J. Food and Dairy Sci., Mansoura Univ., Vol. 4 (1): 13 - 25, 2013

EFFECT OF FEEDING ON SOME DIETARY FIBERS FOR REDUCING BLOOD CHOLESTEROL

El-Sayed, M. E. A.
Food Sci. & Tech. Dept. Fac. of Agric., Tanta Univ.

ABSTRACT

The present study was designed to investigate the effect of some sources of dietary fibers (wheat bran, pectin and soybean hulls) at a level of 10% on the blood cholesterol level and serum transaminase enzymes, as well as, body weight, food intake, food efficiency ratio (FER) and some organs weight in hypercholesterolemic rats.

The supplementation of basal diet with dietary fibers led to significant increase of final body weight, body weight gain (%), food intake and FER. Hypercholesterolemic rats had a higher level of total cholesterol (TC), low density lipoprotein-cholesterol (LDL-C) and total cholesterol/high density lipoprotein-cholesterol (TC/HDL-C) and lower level of HDL-C comparing with normal rats. The addition of dietary fibers in all forms to basal diet improved the previous parameters and they became in the normal range. The feeding of hypercholesterolemic rats on diet containing dietary fibers decreased the liver content of total lipids, phospholipids, cholesterol and triglycerides (TG) to the level, where no significant difference was noticed with normal group. Also, the results revealed that, fecal output, fecal lipid and fecal cholesterol excretion were increased with supplementation of basal diet with dietary fibers. This supplementation improved serum transaminase enzymes especially alanine-aminotransferase enzyme (AST). So, it can be recommended that, using dietary fibers (wheat bran, pectin and soybean hulls) at the level of 10% had a pronounced effect in reducing cholesterol levels.

Keywords: Wheat bran, pectin, soybean hulls, hypercholesterolemic, germination lipid profile.

INTRODUCTION

Diet and nutrition are strongly related with a etiology of hypercholesterolemia and hyper- lipidemia. It is well known that blood high cholesterol level play an important role in occurance of atherosclerosis and subsequently heart diseases (Hui, 1992; Kathleen and Escott – Stump, 2004). Dietary Fibers are defined as the residue derived from plant cell wall that is resistant to hydrolysis by digestive enzymes (Trowell, 1976). Although dietary fibers are generally considered as a group, they do not exert similar systemic effect (Van Soest, 1978). Effect of dietary fibers in lowering blood cholesterol and triglycerides have been investigated (El-Soukary and El-Sherif, 1998; Kendall *et al*., 2009 and Zhang *et. al*., 2011). The feeding of hypocholesterolemic rats on basal diet supplemented with 10% soybean hulls as dietary fibers lead to significant reduction in serum lipids and lipoprotein profile (Metwalli, 2005). Besides the hypocholesterolemic effect, dietary fiber has a potential influence as a dietary aid in the treatment of constipation (Anderson, 1995). It has recommended that the population increase enhances their intake dietary fibers from variety sources (FDA, 1987). The

high fiber breads and cookies are being increasingly accepted by the public (El-Soukary and El-Sherif, 1998) as the major source of dietary fiber. However, the effects of dietary fibers on bile salts and steroid excretion have been investigated by Madar and Stark, (1995). The present study was recommended the adding of some dietary fibers at a level of 10% in food such as soybean hulls led to significant decrease on blood cholesterol level then wheat bran and pectin.

MATERIALS AND METHODS

Materials:

Soybean{(*Glycine max* (L.) *Merr*.} hulls obtained from the Soy Processing Unit, Food Technology Research Institute, Agriculture Research Center, Giza, Egypt, were also ground up to pass through 100 mesh screen sieve.

Wheat bran was obtained from the Middle and West Delta Milling Company, Tanta, Egypt.

Chemical used in this study were purchased from El-Gomhoria Company for Chemical and Drugs; Merk Company for Chemical and Biodiagnostica, Egypt.

Experimental diets:

Table (A) shows the composition of experimental diets.

Table (A): Composition of experimental diets (g/kg diet) as reported by Kim and Shin (1998).

Constituents	No. of recipes				
	1	2	3	4	5
Casein	200	200	200	200	200
Wheat starch	700	687.5	677.5	677.5	677.5
Corn oil	50	50	50	50	50
Mineral mixture	35	35	35	35	35
Vitamin mixture	10	10	10	10	10
DL-Methionine	3	3	3	3	3
Choline bitartrate	2	2	2	2	2
Cholesterol	-	10	10	10	10
Bile salts	-	2.5	2.5	2.5	2.5
Wheat bran	-	-	10	-	-
Pectin	-	-	-	10	-
Soybean hulls	-	-	-	-	10

Diet No. 1: Control diet (basal diet) given to (normal or negative control) group.

Diet No. 2: Basal diet supplemented with 1% cholesterol and 0.25% bile salts given to (positive control) given to group 2.

Diet No. 3: Basal diet supplemented with of 10% wheat bran + 1% cholesterol and 0.25% bile salts, given to (group 3).

Diet No. 4: Basal diet supplemented with of 10% pectin + 1% cholesterol and 0.25 % bile salts, given to (group 4).

Diet No. 5: Basal diet supplemented with of 10% soybean hulls + 1% cholesterol and 0.25% bile salts, given to (group 5).

Animals:

A total of 25 male albino rats. Weighting between 40 and 45 gm. The rats were housed individually in mesh-bottom cages in a well ventilated room maintained at 25 ± 2 ºC, on a 12 hr light-dark cycle. Rats were given free access to food and water throughout the experimental period of 6 weeks.
Rats were feed on basal diet for one week to acclimate them to our facility and basal diet.

After acclimation for one week, rats were randomly divided into 5 groups of 5 each. One group was feed on the basal diet with considered to be as normal group (negative Control G1). To accelerate atherosclerosis, the diet was supplemented with 1g / 100g of analytical grade non-oxidized cholesterol and 0.25g bile salts for one week to raise the cholesterol in their blood (El-Askalany, 2000). The cholesterol and bile salt batches were mixed carefully with the basal diet just before the diets were offered to the rats of the four other groups.

After ensuring that rats became hypercholesterolemia, hypercholesterolemia rats were divided into four sub groups (5 rats each). First sub group was left as hypercholesterolemia control and fed on basal diet supplemented with cholesterol and bile salt (positive control G2). The other groups (G3, G4 and G5 subgroups) were fed on basal diet replacement of the fiber source of the diet (the wheat starch) with 10% wheat bran, pectin and soybean hulls, respectively during the whole experiment (6 weeks). All rats were weighed weekly as for as food intake. Feces were collected in polyethylene packages and stored at (-20 ºC) until analysis. At the end of the experiment weight gain and food efficiency ratio (FER) were calculated for each group of rats (calculated as gram of weight gain per gram of food intake × 100).

Collection of the organs:

All rats were sacrificed and the organs (liver, kidney, heart and spleen) were separated by careful dissection, cleaned from adhesive matter and washed in saline solution, then weighed. The relative weight of the organs were calculated from the following the next equation:

Relative organ weight = (Organ weight / Final body weight) × 100

Blood sampling:

In all the previously mentioned groups blood samples were taken at the end of experiments. The blood collected from the vein plexus eye after 12 hours fasting were put in dry clean centrifuge tubes and left to clot. The blood was centrifuge for ten minutes at 3000 rpm to separate the serum, which was carefully aspirated and transferred into clean plastic tube and kept frozen at -20 ºC until analyzed (El-Khamissy, 2005).

Determination of serum lipids:

The concentration of total cholesterol (TC), HDL-C and TG in the serum were determined without extraction by using enzymatic colorimetric method with commercial available kits (cholesterol, kit # 276-64909; high-density lipoprotein, kit # 278-67409 and triglycerides, kit # 274-69807; Wake Chemical, Osaka, Japan). Kim and Shin (1998) procedures were employed to perform the previous mentioned determinations. Low-density lipoprotein

cholesterol concentration was calculated by the difference between TC and HDL-C according to the method of Kim and Shin (1998).

Determination of liver cholesterol, liver triglycerides and fecal cholesterol:

Liver cholesterol, liver triglycerides and fecal cholesterol concentration were determined according to Kim and Shin (1998) method using the previously mentioned kits. Liver and fecal samples were extracted with solvent before subjecting to the aforementioned analysis according to the method of Folch *et al*., (1957). A solvent system composed of chloroform : methanol, 2:1 (v/v) was used.

Determination of total lipids:

Total lipids content of liver and feces were determined by the method of Folch *et al*. (1957).

Determination of liver phospholipids:

Liver phospholipids were extracted by solvents according to the method of Folch *et al*., (1957). The concentration of liver phospholipids were determined by enzymatic colorimetric method using kit # 996-54001, wake Chemical, Osaka, japan.

Serum transaminase activities:

Alanine amino transferase (ALT) and aspartate amino transferase (AST) activities were determined colorimetrically according to the method described by Reitman and Frankel (1957). The activities of ALT and AST were calculated and expressed as international units (I.U.) by using special Table provided with kits. Colorimetric determination of ALT and AST activity were measured using α-Ketoglutarate in a phosphate buffer-alanine solution (GPT substrate) and α-Ketoglutarate in a phosphate buffer-aspertate solution (GOT substrate), respectively according to a reaction.

$$\text{Alanine+α-Ketoglutarate} \xrightarrow[\text{G.P.T}]{} \text{pyruvate + glutamate}$$

$$\text{Alanine+α-Ketoglutarate} \xrightarrow[\text{G.O.T}]{} \text{Oxaloacetate + glutamate}$$

The pyrovate and oxalaoacetae from were calorimetrically measured in its derivative from 2, 4 dinitrophenylhydrasone, at wave length 546 nm.

Statistical analysis:

Most of the received data were analyzed statistically using the analysis of variance and the means were further tested using the least significant difference test (LSD) as outlined by Stell and Torrie (1980).

RESULTS AND DISCUSSION

Effect of feeding with wheat bran, pectin and soybean hulls on body weigh, body weight gain (%) food intake and food efficiency ratio of hypercholesterolemic rats:

Table (1) summarize the mean values of initial body weight, final body weight, body weight gain, food intake and efficiency ratio of all groups. The mean values initial body weight of all group after one week of

acclimatization feeding on basal diet, were nearly the same and with non significant difference, the mean values ranged from 41.58 to 42.13 g. At the end of experimental feeding (6 weeks) the final body weight of the control positive group rats (fed on basal diet without any addition) was significantly lower than non hypercholesterolemic control (normal group). The mean values of final body weight for other hypercholesterolemic group fed on basal diet supplemented with 10 % wheat bran, pectin and soybean hulls were higher compared with control hypercholesterolemic group, but still than normal group. The results in Table (1) also indicated than, hypercholesterolemic rats fed on a diet containing wheat bran, pectin and soybean hulls had a greater body weight gain, food intake and FER than those of positive group. On the other hand, the were high significantly less than that of normal group, where the body weight gain was positive group (30.25 g) compared with that of normal group (52.41 g). The results also revealed that, supplementation of basal diet with wheat bran, pectin and soybean hulls led to increase in final body weight, body weight gain, food intake and FER of hypercholesterolemic rats. This may be to the improvement in their health due to the effect of lowering the lowering the blood glucose and helped the rats to overcome the impaired body function and recovered the appetite to food and gain in weight (Gaber, 1998).

Table (1): Effect of feeding with wheat bran, pectin and soybean hulls on body weigh, body weight gain, food intake and food efficiency ratio of hypercholesterolemic rats:

Dietary groups	Initial body weight (g)	Final body weight (g)	Body weight gain		Food intake (g)	Food efficiency ratio (FER) **
			(g)	% *		
Normal group (control G1)	42.13 a	94.54 d	52.41 d	124.40	556.50 c	9.42 b
Positive group (control G2)	41.91 a	72.16 a	30.25 a	72.18	430.50 a	7.03 a
Wheat bran (G3)	41.80 a	83.20 c	41.40 cb	99.04	521.64 c	7.94 a
Pectin (G4)	41.69 a	84.89 c	43.20 c	103.62	540.54 c	7.99 a
Soybean hulls (G5)	41.58 a	80.83 b	39.25 b	94.40	447.30 b	8.77 b

*** Body weight gain (%) = (Final body weight – Initial body weight) ÷ Initial body weight × 100**

**** Food Efficiency ratio = Body weight gain ÷ Food intake × 100**

Each value was an average of five determinations.

Values followed by the same letter in column are not significantly different at P ≤ 0.05.

Normal group (G1) (non hypercholesterolemic control) normal rats fed on basal diet.

Positive group (G2), hypercholesterolemic rats fed on basal diet.

Group 3, hypercholesterolemic rats fed on basal diet supplemented with 10% wheat bran.

Group 4, hypercholesterolemic rats fed on basal diet supplemented with 10% pectin.

Group 5, hypercholesterolemic rats fed on basal diet supplemented with 10% soybean hulls.

Effect of feeding with wheat bran, pectin and soybean hulls on the organs weight and relative organs weight of hypercholesterolemic rats:

Liver, kidney, heart and spleen of rats fed on basal diet and other treatments, as well, were weight at the end of experimental period (6 weeks) and the ratio of each organ to final body weight of rats was calculated. The results are present in Table (2).

As shown in Table (2), rats fed on the standard diet (G1) had lower organs weights than those fed on both a high cholesterol diet (G2) or the high cholesterol diets supplemented with 10 % wheat bran, pectin or soybean hulls. These results revealed that cholesterol and bile salts, added to the basal diet, caused significant changes of such values, in agreement with Kahlon *et al*., (1993) and Doweidar (2001) who published the increasing of organs weight by hypercholesterolemic agents. The results in Table (2) also revealed that, the differences between heart and spleen weight of the normal rats and hypercholesterolemic rats fed on supplemented diet with wheat bran, pectin and soybean hulls were not significant.

In relation to the percentage of organs to body weight, the results in Table (2) indicated that, the mean value of liver weight to body weight ratio of hypercholesterolemic rats fed on basal diet (positive group 5.19%) showed a noticeable increasing compared to those fed on basal diet (normal group 4.04%) and fed on a diets supplemented with wheat bran, pectin and soybean hulls, 4.52, 4.42 and 4.24%, respectively. The mean values of kidney, heart and spleen weight to body weight ratio gave the same results and trend. This may be due to the hepatocytic degeneration, necrosis, pathological and physiological disturbance (Lehninger *et al*., 1993).

Table (2): Effect of feeding with wheat bran, pectin and soybean hulls on the organs weight and relative organs weight of hypercholesterolemic rats:

Dietary groups	Final body weight (g)	Liver		Kidney		Heart		Spleen	
		gm	R.O.W.* %	gm	R.O.W.* %	gm	R.O.W.* %	gm	R.O.W.* %
Normal group (control 1)	94.54 d	3.82 b	4.04	0.74 c	0.78	0.33 a	0.34	0.22 a	0.23
Positive group (control 2)	72.16 a	3.74 b	5.19	0.69 ab	0.96	0.34 a	0.47	0.20 a	0.27
Wheat bran (G3)	83.20 c	3.76 b	4.52	0.70 bc	0.84	0.34 a	0.41	0.21 a	0.25
Pectin (G4)	84.89 c	3.75 b	4.42	0.73 bc	0.86	0.35 a	0.41	0.21 a	0.25
Soybean hulls (G5)	80.83 b	3.43 a	4.24	0.65 a	0.80	0.33 a	0.41	0.20 a	0.25

Each value was an average of five determinations.
Values followed by the same letter in column are not significantly different at P ≤ 0.05.
*** Relative organ weight (R.O.W.) = organ weight ÷ Final body weight × 100**
Normal group, positive group, group 3 …etc. as Table 1.

Effect of feeding with wheat bran, pectin and soybean hulls on some serum lipid parameters of hypercholesterolemic rats:

Blood samples were collected from rats after six weeks of dietary treatment, for analysis of serum total cholesterol, lipoprotein cholesterol (LDL-C & HDL-C) and TG concentration, and the results are given in Table (3).

It could be seen from the data presented in Table (3) that, hypercholesterolemic rats fed on basal diet supplemented with wheat bran, pectin and soybean hulls had significantly lower serum total cholesterol, total triglyceride and LDL-C compared with positive group. In contrary, these groups had a significantly higher level of HDL-C. Meanwhile, normal group fed on basal diet had a significantly lower mean values for TC, TG and LDL-C as well as, higher significant mean value of HDL-C. Data in Table (3) also indicated that, soybean hull gave the nearest mean values of TC, TG, LCL-C and HDL-C to the normal group, and recorded a more noticeable effect on hypercholesterolemia of serum total cholesterol and lipoprotein profile followed by wheat bran and pectin came in last. Several differences in the distribution of cholesterol among serum lipoprotein were observed as well. Mean values of TC; LDL-C and TG failed from 257.88, 229.64 and 166.15 mg/dl in positive group to 130.32, 73.66 and 96.78 mg/dl in rats fed on basal diet supplemented with 10% soybean hulls, respectively, while HDL-C become higher to reach to 69.15 from 28.24 mg/dl in the same two treatments.

Numerous reports and earlier experiments also showed similar results with a decrease in level total cholesterol corresponding to a decrease in the LDL fraction (Sayed-Ahmed, 2002 and Metwalli, 2005).

Nevertheless, other factors may be associated with the fibers effect on cholesterol metabolism. Although, containing less water-soluble fibers, soybean hull fibers, which contained a high level of cellulosic residues (Lo, *et al*., 1986), had repeatedly showed to exert hypocholesterolemic effects (Lo *et al*., 1986 and 1987).

Total cholesterol is not as useful a predictor of coronary heart diseases risk as the relative distribution of cholesterol among lipoprotein e.g. TC/HDL-C and LDL-C/HDL-C ratios (Katan *et al*., 1994). It has been stated that, the ratio of TC/HDL-C to desirable below 4.0; borderline 4.0-6.0 and high risk of heart disease above 6.0 (Baur, 1995).

Table (3): Effect of feeding with wheat bran, pectin and soybean hulls on some serum lipid parameters of hypercholesterolemic rats:

Dietary groups	Total cholesterol mg/dl	HDL-C mg/dl	LDL-C mg/dl	TC/HDL-C ratio	TC/LDL-C ratio	LDL-C/HDL-C ratio	Total triglyceride mg/dl	Total lipids mg/dl
Normal group (control G1)	112.98 a	74.84 d	38.14 a	1.51 a	2.96 d	0.51 a	71.56 a	479.00 a
Positive group (control G2)	257.88 d	28.24 a	229.64 d	9.13 d	1.12 d	8.13 d	166.15 e	875.50 e
Wheat bran (G3)	149.18 c	60.88 b	112.39 c	2.45 c	1.33 c	1.85 c	131.81 d	683.50 d
Pectin (G4)	145.20 c	62.70 b	109.10 c	2.32 b	1.33 c	1.74 c	126.68 c	677.50 c
Soybean hulls (G5)	130.32 b	69.15 c	73.66 b	2.30 b	1.77 b	1.30 b	96.78 b	534.00 b

Each value was an average of five determinations ± standard error.
Values followed by the same letter in column are not significantly different at P ≤ 0.05.
Normal group, positive group, group 3 …etc. as Table 1.
Normal values in human should be in the range of:
Total cholesterol (below 200 mg/dl) HDL-C (above 45 mg/dl)
Total triglyceride (50 – 250 mg/dl) LDL-C (< 160 mg/dl) (Baur, 1995)

The ratios of TC/HDL-C, TC/LDL-C and LDL-C/HDL-C were calculated for all groups of rats fed on different experimental diets and the data are shown in Table (3). The results indicated that, hypocholesterolemic control (positive group) had a ratio of TC/HDL-C (9.13), which was about four folds comparing with normal group and more acceptable to high risk of heart diseases. In contrary a lowest ratio was recorded for TC/LDL-C. in relation to LDL-C/HDL-C ratio which accounted a value of 0.51 for the normal rats, this ratio reach to about folds (8.13) in positive group. Supplementation of basal diet with all type of soybean hulls led to improvement the TC/HDL-C and TC/LDL-C ratios. Soybean hulls also recorded the best and nearest of TC/HDL-C, TC/LDL-C and LDL-C/HDL-C to the normal control and comparing with other group, the mean value were 2.30, 1.77 and 1.30, respectively. These values were significantly different comparing with that recorded in positive group. Sayed-Ahmed (2002) support our findings.

Effect of feeding with wheat bran, pectin and soybean hulls on liver lipids, phospholipids, cholesterol and triglycerides concentration of hypocholesterolemic rats:

Table (4) illustrate the mean values of total lipid, phospholipids, cholesterol and triglycerides in liver for normal and positive groups, as well as the other treatments. The mean values of these parameters were 31.09, 1.60, 2.02 and 2.62 mg/g liver in normal group, respectively. These mean values increased to 56.30, 2.78, 3.68 and 6.40 mg/g liver of positive group, and became high significantly comparing with normal control or other treatment. Supplementation the diet with wheat bran, pectin and soybean hulls led to significantly reduce in all previous parameter. The highest reduction was observed with soybean hulls treatment. With the exception of Metwalli (2005), who studied the effect of supplementation of diet with soybean hulls on hyper-cholesterolemic rats, and indicated that the feeding of hyper-cholesterolemic rats for 6 weeks on basal diet supplemented with 10% of soybean hulls led to significant reduction of total cholesterol and total lipids in liver, no available studies were found in literature about the changes in liver content of lipid.

Table (4): Effect of feeding with wheat bran, pectin and soybean hulls on liver lipids, phospholipids, cholesterol and triglycerides concentration of hypocholesterolemic rats:

Dietary groups	Total lipid mg/g wet liver	Phospholipids mg/g wet liver	Cholesterol mg/g wet liver	Triglyceride mg/g wet liver
Normal group (control 1)	31.09 a	1.60 a	2.02 a	2.62 a
Positive group (control 2)	56.30 c	2.78 d	3.68 d	6.40 e
Wheat bran (G3)	43.17 b	2.29 c	2.64 c	5.60 d
Pectin (G4)	39.30 b	2.14 bc	2.55 b	4.73 c
Soybean hulls (G5)	30.46 a	2.00 b	1.96 a	4.45 b

Each value was an average of five determinations.
Values followed by the same letter in column are not significantly different at P ≤ 0.05.
Normal group, positive group, group 3 …etc. as Table 1.

Fecal output, fecal lipids and fecal cholesterol extraction in rats fed on different experimental diets:

The primary hypothesis concerning the mechanism of the cholesterol-lowering effect of fibers is increased excretion of cholesterol and bile acids (Moundras *et al*., 1997). As shown in Table (5) the mean values of fecal output had no significant differences in most tested groups. However, addition of different experimental diets caused significantly greater fecal lipids and fecal cholesterol excretion in rats compared with those of normal rats or positive group rats. The minimal mean values for fecal lipids and fecal cholesterol excretion were attained in positive group rats fed on basal diet (121.41 and 1.49 mg/g dry weight feces).

The hypocholesterolemic effect of pectin seemed likely to be mediated through an increasing conversion of cholesterol to bile acid to compensate for its increased fecal loss (Reddy *et al*., 1980). Certain dietary fibers and their components could affected the enterohepatic circulation of bile acids and cholesterol. In addition, different types of dietary fibers can also alter the activity of gut microflora, which affect the metabolism of bile acids and cholesterol.

Table (5): Fecal output, fecal lipids and fecal cholesterol extraction in rats fed on different experimental diets.

Dietary groups	Fecal output g dry weight / day	Fecal lipid mg/g dry weight feces	Fecal cholesterol mg/g dry weight feces
Normal group (control G1)	0.99 a	142.88 b	3.36 c
Positive group (control G2)	0.94 a	121.41 a	1.49 a
Wheat bran (G3)	0.97 a	152.56 c	2.53 b
Pectin (G4)	0.95 a	163.65 d	2.67 b
Soybean hulls (G5)	0.96 a	167.21 e	3.47 c

Each value was an average of five determinations.
Values followed by the same letter in column are not significantly different at P ≤ 0.05.
Normal group, positive group, group 3 …etc. as Table 1.

Effect of feeding with wheat bran, pectin and soybean hulls supplementing the hypercholesterolemia-producing diet on serum transaminase enzymes:

The assay of enzyme levels in the extracellular body fluid such as blood serum, are important aids to the clinical diagnosis and management of a disease. Measurements of the changes in enzyme levels offer more information on the identify of the damaged cell and indicate the degree of injury, than is possible using the other clinico-chemical parameters. Most significant for development of diagnostic enzymeology were studies on the transaminases, particularly alanine and aspertate transminase. In all liver dysfunction, the alanine and aspertate aminotransferase levels are increased in serum, the extents giving a useful differential index of the type of dysfunction. The activities of key hepatic enzymes; alanine-aminotranferases (ALT), formerly known as glutamic-pyruvic transminase (GOT) and aspertate

aminotrasferase (AST), formerly known as glutamate-oxaloacetic aminotrasferase (GOT). In healthy human, the concentration of cellular enzymes in the extracellular fluids are fairly low, ALT and AST ranging between 5-30 IU/L and 8-40 IU/L, respectively (Louz, 1997). The enzyme assayed most commonly in liver dysfunction, were measured in rats fed on the basal diet (normal and positive group) and diet supplemented with wheat bran, pectin and soybean hulls and the results are expressed as international unit (IU/L) and are shown in Table (6).

Table (6): Serum alanine aminotransferase (ALT) and aspertate aminotransferase (AST) activities in normal and hypercholesterolemic rats fed on different experimental diets for 6 weeks.

Dietary groups	ALT (IU/L)	AST (IU/L)	AST/ALT ratio
Normal group (control G1)	22.80 a	38.85 a	1.70
Positive group (control G2)	28.90 c	81.20 c	2.81
Wheat bran (G3)	24.30 b	55.80 b	2.30
Pectin (G4)	23.75 b	54.20 b	2.28
Soybean hulls (G5)	22.25 a	39.10 a	1.76

Each value was an average of five determinations.
Values followed by the same letter in column are not significantly different at P ≤ 0.05.
Normal group, positive group, group 3 …etc. as Table 1.

The results in Table (6) showed that, the values of ALT activity reached 22.25 IU/L for the rats fed on basal diet supplemented with 10% soybean hulls and 28.90 IU/L for the positive group, the activity of normal group was 22.80 IU/L. the results also indicated that, the values measured for ALT activity in all groups and fed on different experimental diets were within the reference value in human and reflecting no volume of cellular damage. On the contrary, the serum AST values recorded for all groups fed on different experimental diets were higher than the reference value in human. Normal group and rats fed on diet supplemented with 10% soybean hulls gave the nearest values to the reference (38.85 and 39.10 IU/L), respectively. Whereas, positive group recorded higher activity of AST (81.20 IU/L).

From aforementioned obtained results, it should be concluded that, wheat bran, pectin and soybean hulls significantly reduced the levels blood lipids and liver. Moreover, they also had a positive effect on the activities of serum enzymes. Soybean hulls had the highest effect on the previously mentioned parameters followed both wheat bran and pectin.

REFERANCES

Anderson, T. (1995). Functional properties lead to healthier snacks with sugar beet fiber. Food Tech. Europe 1, 5, 124-126.

Baur, F. J. (1995). Nutritional aspects of oils and fats. In: Food Oils and Fats, Technology, Utilization and Nutrition. Lawson, H. (ed.). Chapman & Hall, New York, pp. 203-280.

Doweidar, M. M. M. (2001). Chemical and Physical Studies on Some Natural Resources Used in Improving Bakery Products. Ph. D. Thesis, Dep. of Biochemistry, Fact. of Agric. Cairo, Univ., Cairo, Egypt.

El-Askalany, A. A. H. (2000). Evaluation of Using Agricultural Wastes to Produce Low Calories Food. M. Sc. Thesis. Institute of Environmental Studies and Researches, Ain shams Univ., Cairo, Egypt.

El-Khamissy, A. (2005). Studies on biological effects of some diabetes food. Ph. D. Thesis, Faculty of Specific Education. Home Economics, Dept. Tanta Univ.

El-Soukary, F. A. and El-Sherif, S. A. (1998). Physiological responses of rats to high-fiber biscuit diets containing several sources of hulls or bran. Menofiya J. Agric. Res., 23 (6): 1635-1655.

Folch, J.; Lees, M. and Stanley G. H. (1957). A simple method for the isolation and purification of total lipids from animal tissues. J. Biol. Chem. 226: 497-509.

(FDA) Food and Drug Administration. (1987). Physiological effects and health consequences of dietary fiber. Health and Human Services, Washington. Fed. Regis, 1975, 40, 56, 12907.

Gaber, F. A. (1998). Biochemical studies of some wild plants. Ph. D. Thesis Fac. Agric. Cairo Univ., Egypt.

Hui, Y. H. (1992). Encyclopedia of Food Science and Technology. 1: 406-416. John Wiely and Sons, Inc. New York.

Kahlon, T. S; Chow, F. I; Knuckles, B. E. and Chiu, M. M. (1993). Cholesterol-lowering effects in hamsters of β-glucan enriched fraction, dehulled whole barley, rice bran, and oat and their combination. Cereal Chem., 70 (4): 455.

Katan. M. B.; Zock. P. L. and Mensink, R. P. (1994). Effect of fats and fatty acids on blood lipids in human: An Overview. AM. J. Clin. Nutr., 60: 1017-1022.

Kathleen, L. M. and Escott-Stump, S. (2004). Krause's food, Nutrition & Diet Therapy, 11th Ed., Saunders. Pp: 49.

Kendall, C. W.; Esfahani, A. and Jenkins, D. J. A. (2009). The link between dietary fiber and human health, Food Hydrocolloids. 24: 42-48.

Kim, M. and Shin, H. K. (1998). The water-soluble of chicory influences serum and liver lipid concentration, cecal short-chain fatty acids concentration and faecal lipid extraction in rats. J. Nutr. 128 (1): 1731-1736.

Lehninger, A. L.; Nelson, D. L. and Cox. M. M. (1993). Principles of Biochemistry: The Molecular Basis of Cell Structure and Function. 2nd ed. Worth Publishers, Inc., New York, USA.

Lo, G. S.; Evans, R. H.; Phillips, K. S.; Dahlgren, R. R. and Steinke, F. H. (1987). Effect of soy fiber and soy protein on cholesterol metabolism and atherosclerosis in rabbits. Atherosclerosis, 64 (1): 47-54.

Lo, G. S.; Goldberg, A. P.; Lim, A.; Grundhauser, J. J.; Anderson, C. and Schonfeld, G. (1986). Soy fiber improves lipid and carbohydrate metabolisim in primary hyperlipidemic subjects. Atherosclerosis, 62 (3): 239-48.

Louz, S. L. (1997). Biological study on soybean product. M. Sc. Thesis, Dept. of Biochemistry, Fac. of Agric., Cairo Univ., Cairo, Egypt.

Madar, Z. and Stark, A. (1995). Possible mechanisms by which dietary fibers affect lipid metabolism. Agro. Food Industry. 6: 40-42.

Marshall, T. (2000). Exploring a fiscal food policy: The case of diet and ischemic disease. Br. Med. J., 320: 301-305.

Metwalli, A. A. (2005). Utilization of some foods for reducing blood cholesterol. Ph.D. Thesis, Agric., Food Technol. Dept. Kafr El-Sheikh, Tanta Univi., Egypt.

Moundras, C.; Behr, S. R.; Remesy, C. and Demigne, C. (1997). Fecal losses of sterols and bile acids induced by feeding rats guar gum are due to greater pool size and liver bile acid secretion. J. Nutr., 127 (6): 1068-1076.

Reddy, K.; Watanabe, K. and Sheinfil, A. (1980). Effect of dietary wheat bran, alfalfa, pectin and carrageen an on plasma cholesterol, fecal bile acid and neutral sterol excretion in rats. J. Nut. 110, 1247-1253.

Reitman, S. and Frankel, S. (1957). Colorimetric method for the determination of serum glutamic, oxaloacetic and glutamic pyruvic transaminase. Am. J. Clin. Path., 28: 56-66.

Sayed-Ahmed, E. F. (2002). Studies on Some Foods for Cardiac Disease and Atherosclerosis. Ph. D. Thesis. Dept. Food Technol., Fac. of Agric., Moshtohor, Zagazig Univ. (Benha Branch), Egypt.

Steel, R. G. and Torrie, J. H. (1980). In: “Principles and Procedures of Statistics.” 2nd Ed. Mc-Graw-Hill, New York, USA, pp. 120-150.

Trowel, H. (1976). Definition of dietary fiber and hypothesis that it is a protective factor in certain disease. Am. J. Clin. Nut. 29 417-427.

Van Soest, P. J. (1978). Dietary fibers: their definition and nutritional properties. Am. J. Clin. Nut. 31: 125-205.

Zhang, N.; Huang, C. and Ou, S. (2011). In vitro binding capacities of three dietary fibers and their mixture for four toxic elements, cholesterol, and bile acid. J. of Hazardous Materials. 186: 236-239.

تأثير التغذية على بعض الألياف الغذائية لخفض كوليسترول الدم

محمود إمام عبدالعزيز السيد
قسم علوم وتكنولوجيا الأغذية – كلية الزراعة – جامعة طنطا

أجريت هذه الدراسة لبحث تأثير إضافة بعض مصادر الألياف الغذائية كنخالة القمح والبكتين وقشور فول الصويا بنسبة ١٠٪ من الغذاء على مستوى كوليسترول الدم وكذلك إنزيمات الـ Transaminases بالإضافة إلى وزن الجسم وكمية وكفاءة الغذاء المتناول وكذلك وزن الأعضاء الداخلية في الفئران المصابة بارتفاع الكوليسترول. ويمكن تلخيص النتائج المتحصل عليها في الأتي:

أدت تغذية الفئران على الوجبة الأساسية المحتوية على الألياف الغذائية إلى زيادة معنوية في وزن الجسم النهائي نتيجة زيادة كمية وكفاءة الغذاء المتناول.

كانت القياسات الخاصة بالكوليستيرول الكلي، الليبوبروتين منخفض الكثافة ونسبة الكوليستيرول الكلي إلى الليبوبروتين عالي الكثافة في الفئران المصابة بالكوليستيرول أعلى عند مقارنتها بالقياسات الموجودة في الفئران السليمة بينما كان نسبة الليبوبروتين عالي الكثافة منخفضا وبصفة عامة فإن إضافة الألياف الغذائية إلى الوجبة الأساسية يحسن من كل القياسات السابقة ويجعلها في الحدود الطبيعية.

أدت تغذية الفئران المصابة بالكوليسترول على الوجبة الأساسية المحتوية على الألياف الغذائية إلى خفض محتوى الكبد من الليبيدات الكلية والفوسفوليبيدات والكوليسترول والجليسريدات الثلاثية، وإلى زيادة كمية الفضلات وزيادة ليبيدات وكوليسترول الفضلات كما أدت إلى تحسين إنزيمات الـ Transaminases وخاصة الـ AST .

وبناء على ما سبق يمكن التوصية بأن إضافة بعض مصادر الألياف الغذائية بنسبة ١٠٪ في الأغذية مثل قشور فول الصويا أدت إلى حدوث تأثير واضح في خفض كوليسترول الدم يليها نخالة القمح ثم البكتين.

بتحكيم البحث

أ.د / مسعد عبد العزيز ابو ريه	**كلية الزراعة – جامعة المنصورة**
أ.د / عبد الباسط عبد العزيز سلامه	**كلية الزراعة – جامعة كفر الشيخ**