten eggs. Sugar – oil creamed was added to egg. Vanillin mixture and well beaten at low speed for 5 min. Dry Ingredients (soft wheat flour or its blends and baking powder) were stirred together and added to the mixture until the blend became templates , then baking process was carried out in electrically heated oven at 170 c atfor 20 min . After baking, cakes were allowed to cool at room temperature for 1 hr, before organolyptic evalution.

Preparation of Biscuit:

Biscuit samples were prepared by following the procedure suggested by singh *et al.,* (2006) with slight modification which is shown in Table (2).

Table (1): The formula of control cake

Ingredients	Amounts(gm)	%
Soft wheat flour	1000→	25.bo
Milk	720→	18.43
Butter	800→	18.43'20.48
Baking powder	40→	1.02
Egg (fresh, whole)	600→	15.3b
Vanilla	20→	0.5
Salt	6→	0.15
total	3906→	100

The Ingredients gave 2400(gm)cake.

Table (2): The formula of control Biscuit.

Ingredients	Amounts(gm)	%
Soft wheat flour	500→	49.8o
Butter	250→	24.9
Baking powder	20→	1.9
Egg (fresh, whole)	210→	20.9
Vanilla	20→	1.9
Salt	3→	0.07
total	1003→	100

For making biscuits, add butter to sugar manner rubbing then add the eggs one by one and then latter Alvanlia and baking powder and flour and is forming, then baking process was carried out in electrically heated oven at 170 ċ atfor 20 min . After baking, cakes were allowed to cool at room temperature for 1 hr, before organolyptic evalution.

Grouping design and feeding of rats

The experiment was done in Animal House of Faculty of Home Econmics EL Azhar Univeristy. Rats were housed in wire cages in a room maintained at 25_+2C and kept under hygienic condation. All rats were fed one week on ration.The rats were divided into two main groups. The frist group (n=6rats) was only fed on raion and tap water and kept as control negative group (normal rats).The second maingroup (n=36rats) Was fed on ration andtap water , all rats in the second main groups were given low protin diet (casein 2%)for 3weeks so as to events malnutrition for 3 weeks in Table (3).

Biological evaluations:

At the end of the experiment, feed intake, body weight gain were determined . according to Chapman *et al.,* (1959) , Body weight gain and feed intake were determined using the following equations :

Food intake = Initial weight diet (gm) – Loss weight diet (gm)

Body Weight Gain =

$$\frac{\text{Final weight (gm)} - \text{initial weight (gm)}}{\text{Initial weight (gm)}} \times 100$$

Biochemical analysis of serum:

After sacrificeing of rats at the end of the experiment , blood samples were collected from aorta . Each sample was placed in a dry clean centrifuge tube , then centrifuged for 10 minutes at 3000 round per minute " r.p.m " to separate the serum . Serum was carefully separated into dry clean Wassermann tubes by using a Pasteur pipette and kept frozen till analysis . Total cholesterol , triglycerides , HDL-C , VLDL-C , LDL-C , AST ,ALT ,ALP were determined .

Determination of serum total cholesterol :-

Total cholesterol was determined in the serum according to the method described by **(**Allain *et al.,* 1974) : \

Determination of serum triglycerides :-

Triglycerides were determined in the serum according to the method described by (Trinder and Ann , 1969) :

Table (3): Composition of low protein diet usd in the experiment(g\100g)

Compound	Amounts
Protein	2.00%
Corn oil	4.00%
Mineral mixture	3.50%
Vitamin mixture	1.00%
Fiber	5.00%
Corn starch	72

Rats with (low protein daitinduced malnutraition)were allocated into 6 groups (n=6 rats for each group)as follows:

Groups (2):control positive group was fed on a ration only

Group(3):were fed on basal diet supplemented by Chickpea 20%,

Group(4):were fed on basal diet supplemented by normal Cake 20% by 10%chickpea, Group(5) were fed on basal diet supplemented by normal Cake 20%, Group(6) were fed on basal diet supplemented by normal Biscuit 20%by 10%chickpea), Group(7): were fed on basal diet supplemented by normal Biscuit 20%,

Determination of serum HDL-cholesterol :

HDL-C was determined in the serum according to the method described by (Lopes - Virella *et al.,* 1977) :

Determination of serum VLDL-cholesterol :

Serum VLDL-C was determined according to (Friedwald *et al.,* 1972) using the following equation :

$$\text{VLDL-C Concentration (mg/dL)} = \frac{\text{TG (mg/dL)}}{5}$$

Determination of serum LDL-cholesterol :

Serum LDL-C was determined according to (Friedwald *et al.,* 1972) using the following equation :

LDL-C = Total Cholesterol – [(VLDL-C) + (HDL-C)]

- Histopathological examination of hearts and livers:

The hearts and livers of sacrificed rats were taken and immersed in 10% formalin solution. The fixed specimens were then trimmed, washed and dehydrated in ascending grades of alcohol. They were then cleared in xylol, embedded in paraffin, sectioned at 4-6 microns thickness and stained with Heamtoxylin and Eosin for examining heart and liver parts according to Carleton (1979).

Statistical Analysis

The data obtained from chemical composition,sensory and biologically evaluations were statistically analy3ed by the Duncan´s multiple range test at 0,05levels probability procedure to Duncan, (1974).

RESULTS AND DISCUSSION

Chemical analysis

Chemical analysis for chickpea –cake-cake10%-biscuit and biscuit10% table (4).

Chemical analysis for chickpea –cake-cake10%-biscuit and biscuit10% table (5).

Table (4): Chemical analysis to measure the level of iron and zink in the blood serum for chickpea –cake-cake10%-biscuit and biscuit10%

Samples	Test methods	Test results	
		Fe	Zn
Chickpea	AOAC (2007)	169.89	39.66
Cake		250.27	11.87
Cake10%		124.27	13.11
Biscuit		87.71	19.77
Biscuit10%		68.55	10.97

Analysis was by determined a factor of Food Technology Institute in Giza.

Table (5): Fats, Carbohydrate and protien analysis.

Samples	Fats results mg\100g	Cho results Mg\100g	Protein results mg\100g
Chickpea	0.06	2.58	9.8
Cake	0.205	1.69	6.3
Cake10%	0.211	2.27	5.25
Biscuit	0.247	4.26	5.05
Biscuit10%	0.185	4.95	4.72

Analysis was by Central Laboratory, Faculty of Agriculture Minoufia University.

Nutrition evaluations:

Biological changes:

1Boody weight gain, feed intake and feed efficiency ratio:

Effect of chickpea powder on body weight gain (BWG%) and feed efficiency ratio of rats with protein malnutrition table (6)**.**

The mean value of BWG% showed asignificant decrease in positive control group as compared to negative control group was (0.675±1.96^{b} and 26.1±7.7^{a} g respectively). Feed intake (F1) it could be observed that the mean value of positive control group was significant higher than negative control group (18.66±0.05^{abc} and 18.77±0.05^{ab} g/dayrespectively. FER showed significant increase in positive control group as compared to negative control group was (0.03±0. 02^{b}and 0.025±0.05^{a}g respectively). (BWGT)% showed a significant decrease in positive control group as compared to negative control group it was 5.7±3.13^{c} and 12.24±0.4^{b} respectively .All treated diet (chickpea – cake – cake10% - Biscuit and Biscuit10%) showed significant increase (P≤0.05) as compared to positive control group. FERT% showed a significant increase in positive control group as compared to healthy group was 0.07±0.04^{b} and 0.02±0.07^{bc} respectively .Rats fed on supplemented diet with (cake , cake10% , Biscuit and Biscuit10%) showed a significant defference (P<0.05) as compared to positive control group .But the chickpea group showed non-significant deference (P≤0.05) than for (C+). John *et al*., (1984). All animals demonstrated typical iron deficiency body size was reduced as protein intake decreased. Qureshi and Qureshi ., (2001).they concluded that protein malnutrition is reflected from the decrease in the serum albumin levels of the animals and their weights are also decreased significantly . Thavarajah *et al*., (2012) chickpea-based whole food solutions to global micronutrient malnutrition.

Relative weight of organs:

The effect of different shapes of chickpea powder on brain, lung, heart, kidneys and liver weights of malnourished protein and treated rats in table (7).

These results revealed that the mean values of brain showed a significant decrease in positive control group as compared to negative control group it was 0.77±0. 6^{c} and 0.99 ±0.1^{a} g respectively . All supplemented diet of (chickpea – cake – cake10% - Biscuit and Biscuit10%) showed a significant increase (P≤0.05) as compared to positive control group (c+) .the mean values of lung showed a significant decrease in positive control group as compared to negative control group it was 0.84±0.12^{b}g and 1.1±0.02^{ab} g respectively . rats fed on supplemented diet with chickpea – cake – cake10% - Biscuit and Biscuit10% showed a significant increase (P≤0.05) as compared to positive control group . The mean values of heart showed a significant increase in positive control group as compared to negative control group it was 0.47±0.6^{c} and 0.89±0.01^{a} g respectively .All supplemented diet of (chickpea – cake – cake10% - Biscuit and Biscuit10%) showed a significant increase (P≤0.05) as compared to positive control group (c+) .

The mean values of spleen showed a significant decrease in positive control group as compared to negative control group it was 0.58±0.04^{c} and 1.2 ±0.02^{ab} g respectively . All supplemented diets of (chickpea – cake – cake10% - Biscuit and Biscuit10%) showed a significant increase (P≤0.05) as compared to positive control group . These result revealed that the mean values of kidneys showed non- significant increase in positive control group as compared to negative control group it was 1.3±0.06^{a} and 0.98 ±0.3^{a} g respectively. All treated groups (chickpea – cake – cake10% - Biscuit and Biscuit10%) showed non-significant increase (P≤0.05) as compared to positive control group . The mean values of liver showed a significant increase in positive control group as compared to negative control group it was 3.3±0. 2^{a} and 3.3±0.1^{abc} g respectively . All supplemented diet (chickpea – cake – cake10% - Biscuit and Biscuit10%) showed a significant

decrease (P≤0.05) as compared to positive control group . In addition to Akuyam., (2007) demonstrated that he metabolic changes in PEM (protein energy malnutrition) include water and electrolytes impalance ., amino acids and prtotein deficiencies ., carbohydrates and energy dificiencies ., A decrease in the weight of the orgain. in addition to Santhoshi1 *et al.,* (2013)this result due to Perhaps flavonoids present in the Cicer arietinum seeds may be responsible for the marked Hepatoprotective effect. In addition to Yadav, S. *et al* (2007) showed that there is also a case for increasing chickpea consumption in countries with plentiful protein supply and increase in body weight gain because of the apparent health benefits related to the consumption of chickpea.thise results maybe duo to the subsidized food chickpeas a good source of carbohydrates and protein, and the protein quality is considered to be better than other pulses.

Table (6): Mean values of body weight gain and feed efficiency ratio of malnourished protein and treated rats: (n= 6)

Groups	FI g/day	BWG%	FER	BWGT%	FERT
C(-)	18.77±0.05 ^{ab}	26.1±7.7^{a}	0.025±0.05^{a}	12.2±0.4^{b}	0.07±0.04 ^{b}
C(+)	18.66±0.05 ^{abc}	0.675±1.96 ^{b}	0.03±0.02^{b}	5.7±3.13 ^{c}	0.01±0.07^{bc}
Chickpea	18.42±0.14 ^{c}	0.73±5.7 ^{b}	0.011±0.07^{b}	17.2±3.2 ^{ab}	0.02±0.01^{b}
Cake	18.53±0.16 ^{bc}	0.94±2.5 ^{b}	0.06±0.02^{b}	10.2±0.97^{b}	0.01±0.01 ^{c}
Cake 10%	18.64±0.7 ^{abc}	0.53±6.4 ^{b}	0.06±0.06^{b}	14.4±5.3^{b}	0.02±0.02 ^{bc}
Biscuit	18.69±0.12 ^{abc}	0.31±4.06 ^{b}	0.019±0.02^{b}	13.98±2.29^{b}	0.017±.02 ^{bc}
Biscuit 10%	18.74±0.04 ^{ab}	0. 43±2.5 ^{b}	0.024±0.04^{b}	28.36±8.2^{a}	0.039±0.06^{a}

Table (7): Mean values of Relative Organs weight ratio of protein malnutrition rats: (n= 6)

Groups	Brain	lung	heart	spleen	kidneys	Liver
C(-)	0.99±0.1 ^{a}	1.1±0.02 ^{ab}	0.89±0.01 ^{a}	1.2±0.02 ^{ab}	0.98±0.3 ^{a}	3.3±0.1 ^{abc}
C(+)	0.77±0.6 ^{c}	0.84±0.12 ^{b}	0.47±0.06 ^{c}	0.58±0.04 ^{c}	1.3±0.06 ^{a}	3.3±0.2 ^{a}
Chickpea	1.4±0.3 ^{a}	1.13±0.07 ^{a}	0.85±0.1 ^{ab}	1.13±0.05 ^{a}	1.7±0.03 ^{a}	3.1±0.13 ^{ab}
Cake	0.86±0.4 ^{bc}	0.95±0.02 ^{ab}	0.82±0.02 ^{ab}	1.1±0.08 ^{a}	0.9±0.5 ^{a}	3.5±0.06 ^{abc}
Cake 10%	0.96±0.3 ^{ab}	1.01±0.01 ^{ab}	0.85±0.05 ^{ab}	1.7±0.09 ^{ab}	0.99±0.05 ^{a}	2.8±0.09 ^{bc}
Biscuit	0.85±0.1^{bc}	0.91±0.02 ^{b}	0.72±0.07 ^{b}	0.89±0.03 ^{b}	0.93±0.2 ^{a}	2.7±0.07 ^{c}
Biscuit 10%	0.88±0.1 ^{bc}	0.95±0.03 ^{ab}	0.82±0.02 ^{ab}	0.95±0.05 ^{a}	1.6±0.8 ^{a}	3.2±0.15 ^{ab}

- Biochemical evaluations :

Serum lipid profile

Effect of chickpea powder supplementation rats diet suffered from protein malnutrition in levels of total cholesterol and trig lycerides (Table 8):

These results revealed that the mean values of cholesterol showed a significant decrease in positive control group as compared to negative control group it was 41.8 ± 0.83^{c} and 64± 1.57mg\dl respectively Rats fed on supplemented diet with chickpea , cake 10% Biscuit10% showed a significant increase (p ≤ 0.05) as compared to positive control group . But snpplemented diet with cake and Biscuit showed non-significant increase (p ≤ 0.05) than for control (C+). In the same table show the mean values of triglyceride showed a significant increase in positive control group it was 70 ± 3.65^{a} – 57.5 ± 581^{a} mg|dl .All supplemented diets showed a significant decrease (p ≤ 0.05) when comparing with positive control rats. The obtained data were agreement with theses Talwinder., *et al* (2011) garbanzo diet has the potential to lower the risk of atherosclerosis and improved human health .because Chickpea is cholesterol free and is a good source of dietary fiber Jukanti1 *et al.,* (2012).

Table (9) showed the effect of chickpea powder on serum lipids fraction of protein malnutrition rats:

The mean values of HDL showed a significant decrease in positive control group as compared to negative control group it was 14.3±0.71 ^{e}and 20.6±1.02^{a}mg/dl, respectively .All supplemented diet chickpea – cake – cake10% - Biscuit and Biscuit10% showed a significant increase (P≤ 0.05) as compared to positive control group. These results revealed that the mean values of LDL Showed significant decrease in positive control group as compared to negative control group it was 13.5±0.84^{d} and 31.8±1.24^{ab} mg/dl respectively .All treated groups diet chickpea – cake – cake10% - Biscuit and Biscuit10% showed a significant increase (P ≤ 0.05) as compared to positive control group These result revealed that the mean values of VLDL showed a significant increase in positive control group as compared to negative control group it was 14±0.73^{a}mg|dl and 11.5±0.56^{cd}mg/dl respectively .All supplemented diet chickpea – cake – cake10% - Biscuit and Biscuit10% showed a significant decrease (P≤0.05) as compared to positive control group .The present results are in agreement with Jukanti1 *et al* .,(2012) regular intake of Chickpeas can lower LDL (bad) and total cholesterol and these results due to Chickpea is composed of polyunsaturated fatty acids (PUFA; ~ 66%), monounsaturated fatty acids (~19%) and ~ 15% saturated fatty acids. Chickpea is relatively a good source of nutritionally important PUFA, linoleic acid (51.2 %; LA) and monounsaturated oleic acid (32.6%; OA). Chickpea has higher amounts of linoleic and oleic acid compared to other edible diets Linoleic acid is the dominant fatty acid in chickpea followed by oleic and palmitic

Table (8): Mean values of serum total cholesterol and triglyceride of protein malnutrition rats: (n= 6)

Groups	Total Cholesterol mg/dl	Triglyceride mg/dl
C(-)	64±1.57 ^{a}	57.5±2.81 ^{cd}
C(+)	41.8±.83 ^{c}	70±3.65 ^{a}
Chickpea	67±1.03 ^{a}	57.16±2.08 ^{cd}
Cake	45.8±7.3 ^{c}	64.5±1.17 ^{ab}
Cake 10%	63±2.2 ^{a}	54.3±1.42 ^{d}
Biscuit	46±1.39 ^{c}	62.6±1.21 ^{bc}
Biscuit 10%	58.3±2.47 ^{b}	56±2.51 ^{cd}

Table (9): Mean values of serum HDL-c, LDL-c and VLDL-c of protein malnutrition rats: (n= 6)

Groups	HDL mg/dl	LDL mg/dl	VLDL mg/dl
C(-)	20.6±1.02 ^{a}	31.8±1.24 ^{ab}	11.5±0.56 ^{cd}
C(+)	14.3±0.71 ^{d}	13.5±0.84 ^{d}	14±0.73 ^{a}
Chickpea	21.3±0.88 ^{a}	17.2±2.4 ^{c}	11.4±0.4 ^{cd}
Cake	17.1±0.47 ^{c}	32.8±1.42 ^{a}	12.9±0.2 ^{ab}
Cake 10%	19.6±0.66 ^{ab}	18.3±1.2 ^{c}	10.8±0.2 ^{d}
Biscuit	16.8±0.3 ^{c}	30.8±2.5 ^{ab}	12.5±0.2 ^{bc}
Biscuit 10%	17.8±0.47 ^{bc}	29.3±2.4 ^{b}	11.2±0.5 ^{cd}

Protein fractions

Total protein , albumin , globulin and albumin / globulin (A/G ratio).

The effect chickpea powder on total protein , albumin , globulin and albumin / globulin (A/G ratio) Table (10).

The mean values of total protein showed a significant decrease in positive control group as compared to negative control group it was 3.6±0. 15^{d} and 6.7±0.18^{d} mg/dl respectively . All supplemented diets (chickpea – cake – cake10% - Biscuit and Biscuit10%) showed a These result revealed that the mean values of Albumin showed a significant decrease in positive control group as compared to negative control group it was 1.4±0.05^{c} and 3.6±0.06^{d}mg/dl, respectively .All treated diets (chickpea – cake – cake10% - Biscuit and Biscuit10%) showed a significant increase (P≤0.05) as compared to positive control group significant increase (P≤0.05) as compared to positive control group The mean values of Globulin showed a significant decrease in positive control group as compared to negative control group it was 2.21±0. 13^{c} and 3.1±0.17^{d} mg/dl, respectively .All supplemented diet (chickpea – cake – cake10% - Biscuit and Biscuit10%) showed a significant increase (P≤0.05) as compared to positive control group. Also, in the same table the obtained results showed that there was a significant decrease in albumin / globulin (A/G ratio)in (C+) as compared to normal rats 0.64±0.03^{b} and 1.18±0.07^{d} mg/dl respectively .In rats fed on all treatment diets, there was a significant increase as compared to positive control group. The present results are in agreement with Qureshi and Qureshi ., (2001), the results showed a significant change in the weights of the experimental animals right form the first week of malnutrition while the change in serum albumin level became significant after prolonged malnutrition .they concluded that protein malnutrition is reflected from the decrease in the serum albumin levels of the animals and their weights are also decreased significantly .this result may be due to chickpea it an important source of food proteins. They contain high amounts of lysine, leucine, aspartic acid, glutamic acid and arginine and provide well balanced essential amino acid profiles when consumed with cereals and other foods rich in sulphur-containing amino acids and tryptophan (Boye *et al*., 2010).

Zink and iron minerals*:*

Mean values of serum minerals of protein malnutrition rats table (11) :-

In relation to zinc, it could be observed that the mean values of negative control group was significant higher than positive control group3.50±0.05^{a} and 2.03 ± 0.07^{e}ug/ml, respectively). All supplemented diets of (chickpea – cake – cake10% - Biscuit and Biscuit10%) showed a significant increase (P≤0.05) as compared to positive control group. The mean values of Iron showed a significant decrease in positive control group compared to negative control

group it was 0.2±0.02[c] and 0.7±0.02[a]ug/ml, respectively . All treaded group (chickpea, cake, cake10%, biscuit and biscuit10%) showed a significant increase (P<0.05) as compared to positive control group . Who concluded that Yadav,. (2007) chickpea has the potential to supply ~40% of the adult RDA for manganese and copper, or ~15% for iron and zinc, most chickpea varieties would in fact be able to supply sizeable amounts of the RDA. Of these micronutrient minerals, iron and zinc are needed in the highest daily amounts (18 mg or 11 mg, respectively). (Sivakumar *et al*., 2006). Their zinc intake is lower than the RDA of 8 mg /day.

Since the metabolisms are altered during infection or illness, the serum zinc levels are reduced . The food supplement of chickpea given to children contains adequate amount of micronutrients especially zinc and good amount of protein which might have attributed towards increasing the serum zinc levels.

Table (10): Mean values of serum total protein, albumin, globulin and albumin :globulin ratio (A:G ratio) of protein malnutrition rats: (n= 6)

Groups	Total protein mg/dl	Albumin mg/dl	Globulin mg/dl	A/G ratio
C(-)	6.7±0.18 [a]	3.6±0.06 [a]	3.1±0.17[a]	1.18±0.07[a]
C(+)	3.6±0.15 [d]	1.4±0.05 [c]	2.21±0.13[c]	0.64±0.03[b]
Chickpea	6.3±0.22 [ab]	3.5±0.08 [a]	2.7±0.18[ab]	1.3±0.03[a]
Cake	5.4±0.08 [c]	3.08±0.08 [b]	2.3±0.05[bc]	1.3±0.05[a]
Cake 10%	6.0±0.22 [bc]	3.5±0.17 [a]	2.5±0.15[bc]	1.4±0.12[a]
Biscuit	5.3±0.21 [c]	3.1±0.1 [b]	2.2±0.16[bc]	1.4±0.08[a]
Biscuit 10%	5.6±0.15 [c]	3.2±0.09 [b]	2.4±0.12[bc]	1.3±0.08[a]

Table (11): Mean values of serum minerals of protein malnutrition rats: (n= 6)

Groups	Zinc *(µg/ml)*	Iron *(µg/ml)*
C(-)	3.5±0.05 [a]	0.7±0.02 [a]
C(+)	2.03±0.07 [e]	0.2±0.02 [c]
Chickpea	3.4±0.11[a]	0.7±0.03 [a]
Cake	3.08±0.05 [c]	0.5±0.03 [b]
Cake10%	3.2±0.08 [b]	0.7±0.02 [a]
Biscuit	2.8±0.1 [d]	0.4±0.04 [b]
Biscuit10%	2.9±0.04 [cd]	0.5±0.02 [b]

Histopathological studies

The liver:

Histopathological studies were conducted on liver sections and results were shown in the following photoes (1 :12):

In control group, the liver sections exhibited the normal architecture of hepatic lobules. Each lobule is formed of cords of hepatocytes radiating from the central vein. The hepatocytes are separated by narrow blood sinusoids rich in Kupffer cells

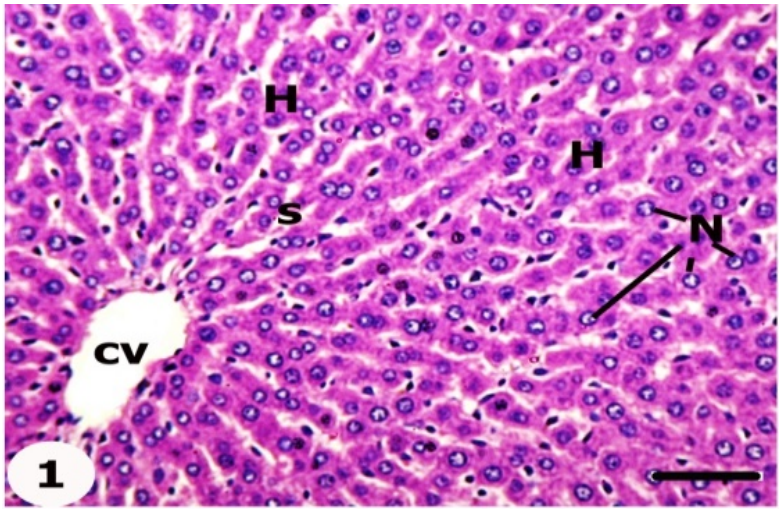

Photo. (1): Section in the liver of control rat showing normal architecture of hepatocyte (H) radiating from central vein (cv) with central vesicular nuclei (arrows). The hepatocytes are separated by narrow blood sinusoids (s). bar =12.5

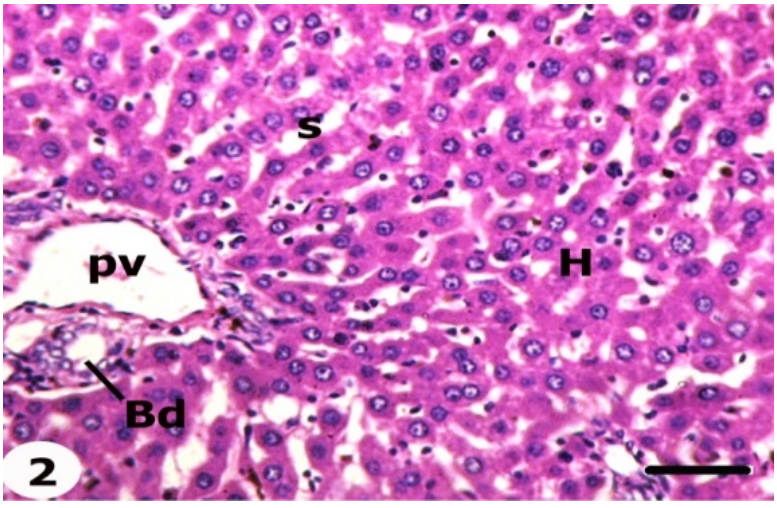

Photo. (2): Showing portal area between hepatic lobules with a branch of bile ductile (BD) and branch of the portal vein (pv). bar =12.5

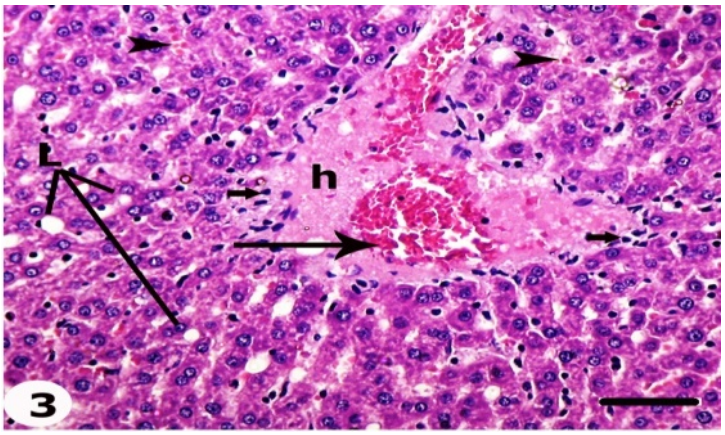

Photo. (3): Section in the liver of rat received low protein diet showing dilatation and congestion of the central vein (long arrow), hyalinization area (h) and inflammatory cells infiltration (short arrows).

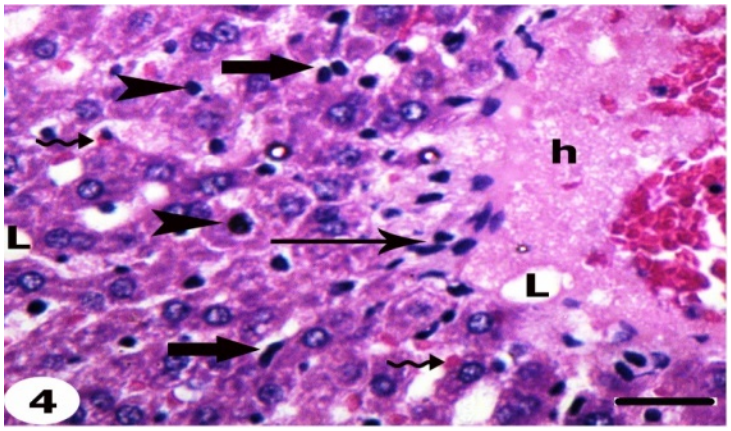

Photo (4): High magnified portion of previous figure showing lipid droplets (L), pyknotic nuclei (head arrows) and proliferation of kupffer cells (thick arrows). bar= 6.25

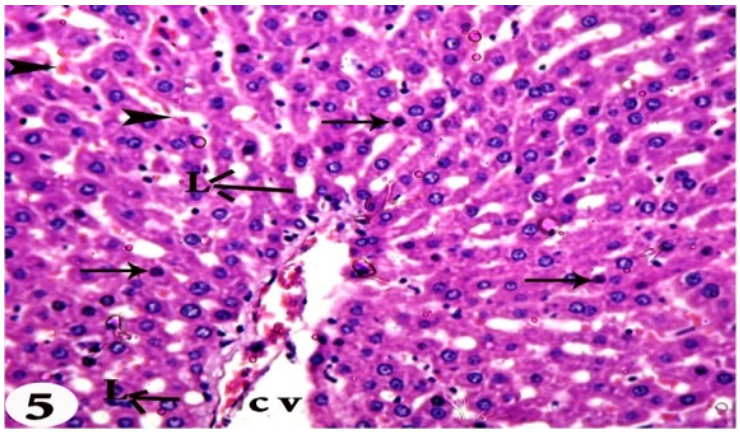

Photo. (5): Showing many lipid droplets (L), pyknotic nuclei (thin arrows), dilatation and congestion of sinusoids (head arrows) in protein malnutrition rat. bar =12.5

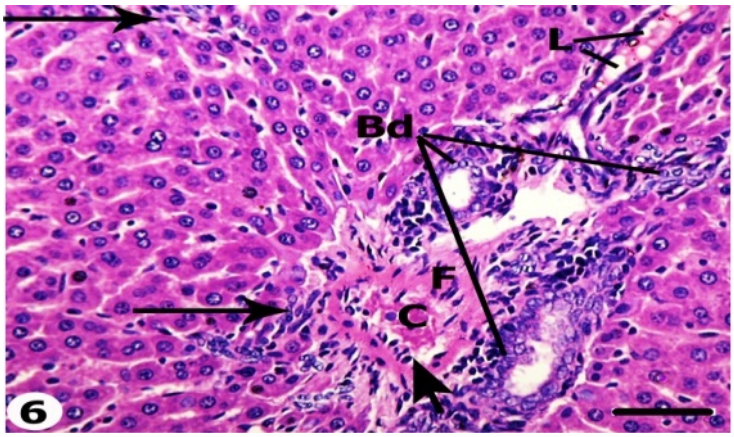

Photo (6): Showing inflammatory cells infiltration in the portal area (long arrows), proliferation of bile ductules (Bd), fibrosis (F) and congestion of portal vein (C) with its swelling endothelial cells (short arrows).

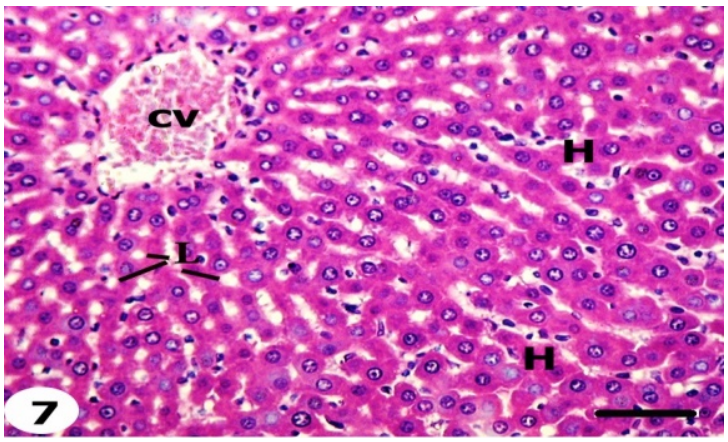

Photo. (7): Section in the liver of malnutrition rat treated with supplemented biscuit with chickpea showing congestion of the central vein (cv) and few lipid droplets (L). bar =12.5

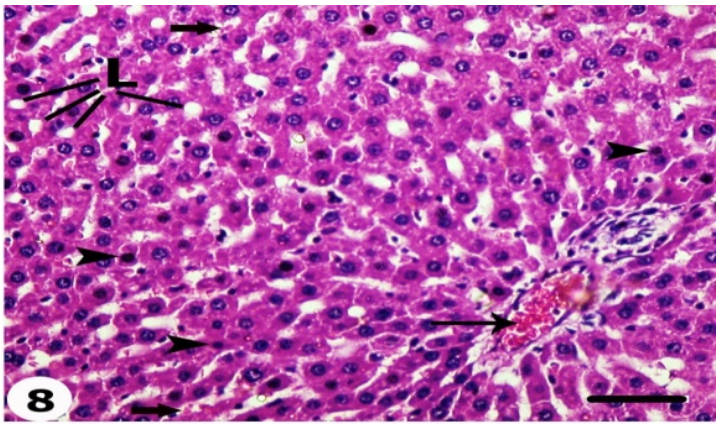

Photo. (8): Showing no inflammatory cells in portal area but congestion of portal vein (thin arrow) are noticed. Lipid droplets (L), pyknotic nuclei (head arrows), dilatation and congestion of sinusoids (thick arrows) still observed. bar =12.5

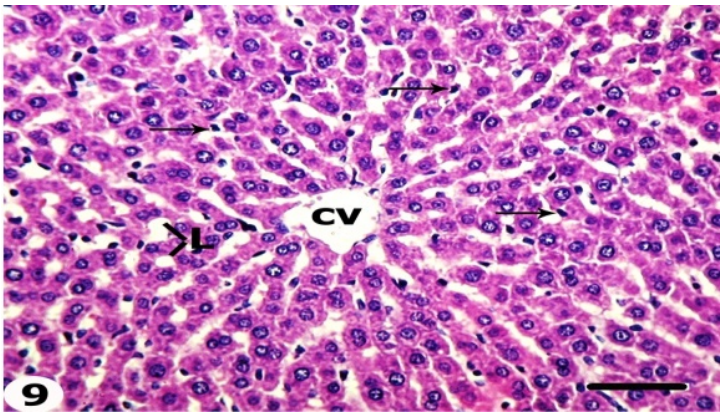

Photo (9): Section in the liver of rat received supplemented cake with chickpea showing very few lipid droplets (L) and slight activation of kupffer cells (arrows). bar =12.5

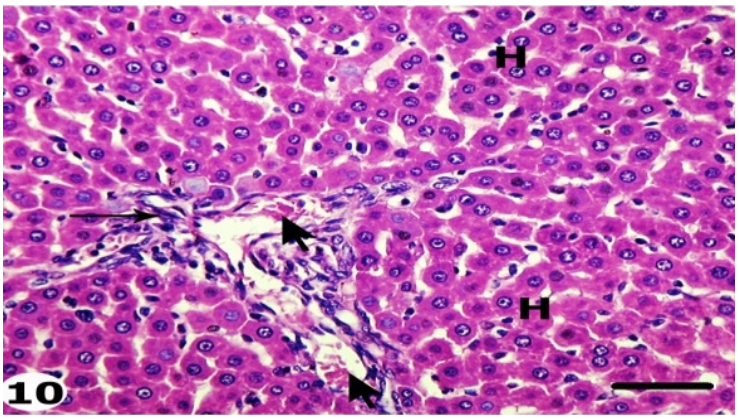

Photo (10): Showing little lymphocyte infiltrations (arrow) at the portal area and slightly congestion of portal vein. No lipid droplets are found. bar =12.5

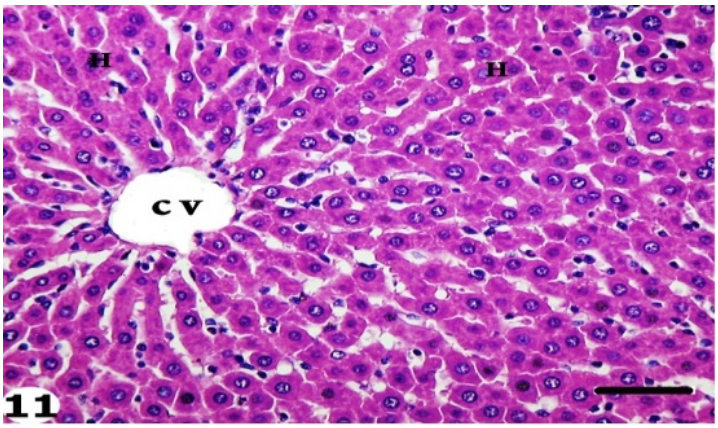

Photo (11): Section in the liver of malnutrition rat treated with chickpea showing normal appearance of hepatocyte and central vein. bar =12.5

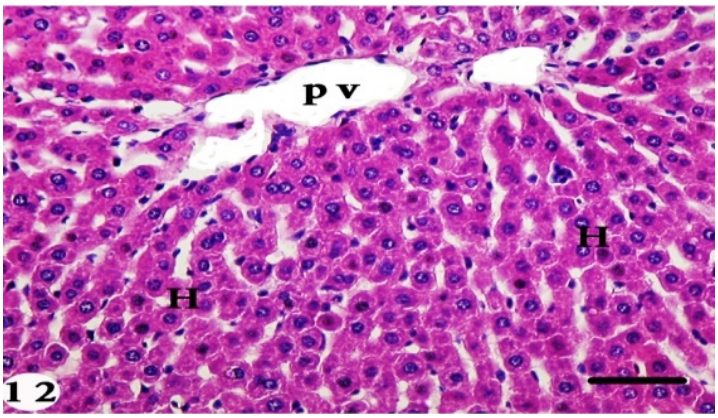

Photo (12): Showing portal area with normal appearance similar to control. bar =12.5

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دراسات غذائية وبيوكيميائية عن التدعيم بمسحوق الحمص المجوهر لغذاء الفئران التى تعانى من سوء التغذية بالبروتين

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الملخص العربي

اجريت الدراسة الحالية لمعرفة التأثير الغذائى لتدعيم غذاء الفئران المصابة بسوء التغذية بالبروتين بمسحوق الحمص المجوهر والكيك والبسكويت المدعم به على مستويات دهون الدم و إنزيمات الكبد وبروتينات السيرم وظائف الكلى ومعادن الحديد والزنك

تم تدعيم الكيك والبسكويت بمستويات 10–20% من مسحوق الحمص المجوهر واجراء اختبار التذوق الحسى والتكنولوجى له لاختيار الافضل قبولا لدى المستهلك. تم تدعيم غذاء الفئران بالكيك والبسكويت الاكثر قبولا وهو المدعم ب 10% تم تنفيذ التجربة على 42 فأر ابيض ذكر من النوع الالبينو وتقسيمهم عشوائيا الى مجموعتين اساسيتين الاولى (6 فئران) تتغذى على الغذاء الاساسى والثانية(36 فأر) تتغذى لمدة 3 أسابيع على الغذاء قليل البروتين 2% لاحداث سوء التغذية بالبروتين. ثم تقسم المجموعة الثانية الى 4 مجموعات تترك واحدة منها على الغذاء قليل البروتين والثلاث الاخرى تقسم كالتالى:

الاولى تدعم غذاؤها الاساسى ب 20% مسحوق حمص مجوهر و الثانية تدعم غذاؤها الاساسى ب 20% مسحوق الكيك المدعم بالحمص المجوهر والثالثة تدعم غذاؤها الاساسى ب 20% مسحوق كيك غير مدعم والرابعة تدعم غذاؤها الاساسى ب20% مسحوق البسكويت المدعم بالحمص المجوهر والخامسة تدعم غذاؤها الاساسى ب 20% مسحوق بسكويت غير مدعم

وتم قياس الكولسترول الكلى، الجلسريدات الثلاثية، الليبوبروتينات (HDL–C, LDLC, VLDLC)،معامل تصلب الشرايين, إنزيمات الكبد(ALT, AST, ALP)، البروتين الكلى ، الألبيومين, الجلوبيولين, النسبة بين الألبيومين إلي الجلوبيولين ,اليوريا,حمض اليوريك,الكرياتنين وتم قياس مستوى الحديد والزنك في الدم كذلك إجراء الفحص الهستوباثولوجى للكبد والقلب.

وقد أظهرت نتائج هذه الدراسة أن تناول الغذاء المدعم بالحمص المجوهر وكذلك الكيك المدعم ب10%من الحمص المجوهر وكذلك البسكويت المدعم ب 10%من الحمص المجوهر قد نتج عنه تحسن في دهون الدم ووظائف الكبد والكلي وتحسن في تغيرات انسجه الكبد والقلب وتحسن نسبة الحديد والزنك في الدم . وطبقا لهذه النتائج فإنه يمكن استخدام الحمص المجوهر والاغذية المدعمة بالحمص المجوهر لتحسين دهون الدم وتحسين نسبة الحديد والزنك وزيادة وزن الجسم .

الكلمات المفتاحية: الحمص المجوهر، الكيك المدعم بالحمص , البسكويت المدعم بالحمص, الحديد ،الزنك،إنزيمات الكبد، دهون الدم، التغيرات الهستوباثولوجية للكبد والقلب.