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1. INTRODUCTION:

Mung bean *(Vigna radiat]a* (L.) Wilczec) introduced to Egypt by the Ministry of Agriculture in the last few years mung bean was an important summer legume crop in the Philippines, all Asia, India, Pakistan, USA and Iraq **(Tulsiani and Pant 1968 [28] ; Shehata and Thannoun 1980 [26]) .**

Li Zixing *et al.* (1981) [17] stated that mung bean powder (7.0%) was given to rabbits feed with a high fat ration for 2.5 months. The increase of serum total cholesterol (TC) and lipoprotein was less than with the control.

Sharma (1987) [25] ; Kingman *et al.* (1993) [14]; Zulet and Martinez (1995) [32]; Zulet *et al.* (1999b) [33] showed that other legumes such as kidney beans, peas, chickpea and etc. have also shown hypocholesterolaemic properties.

Foster Powell and Miller (1995) [10] and Anderson *et al.* (1999) [3].reported that legumes (fenugreek, faba beans and mung beans) having low glycaemic indexes had been shown to have hypocholesterolaemic effects and contain phytochemicals that might act as chemopreventive agents.

Lerer Metzger *et al.* (1996) [16] reported that replacing wheat starch with mung bean (570 g *I* Kg) in a mixed diet for 5 wk. resulted in a reduction in triacylglycerols and a decrease in dipocyto diameter in both normal and diabetic rats.

Nishimura *et al.* (2000) [21] reported that dietary fiber prepared from crude mung bean sprouts was tested for its cholesterol lowering effects in rats. Following 21 day on a fiber enriched diet, a significant reduction in total plasma cholesterol levels was accompanied by an increase in total caecal short chain fatty acids.

Zecharia and Aliza (2002) [31] outlined that feeding diabetic rats on mung bean starch reduced plasma triacylglycerol concentrations and adipocyte volume.

2. MATERIAL AND METHODS:

2.1. Materials:

2.1.1. Source of samples:

50 kg of mung bean *(vigna radiata* (L.) Wilczek) seeds of the Kawmy variety (2003 -2004 Season) were obtained from Agriculture Research Center, Giza, Cairo.

2.1.2. Preparation of samples:

2.1.2.1. Soaking:

Seeds were removed of broken, dust and other foreign materials then soaked in water for 12 h at 25°C. Seeds to water ratio was 1 : 5 (W *IV).* The unimbibed water was discarded. The soaked seeds were washed twice with ordinary water followed by rinsing with distilled water and then dried at 55°C for 30 h.

2.1.2.2. Germination:

The presoaked seeds (12 h) were spread on wet filter paper in stainless steel baskets. The temperature of germinated seeds ranged from 20 to 23 °c during the 72 h of sprouting. Then germinated seeds were dried at 55°C for 30h.

2.1.2.3. Cooking:

Both soaked (12 h) and germinated seeds (72 h) were rinsed in distilled water and put in a stainless steal pan. After adding distilled water 3: .1 seeds to water (W/V), the samples were boiled until soft, as felt between fingers. The cooking water was decanted and the cooked seeds were dried at 70°C for 36 h. Raw seeds were also cooked in the same manner, using a seed to water ratio of 1:7(W/V).

Different seed samples were ground in a laboratory wailly mill to pass through a 40 mesh screen. Then, the ground samples were stored in polyethlene bags at 5°C until required for analysis.

2.1.2..4.. Experimental animals:

Forty adult male white albino rats (Sprague dawley strain) weighing between (100 and 120 g) provided from the animal house of the Faculty of Medicine, Assiut University, were housed individually in wire cages under the normal laboratory conditions and fed on the basal diet for a week as adaptation period.

Body weight gain and feed intake were calculated through and by the end of the experiment.

2.1.2.5. Basal diet and untreated diabetic diet:

The basal diet used is outlined in Table (1):

Table (1) : constituents of the basal diet for 100 g diet.

Item	%
Casein	11.36%
Salt mixture	4.0%
Vitamins mixture	1.0%
Corn oil	5.0%
Corn starch	78.64%
Total	100.0%

According to Pellet and Sossy (1970).

2.1.2.6.. Design of the experiment:

The rats were randomly allocated into (8) main groups of (5) rats each. The number of animals in need during the course of the study was collectively (40) males. Each rat was marked on the tail to differentiate between the animals in the (8) groups. Daily administrations were continued for two successive periods (7) weeks each. The first one group used as control and was fed on basal diets while the other seven groups were injected intramuscularly with alloxan (Sigma, chemical company Lot 110H3367 for Laboratory use only) in a single dose of 1..70 mg / kg body weight **(Pang *et al.*1985 [22])**. The drug was dissolved in distilled water.

In the other seven groups the animals were tested for diabetes after five days from the start of injection of alloxan. The animals were considered diabetic when its glucose level was 250 mg / 100) m. or more (normal blood glucose level was ranged between 90 -120 mg / 100 ml.).

After the onset of induced diabetes with alloxan, the animals were subdivided into the following groups and fed on treated mung beans and products of mung bean as follows:

Treated mung bean groups :

Group 1 : control group was fed on basal diet.

Group 2 : diabetic group was fed on basal diet.

Group 3 : diabetic group was fed on raw mung bean.

Group 4 : diabetic group was fed on soaked mung bean.

Group 5 : diabetic group was fed on germinated mung bean,

Group 6 : diabetic group was fed on raw-cooked mung bean.

Group 7 : diabetic group was fed on soaked cooked mung bean.

Group 8 : diabetic group was fed on germinated cooked mung bean.

2.1.2.7. Blood sampling:

At the end of each experiment, rats were fasted overnight and anesthetized.

Blood samples were collected from the retro-orbital plexus from all animals of each group into clean, dry and labeled tube. The tubes contained heparin (10.0 IU *I* ml) as anticoagulant. Blood was centrifuged (3500 r-p. m for 15 min) to separate plasma which was tightly kept in sealed aliquot tubes at -20°C until biochemical assays according to **Ilwy (2003)** [(12)] .

2 .2. Methods

2.2.1. Chemical Methods:

2.2..1.1. Determination of serum

triglycerides:

Fully enzymatic determination of total triglycerides in serum was estimated spectrophtometrically at 500ŋ m according to the method of **Wahlefeld (1974)** [29] of the enzymatic hydrolysis of triglycerides using Stanbio kits followed by determination of the liberated glycerol by colorimetry.

2.2.1.2. Determination Of serum cholesterol:

Enzymatic determination of cholesterol was carried out according to the method of **Allian *et al.* (1974)** [2] using kits purchased from Stanbio (Texas, USA).

2.2.1.3. Determination of High Density Lipoprotein (HDL) cholesterol:

The kits were provided from Stanbio, Lab., Inc. Texas. According to **Warnick *et al.* (1983)** [30]. Low density Lipoprotein (LDL) cholesterol is precipitated from serum by magnesium chloride / dextran sulfate reagent.

High density lipoprotein (HDL) cholesterol is then determined in the Supematant using cholesterol reagent.

2.2.1.4.Low Density Lipoprotein (LDL) cholesterol calculation:

LDL was calculated by the difference between total cholesterol, HDL cholesterol and triglycericde. According to **Friedewald *et al.* (1972)** [11] as follows:

Calculation:

$$\text{LDL} = \text{Total cholesterol} - \left(\text{HDL} - \frac{\text{Triglycerides}}{5} \right)$$

2.2.2. Statistical analysis:

Data was analyzed with analysis of variance (ANOY A) procedures using the MSTA T - C Statistical software package **(Michigan State University 1983)** [18]. Where the F-test showed significant differences among means Duncan multiple range test **(1955)** [8] was performed at the 0.05 level of probability to separate means.

3. Results and discussion :

3.1. Blood serum triglycerides in treated mung bean:

The result given in Table (2) and Figure (1) revealed that the blood serum triglycerides of the experimental animals showed significant differences among all the eight studied groups, and feeding weeks as well as interaction between studied groups and feeding weeks at ($P < 0.01$)..

However, the data revealed that the mean values of decrement in the blood serum triglycerides for treated mung bean groups 1, 2, 3, 4, 5, 6, 7 and 8 i.e., control group fed on basal diet, diabetic group fed on basal diet, diabetic group fed on germinated mung bean, diabetic group fed on raw mung bean, diabetic group fed on gem1inated mung bean, diabetic group fed on soaked cooked mung bean, diabetic group fed on raw-cooked mung bean and diabetic group fed on soaked mung bean were 45±62 (De), 118.88 {De), 130.67 (De),135.18 (De), 143.10 (De), 136.60 (De), 125.48 (De) and 131.93 (De); respectively.

Such data confirmed that the most effective group in decreasing serum triglycerides in the experimental animals was group (3) diabetic group fed on germinated mung bean recording (14.45±1.02 mg / dl) decrement by the end of feeding time of experiments, However, the least decrement value was observed for group (2) diabetic group fed on basal diet recording (84.87±2.77 mg / dl) by the end of the feeding time of experiments (the 7th week),

The present data given in Table (2) and Figure (1) showed lowered blood serum triglycerides in the serum of the experimental animals. Such data agree with **Lerer-Metzger *et al.* (1996)** [16] who found reduction in triacylglycerols in both normal and diabetic rats in which replacing wheat starch was replaced with mung bean starch in a mixed diet for 5 weeks.

On the other hand **Kabir *et al.* (1998)** [13] found that plasma triglycerides were not significantly affected by mung bean diet in either normal or diabetic rats.

Table (2): Serum triglycerides content (mg / dl) of the rats fed on different mung bean diets.

Time of observation	Control	Diabetic	Germinated mung bean	Raw mung bean	Germinated - cooked mung bean	Soaked-cooked mung bean	Raw-cooked mung bean	Soaked mung bean
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
End of 1st week	53.16^{tu}	175.51^{hij}	234.48^{abc}	248.81^{a}	245.20^{ab}	232.67^{bc}	222.03^{cd}	206.76^{e}
± S. E.	± 3.67	± 7.38	± 8.22	± 9.28	± 6.57	± 6.22	± 6.25	± 3.76
End of 2nd week	$35.44^{wxy..}$	145.22^{lm}	197.07^{efg}	198.50^{efg}	210.29^{de}	204.83^{ef}	190.93^{fgh}	176.32^{hij}
± S. E.	± 2.07	± 5.31	± 2.38	± 2.26	± 6.59	± 4.82	± 4.59	± 4.92
End of 3rd week	$51.32^{tuv..}$	142.08^{m}	175.61^{hij}	176.08^{hij}	186.09^{ghi}	189.00^{gh}	172.79^{ij}	177.07^{hij}
± S. E.	± 2.65	± 7.31	± 3.09	± 2.19	± 7.09	± 5.83	± 3.30	± 3.28
End of 4th week	$45.15^{uvw..}$	123.55^{n}	151.06^{klm}	157.91^{kl}	162.56^{jk}	150.18^{klm}	144.53^{lm}	143.82^{lm}
± S. E.	± 3.07	± 3.53	± 6.76	± 6.43	± 8.90	± 6.79	± 3.50	± 5.76
End of 5th week	31.10^{xyz}	75.50^{rs}	97.85^{opq}	105.67^{op}	107.65^{o}	102.00^{op}	72.80^{rs}	86.95^{qr}
± S. E.	± 1.97	± 3.46	± 3.98	± 3.60	± 5.33	± 2.35	± 3.22	± 4.49
End of 6th week	$50.85^{tuv..}$	85.51^{qr}	$44.17^{uvw..}$	$36.83^{vwx..}$	66.16^{st}	54.51^{tu}	$45.89^{uvw..}$	91.28^{pq}
± S. E.	± 4.60	± 4.93	± 3.27	± 1.67	± 3.86	± 2.06	± 3.54	± 2.81
End of 7th week	52.31^{tuv}	84.87^{qr}	14.45^{z}	22.44^{yz}	23.74^{yz}	23.02^{yz}	29.42^{xyz}	$41.33^{uvw..}$
± S. E.	± 4.26	± 2.77	± 1.02	± 2.73	± 1.35	± 1.51	± 1.45	± 3.55
Mean	45.62^{F}	118.88^{E}	130.67^{C}	135.18^{BC}	143.10^{A}	136.60^{B}	125.48^{D}	131.93^{BC}

S. E. = Standard Error **S = Significant**

Values followed by the same letter within the same column were not significantly different ($P < 0.05$).

F. Test (A) group = (A) 285.92^{**}

F. Test weeks = (B) 1271.59^{**}

F. Test (g × w) = (AB) 40.42^{**}

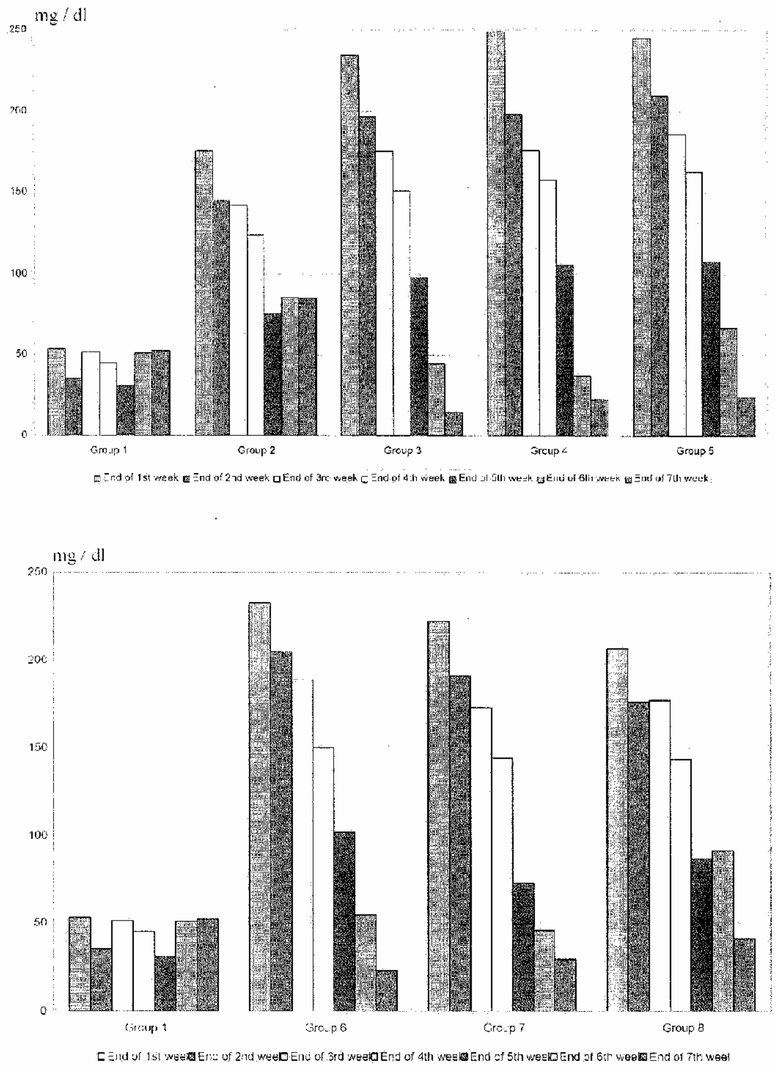


Figure (1): Serum triglycerides content (mg / dl) of the rats fed on different mung bean diets.

3.1.1.Blood serum total cholesterol in treated mung bean:

The results given in Table (3) and Figure (2) revealed that the blood serum total cholesterol showed significant differences among all the eight studied groups, all feeding weeks as well as interaction studied groups and feeding weeks at ($P < 0.01$) in experimental period.

However, the data revealed that the mean values of decrement in the blood serum total cholesterol for treated mung bean groups 2, 3, 4, 5, 6, 7 and 8 i.e., diabetic group fed on basal diet, diabetic group fed on germinated mung bean, diabetic group fed on raw mung bean, diabetic group fed on germinated cooked mung bean, diabetic group fed on germinated-cooked mung bean, diabetic group fed on raw-cooked mung bean and diabetic group fed on soaked mung bean were 111.05 decrement, 96..40 decrement, 98.31 decrement, 99.92 decrement, .1 02.07 decrement, .1 04.19 decrement and 107.24 decrement, while group (1) control group fed on basal diet recorded 66.06 increment.

Such data confirmed that the most effected group in decreasing blood serum total cholesterol in the experimental animals was group 3 (diabetic group fed on germinated mung bean) recording (73.36 ± 3.21 mg / dl) by the end of feeding time of experiments. However, the least decrement value was observed for group (2) diabetic group fed on basal diets recording (105.42 ± 2.69 mg / dl) by the end of the feeding time of experiments (the 7th week).

Such data confirmed that the most effective group in decreasing serum triglycerides in the experimental animals was group (3) diabetic group fed on germinated mung bean recording (14.45 ± 1.02 mg / dl) decrement by the end of feeding time of experiments, However, the least decrement value was observed for group (2) diabetic group fed on basal diet recording (84.87 ± 2.77 mg / dl) by the end of the feeding time of experiments (the 7th week),

Table (3): Serum total cholesterol content (mg / dl) of the rats fed on different mung bean diets

Time of observation	Control	Diabetic	Germinated mung bean	Raw mung bean	Germinated - cooked mung bean	Soaked-cooked mung bean	Raw-cooked mung bean	Soaked mung bean
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
End of 1st week ± S. E.	65.48^{r} ± 6.50	115.31^{abc} ± 4.99	$113.60^{abc..}$ ± 5.40	116.90^{a} ± 4.59	$112.98^{abc..}$ ± 3.44	$114.22^{abc..}$ ± 4.42	$114.60^{abc..}$ ± 3.69	116.16^{ab} ± 5.38
End of 2nd week ± S. E.	66.49^{r} ± 3.19	$114.08^{abc..}$ ± 4.46	$106.42^{abc..}$ ± 3.17	$107.20^{abc..}$ ± 3.02	$109.20^{abc..}$ ± 3.23	$110.28^{abc..}$ ± 3.21	$112.44^{abc..}$ ± 3.81	$113.85^{abc..}$ ± 4.05
End of 3rd week ± S. E.	65.10^{r} ± 3.18	$113.14^{abc..}$ ± 4.11	$102.30^{def..}$ ± 3.14	$103.60^{bcd..}$ ± 3.10	$106.20^{abc..}$ ± 3.13	$108.18^{abc..}$ ± 3.18	$110.00^{abc..}$ ± 3.19	$112.00^{abc..}$ ± 3.72
End of 4th week ± S. E.	66.04^{r} ± 3.16	$111.20^{abc..}$ ± 3.50	$99.12^{ghi..}$ ± 3.13	$101.30^{efg..}$ ± 3.12	$103.40^{cde..}$ ± 3.01	$105.00^{abc..}$ ± 3.33	$107.00^{abc..}$ ± 3.36	$109.00^{abc..}$ ± 3.35
End of 5th week ± S. E.	65.72^{r} ± 3.17	$110.60^{abc..}$ ± 3.67	$97.42^{ijk..}$ ± 3.98	$98.44^{hij..}$ ± 3.27	$100.00^{fgh..}$ ± 3.49	$103.40^{cde..}$ ± 3.01	$104.00^{bcd..}$ ± 3.33	$105.90^{abc..}$ ± 3.31
End of 6th week ± S. E.	66.18^{r} ± 3.20	$107.60^{abc..}$ ± 2.86	$82.60^{nop..}$ ± 3.09	$84.30^{nop..}$ ±3.25	$87.50^{mno..}$ ± 3.09	$89.36^{lmn..}$ ± 4.41	$94.00^{jkl..}$ ± 2.85	$102.20^{def..}$ ± 3.34
End of 7th week ± S. E.	67.40^{r} ± 3.01	$105.42^{abc..}$ ± 2.69	73.36^{qr} ± 3.21	76.48^{pqr} ± 3.03	80.25^{opq} ± 3.18	$84.02^{nop..}$ ± 3.02	$87.26^{mno..}$ ± 3.17	$91.60^{klm..}$ ± 3.32
Mean	66.06^{F}	111.05^{A}	96.40^{E}	98.31^{DE}	99.92^{DE}	102.07^{CD}	104.19^{BC}	107.24^{B}

S. E. = Standard Error **S = Significant**

Values followed by the same letter within the same column were not significantly different ($P < 0.05$).

F. Test (A) group = (A) 105.08**
F. Test weeks = (B) 50.69**
F. Test ($g \times w$) = (AB) 2.12**

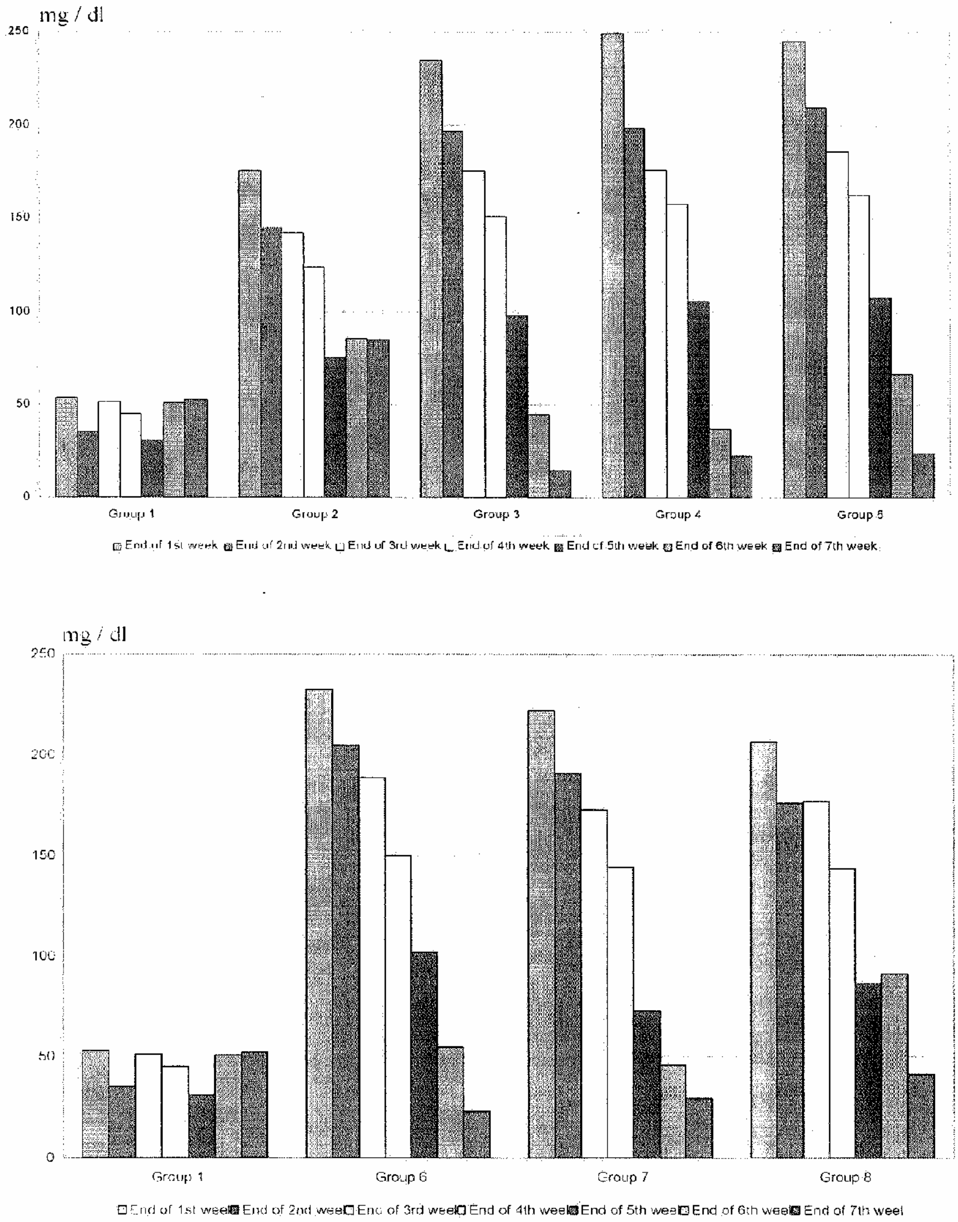


Figure (1): Serum triglycerides content (mg / dl) of the rats fed on different mung bean diets.

The present data given in Table (3) and Figure (2) on blood serum total Cholesterol in the serum of the experimental animals agree with **Kabir *et al.* (1998)** [(13)] who found that there was no difference in the fatty acid synthase activity in either the adipose tissue (153 $\pm$ 22 vs. 122 $\pm$ 23 mung protein, MB vs. WCS) in diabetic rats, While waxy cornstarch diet led to an over expression of tl1e fatty acid synthase gene only in normal rats ($P < 0.05$), in diabetic rats fatty Acid synthase expression was lower than that in normal rats and no difference was detected between the two diet groups.

On the other hand, **Miura *et al.* (1996)** [(19)] found that the total cholesterol concentration was lower in female mice *fed* B14F4 mung bean compared to other females.

However on lipid biosynthesis, dietary high glycemic index starch might also increase circulating lipid levels through an effect on Lipoprotein Lipase (LPL), one of the major lipoprotein catabolizing enzymes **(Eckel 1989)** [(9)].

The data disagree with **Roberto et *al.* (2004)** [(24)] who 1ound an increase in serum total cholesterol in the experimental animals fed on mung bean.

Kabir *et at.* (1998) [(13)] reported that one of the characteristics other than the amylose amylopectin content of the mung bean and the waxy cornstarch to be considered is the resistant starch content.

De Deckere *et at.* (1995) [(6)] fed a diet rich in resistant starch to rats for six weeks and found a reduction in energy absorption and a decrease in epididymal fat pads.

Table (3): Serum total cholesterol content (mg / dl) of the rats fed on different mung bean diets

Time of observation	Control	Diabetic	Germinated mung bean	Raw mung bean	Germinated - cooked mung bean	Soaked-cooked mung bean	Raw-cooked mung bean	Soaked mung bean
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
End of 1st week ± S. E.	65.48^{f} ± 6.50	115.31^{abc} ± 4.99	$113.60^{abc..}$ ± 5.40	116.90^{a} ± 4.59	$112.98^{abc..}$ ± 3.44	$114.22^{abc..}$ ± 4.42	$114.60^{abc..}$ ± 3.69	116.16^{ab} ± 5.38
End of 2nd week ± S. E.	66.49^{f} ± 3.19	$114.08^{abc..}$ ± 4.46	$106.42^{abc..}$ ± 3.17	$107.20^{abc..}$ ± 3.02	$109.20^{abc..}$ ± 3.23	$110.28^{abc..}$ ± 3.21	$112.44^{abc..}$ ± 3.81	$113.85^{abc..}$ ± 4.05
End of 3rd week ± S. E.	65.10^{f} ± 3.18	$113.14^{abc..}$ ± 4.11	$102.30^{def..}$ ± 3.14	$103.60^{bcd..}$ ± 3.10	$106.20^{abc..}$ ± 3.13	$108.18^{abc..}$ ± 3.18	$110.00^{abc..}$ ± 3.19	$112.00^{abc..}$ ± 3.72
End of 4th week ± S. E.	66.04^{f} ± 3.16	$111.20^{abc..}$ ± 3.50	$99.12^{ghi..}$ ± 3.13	$101.30^{efg..}$ ± 3.12	$103.40^{cde..}$ ± 3.01	$105.00^{abc..}$ ± 3.33	$107.00^{abc..}$ ± 3.36	$109.00^{abc..}$ ± 3.35
End of 5th week ± S. E.	65.72^{f} ± 3.17	$110.60^{abc..}$ ± 3.67	$97.42^{ijk..}$ ± 3.98	$98.44^{hij..}$ ± 3.27	$100.00^{fgh..}$ ± 3.49	$103.40^{cde..}$ ± 3.01	$104.00^{bcd..}$ ± 3.33	$105.90^{abc..}$ ± 3.31
End of 6th week ± S. E.	66.18^{f} ± 3.20	$107.60^{abc..}$ ± 2.86	$82.60^{nop..}$ ± 3.09	$84.30^{nop..}$ ±3.25	$87.50^{mno..}$ ± 3.09	$89.36^{lmn..}$ ± 4.41	$94.00^{jkl..}$ ± 2.85	$102.20^{def..}$ ± 3.34
End of 7th week ± S. E.	67.40^{f} ± 3.01	$105.42^{abc..}$ ± 2.69	73.36^{qr} ± 3.21	76.48^{pqr} ± 3.03	80.25^{opq} ± 3.18	$84.02^{nop..}$ ± 3.02	87.26^{mno} ± 3.17	$91.60^{klm..}$ ± 3.32
Mean	66.06^{F}	111.05^{A}	96.40^{E}	98.31^{DE}	99.92^{DE}	102.07^{CD}	104.19^{BC}	107.24^{B}

S. E. = Standard Error S = Significant

Values followed by the same letter within the same column were not significantly different ($P < 0.05$).

F. Test (A) group = (A) 105.08^{**}

F. Test weeks = (B) 50.69^{**}

F. Test (g × w) = (AB) 2.12^{**}

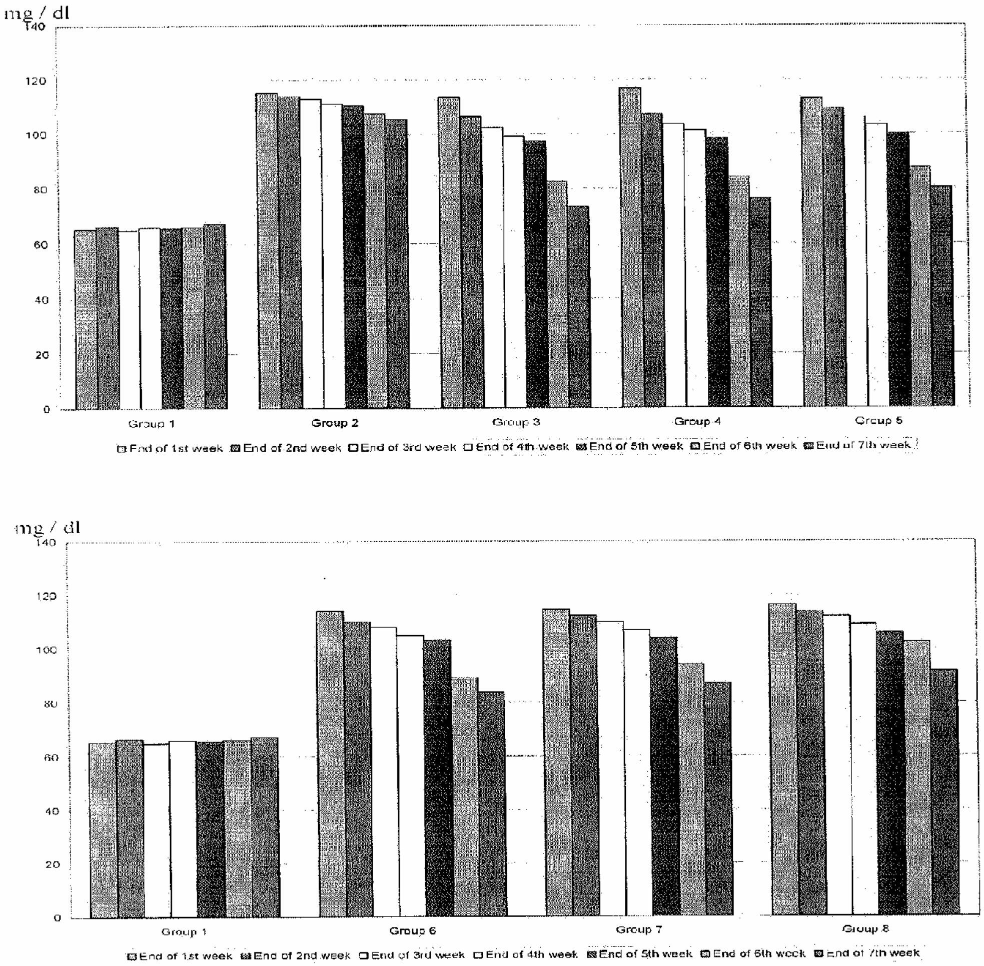


Figure (2): Serum total cholesterol content (mg / dl) of the rats fed on different mung bean diets

The effect of legume proteins had been attributed to their amino acid profile **(Nagata *et at.* .1982[20] and Dabai *et* at 1996[4])** which led to limited number of LDL particles being available *for* transport of cholesterol in the plasma **(Kingman *et al* 1993)[14]**. Thus. a high lysine, arginine ratio induced hypercholesterolaemia **(Kritchevsky *et al.* 1982)** [15] as do a high methionine content and a high methionine glycine ratio. These findings are also agree with **Tanaka and Sugano (1989)** [27] **and Abd-EI-Rahman (1999)** [1] on mung bean seeds.

Starches showed a slight difference where the different rates of digestion could have different chronic effects on glucose and lipid metabolism as the cellular level **Kabir *et al.*, (1998)** [13].

3.1.2. Blood serum HDL (High Density Lipoprotein) in treated mung bean:

The results given in Table (4) and Figure (3) revealed that the blood serum HDL of the experimental animals showed significant differences among all the eight studied groups, all feeding weeks as well as interaction between studied groups and feeding weeks at ($P < 0.01$) in experimental period.

However, the data revealed that the mean values in the blood serum HDL for rats fed on treated mung bean groups 1, 2, 3, 4, 5, 6, 7 and 8 i.e., control group *fed* on basal diet, diabetic group fed basal diet, diabetic group fed on germinated mung bean, diabetic group fed on raw mung bean, diabetic group fed on germinated-cooked mung bean, diabetic group fed on soaked-cooked mung bean, diabetic group fed on raw-cooked mung bean and diabetic group .fed on soaked mung bean were 38.55 (In), 60.91 (De), 48.78 (In), 49.55 (In) 49.52 (In), 51.37 (In), 54.39 (In) and 56.17 (In); respectively.

Such data coincide with **Li Zixing *et at.* (1981)** [17], who found mung bean powder. (70%) was given to rabbits feed with a high fat ration *for* 2.5 months. The increase of serum total cholesterol (TC) and lipoprotein was less than with the control.. Likewise, **Sharma (1987)** [25]; **Kingman *et at.* (1993)** [14]; **Zulet and M.trtincz (1995)** [32]; **Zulet *et at.* (1999b)** [33] reported that other legumes such as kidney beans, peas, chickpea and etc. have also shown hypocholesterolaemic properties.

Table (4): Serum HDL (High Density Lipoprotein) content (mg / dl) of the rats fed on different mung bean diets

Time of observation	Control	Diabetic	Germinated mung bean	Raw mung bean	Germinated cooked mung bean	Soaked-cooked mung bean	Raw-cooked mung bean	Soaked mung bean
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
End of 1st week	37.01^{u}	59.52^{def}	46.80^{st}	47.19^{st}	44.86^{t}	47.51^{rst}	$49.05^{mno..}$	$52.42^{ijk..}$
± S. E.	± 3.17	± 3.41	± 3.39	± 3.48	± 3.34	± 3.09	± 3.32	± 3.33
End of 2nd week	37.02^{u}	62.54^{bcd}	46.91^{st}	47.21^{st}	47.03^{st}	48.25^{pqr}	52.01^{jkl}	$52.48^{ijk..}$
± S. E.	± 0.52	± 3.28	± 1.76	± 1.59	± 2.07	± 1.78	± 3.17	± 3.03
End of 3rd week	37.76^{u}	68.25^{a}	46.60^{st}	47.37^{st}	47.52^{rst}	$48.54^{opq..}$	$52.01^{jkl..}$	$55.05^{ghi..}$
± S. E.	± 3.02	± 3.02	± 3.25	± 3.36	± 3.04	± 3.39	± 3.02	± 3.02
End of 4th week	38.49^{u}	61.77^{bcd}	47.41^{st}	$48.08^{qrs..}$	$48.90^{nop..}$	$51.64^{klm..}$	$53.81^{hij..}$	$55.44^{ghi..}$
± S. E.	± 3.18	± 4.62	± 3.01	± 3.16	± 3.02	± 3.17	± 3.20	± 3.30
End of 5th week	38.81^{u}	60.06^{cde}	46.95^{st}	$47.98^{qrs..}$	$51.15^{lmn..}$	$50.01^{mno..}$	$55.04^{ghi..}$	63.21^{bc}
± S. E.	± 3.34	±3.07	± 3.15	± 3.36	± 3.33	± 4.91	± 3.16	± 3.17
End of 6th week	40.32^{u}	58.10^{efg}	$51.05^{lmn..}$	$53.98^{hij..}$	$51.15^{lmn..}$	$54.11^{hij..}$	63.80^{b}	56.57^{fgh}
± S. E.	± 1.21	±3.26	± 3.04	± 3.16	±3.02	± 3.02	± 3.02	± 3.32
End of 7th week	40.42^{u}	56.15^{fgh}	55.79^{ghi}	$55.06^{ghi..}$	$56.05^{gh..}$	59.50^{def}	$55.04^{ghi..}$	58.00^{efg}
± S. E.	± 3.00	± 2.85	± 3.33	± 3.12	± 3.33	± 3.32	± 3.16	± 3.18
Mean	38.55^{F}	60.91^{E}	48.78^{F}	49.55^{E}	49.52^{D}	51.37^{C}	54.39^{B}	56.17^{A}

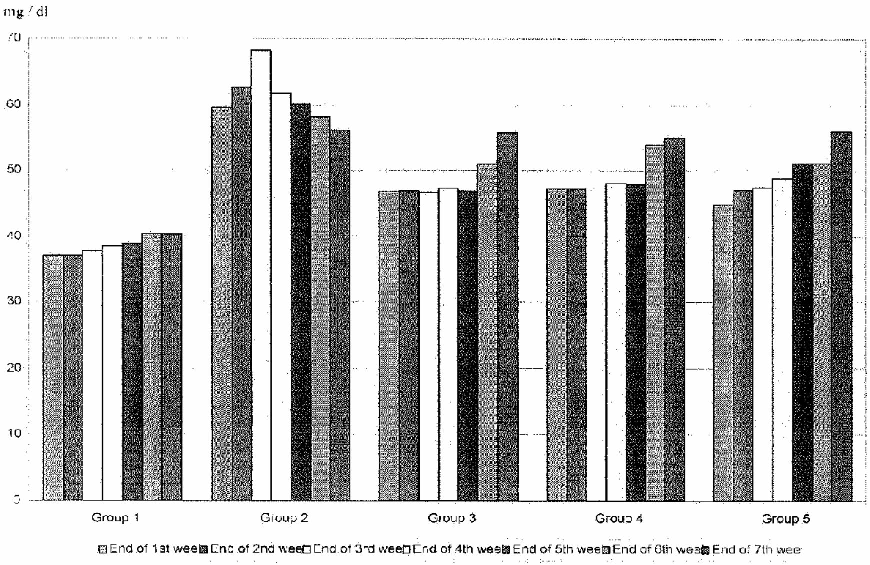
S. E. = Standard Error S = Significant

Values followed by the same letter within the same column were not significantly different ($P < 0.05$).

F. Test (A) group = (A) 267.32^{**}

F. Test weeks = (B) 81.94^{**}

F. Test ($g \times w$) = (AB) 2.09



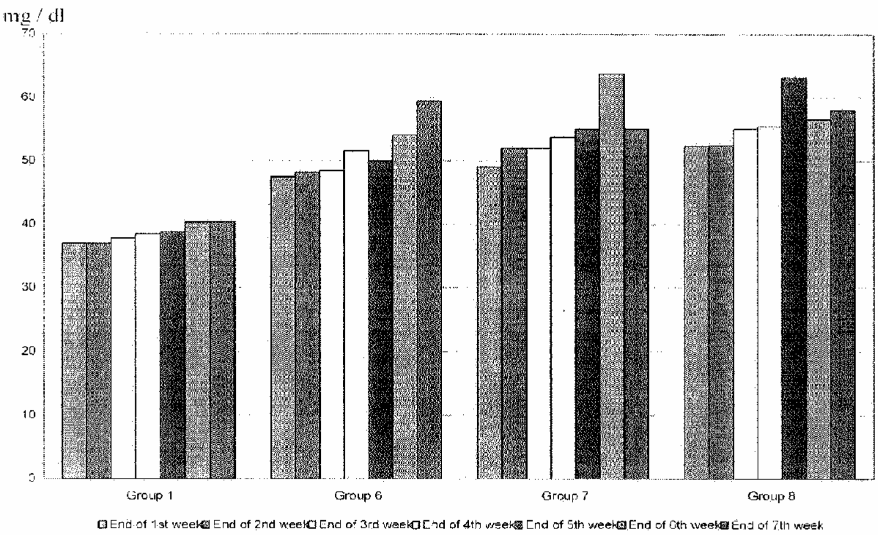


Figure (3): Serum HDL (High Density Lipoprotein) content (mg / dl) of the rats fed on different mung bean diets

Such data clarified that the most effective group in increasing blood serum HDL in the experimental animals was group (3) diabetic group fed on germinated mung bean recording .(55.791:3.33 mg / dl) increment by the end of feeding time of experiments. However, .the least decrement value was observed for group (2) diabetic group fed on basal diet recording (56.151:2.85 mg / dl) by the end of the feeding time of experiments (the 7th week).

3.1.3. Blood serum LDL (Low Density Lipoprotein) in treated mung bean:

The results given in Table (5) and Figure (4) revealed that the blood serum LDL showed significant difference among all eight studied groups, all feeding weeks as well as interaction between studied groups and feeding weeks at ($P < 0.01$) in experimental period.

However, the data revealed that the mean values of decrement in the blood serum LDL for treated mung bean groups **1,** 2, 3, 4, 5, 6, 7 and 8 i.e., control group .fed on basal diet, diabetic group fed basal diet, diabetic group fed on germinated mung bean, diabetic group fed on raw mung bean, diabetic group fed on germinated-cooked mung bean, diabetic group fed on soaked cooked mung bean, diabetic group .fed on raw-cooked mung bean and diabetic group fed on soaked mung bean were 18]6 (De), 26.96 (De), 20.52 (De), 21.73 (De), 21.76 (De), 22.84 (De), 24.21 (De) and 25..12 (De); respectively.

Such data confirmed that the group (5) diabetic group fed on germinated cooked mung bean recording (19.081:0.47 mg / dl) was the highest rate of decrement in blood serum LDL in the experimental animals. However, the least rate of decrement was observed for group (2) diabetic group fed basal diet Recording (25.721:1.43 mg / dl) by the end of the feeding time of experiments (the 7^{th} week).

The data are in good agreement with **Duane (1997)** [7], who reported that legumes lower serum LDL-cholesterol Likewise, **David Saunders (2005)** [5] stated that beans and legumes contain soluble fiber which helps to increase the HDL cholesterol and reduce the LDL cholesterol and lower the cholesterol content.

Table (5): Serum LDL (Low Density Lipoprotein) content (mg / dl) of the rats fed on different mung bean diets

Time of observation	Control	Diabetic	Germinated mung bean	Raw mung bean	Germinated - cooked mung bean	Soaked-cooked mung bean	Raw-cooked mung bean	Soaked mung bean
	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
End of 1th week ± S. E.	$18.45^{vwx..}$ ± 0.81	28.39^{a} ± 2.21	$21.92^{klm..}$ ± 0.95	$24.01^{fgh..}$ ± 1.26	$24.36^{efg..}$ ± 1.28	$25.41^{cde..}$ ± 1.59	$26.34^{bcd..}$ ± 1.90	$26.76^{abc..}$ ± 1.89
End of 2th week ± S. E.	$18.25^{wxy..}$ ± 1.00	27.96^{ab} ± 1.30	$21.35^{lmn..}$ ± 1.19	$22.96^{ijk..}$ ± 0.92	$23.12^{ijk..}$ ± 0.95	24.35^{efg} ± 1.38	26.43^{bcd} ± 1.88	$25.94^{cde..}$ ± 1.60
End of 3th week ± S. E.	$19.08^{tuv..}$ + 1.31	27.25^{abc} + 1.90	$21.26^{mno..}$ ± 0.67	$22.23^{jkl..}$ ± 1.27	$22.22^{jkl..}$ ± 1.55	$23.50^{ghi..}$ ± 0.94	$25.64^{cde..}$ ± 1.58	$25.30^{cde..}$ ± 1.57
End of 4th week ± S. E.	18.20^{xyz} ± 0.82	$26.74^{abc..}$ ± 1.88	$20.10^{pqr..}$ ± 0.67	$21.64^{klm..}$ ± 0.63	$21.99^{klm..}$ ± 1.27	$23.32^{hij..}$ ± 0.92	$24.28^{fgh..}$ ± 1.17	$24.80^{def..}$ ± 1.28
End of 5rd week ± S. E.	17.83^{yz} ± 0.95	$26.62^{abc..}$ ± 1.73	$19.78^{qrs..}$ ± 1.12	$21.01^{nop..}$ ± 0.95	$21.46^{klm..}$ ± 0.77	$21.84^{klm..}$ ± 1.19	$23.43^{ghi..}$ ± 1.68	$24.10^{fgh..}$ ± 1.29
End of 6nd week ± S. E.	$19.09^{uvw..}$ ± 0.65	$26.06^{bcd..}$ ± 1.34	$19.70^{rst..}$ ± 0.63	$20.29^{opq..}$ ± 0.64	$20.11^{pqr..}$ ± 0.93	21.06^{mno} ± 1.25	$22.24^{jkl..}$ ± 0.54	$24.13^{fgh..}$ ± 1.12
End of 7st week ± S. E.	17.53^{z} ± 0.81	25.72^{cde} ± 1.43	$19.50^{stu..}$ ± 0.49	$19.95^{pqr..}$ ± 0.63	$19.08^{uvw..}$ ± 0.47	$20.42^{opq..}$ ± 0.71	$21.14^{mno..}$ ± 0.73	$24.79^{def..}$ ± 1.39
Mean	18.36^{E}	26.96^{F}	20.52^{F}	21.73^{E}	21.76^{D}	22.84^{C}	24.21^{B}	25.12^{A}

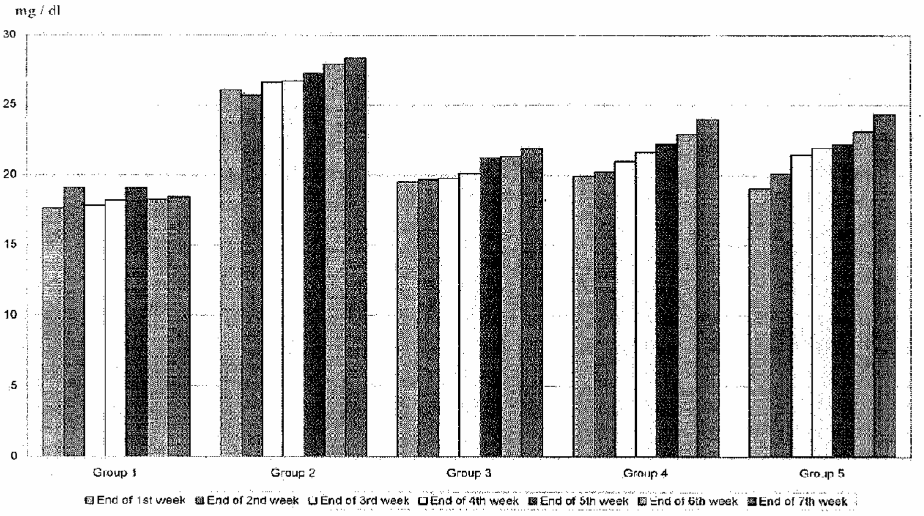
S. E. = Standard Error S = Significant

Values followed by the same letter within the same column were not significantly different ($P < 0.05$).

F. Test (A) group = (A) 138.94^{**}

F. Test weeks = (B) 32.65^{**}

F. Test ($g \times w$) = (AB) 1.43^{*}



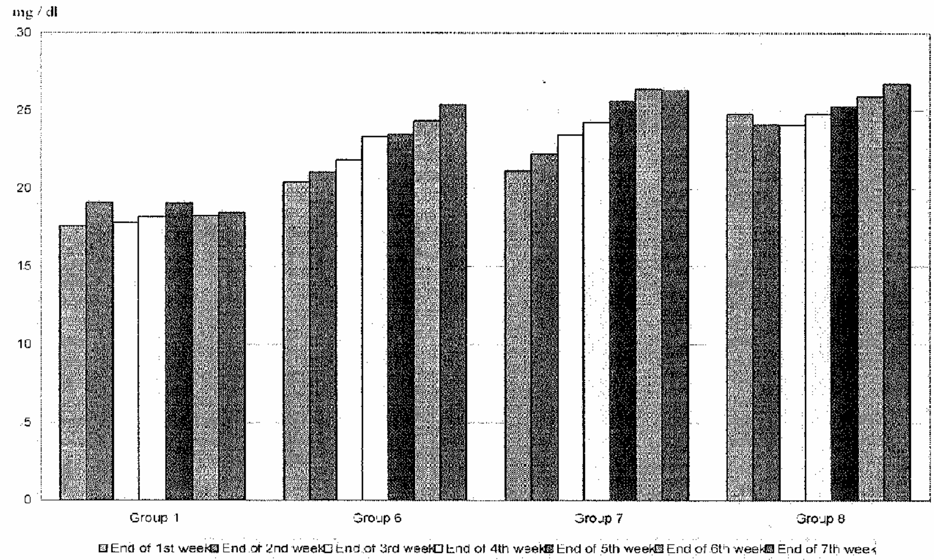


Figure (4): Serum LDL (Low Density Lipoprotein) content (mg / dl) of the rats fed on different mung bean diets

Conclusion:

1.There were significant differences between (8) studied groups in serum triglycerides at ($P < 0.01$). The least decrement value was observed in group (2) diabetic group fed on basal diet recording 84.87± 2.77 mg / dl while group (3) diabetic group fed on germinated mung bean recording l4.45± 1.02 mg / dl.

2.There were significant differences between (8) studied groups in serum total cholesterol at ($P < 0.01$). The most effective group in decreasing blood serum total cholesterol was group (3) diabetic group fed on germinated mung bean recording 73.36±3.21 mg / dl decrement. However, the least decrement value was observed for group (2) diabetic group fed on basal diet recording 105.42± 2.69 mg/ dl.

3.There were significant differences between (8) studied groups in serum HDL-cholesterol group (6) diabetic group fed on soaked-cooked mung bean recording an increasing blood serum HDL in the experimental animals was 59.50± 3.32 mg / dl increment by the end of feeding experiment. However, the least decrement value was observed for group (7) diabetic group fed on raw-cooked recording 55.04± 3.16 mg / dl.

4.There were significant differences between (8) studied groups in serum LDL-cholesterol. Group (2) diabetic group fed on basal diet recording 25.72± 1.43 mg'/dl was the highest rate of decrement in blood serum LDL in the experimental animals. However, the least rate of decrement was observed for group (5) diabetic group fed on geminated-cooked mung bean recording 19.08± 0.47 mg / dl.

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