The physiological effects of different types of soluble dietary fiber (guar gum, locust bean gum and pectin), on serum lipids and liver tissue in rats.

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Abstract

This study was designed to determine the effects of administering soluble indigestible polysaccharides separate and in combinations on body weight, serum lipids and liver histology in rats. Thirty six Sprague-Dawley rats divided into 6 groups, and were fed as the following: group (A) on basal diet, group(B) on basal diet supplemented with 5% guar gum (GG), group (C) on basal diet supplemented with 5% pectin (P), group (D) on basal diet supplemented with 5% locust bean gum (LBG), group (E) on basal diet supplemented with (2.5% GG + 2.5 % P) and group (F) on basal diet supplemented with (2.5% LBG + 2.5 % P) for 6 weeks. The investigated parameters included: changes in food intake, body weight, FER, total serum cholesterol, triglycerides, HDL-C, LDL-C, VLDL-C, and the histological changes in liver. Results showed a significant reduction in body weight at ($P \leq 0.05$) in both pectin and LBG fed groups. However groups fed on combination of soluble dietary fiber showed the lowest values ($P \leq 0.01$) compared with the control group. There were a highly significant decrease in triglycerides in groups fed on GG and pectin at 5% ($P \leq 0.01$, $P \leq 0.05$) respectively. While, there were a highly significant decrease at ($P \leq 0.01$) in VLDL-C in both groups of rats fed on GG 5% and pectin 5% compared with the control group. No histological changes were observed in rats' liver of groups fed on GG and pectin at 5% level. The findings provide evidences that, the supplementation of soluble dietary fiber separately were more effective than the combinations of two different types of soluble fibers. The study recommended that supplementing diet with guar gum, locust bean gum and pectin of dietary fiber individually might cause great beneficial effects in case of obesity and incidence of hyperlipidemia.

Key words: Guar – Locust bean -Pectin- serum lipids - Triglycerides- (HDL-C) and (VLDL-C) - liver histology

Introduction

Dietary fiber plays an essential role in human health. There are two types of fiber "soluble and insoluble'' and most whole foods contain a combination of the two types. Both types of fiber help maintain the health of digestive system and promote regular bowel movements. Soluble fiber pulls in

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sugar. Consequently, cholesterol levels go down over time, which may help to prevent heart disease and stroke (Bazzano 2008 and Anderson et al., 2009).

Dietary fiber has received increasing attention from researchers due to the likely beneficial effects on the reduction of cardiovascular diseases (Borderias et al., 2005). In addition to its nutritional effects, dietary fiber has functional properties such as water binding capacity (WBC) and fat binding capacity (FBC). Thus, the addition of dietary fiber to a wide range of products will contribute to the development of value-added foods or functional foods that are currently in high demand (Day et al., 2009).

Non starch polysaccharides subdivided into two general groups of soluble and insoluble. This grouping is based on chemical, physical, and functional properties. Soluble fiber dissolves in water forming viscous gels. They bypass the digestion of the small intestine and are easily fermented by the microflora of the large intestine. They consist of pectin, gums, inulin-type fructans and some hemicelluloses. In the human gastro intestinal tract, insoluble fibers are not water soluble, they do not form gels due to their water insolubility and fermentation is severally limited. Most fiber containing foods include approximately one-third soluble and two-third insoluble fiber (Lattimer and Haub, 2010).

There is a steady rise in the use of gums in different food products because of the rapid increase in the consumption of ready-made meals and novelty foods, also because of the consumers' growing awareness of the need to increase the amount of fiber and reduce the amount of fat in their diet (Williams and Phillips, 2003). Furthermore, gums used as excellent stabilizing and thickening agents in food system (Kaur et al., 2008).

Galactomannans are neutral water-soluble polysaccharides derived from the seed endosperm of Leguminosae and may give viscous solutions even at low concentrations. They consist of a linear β-D- mannopyranose backbone with branch points from their 6-positions linked to α -D-galactose unit. Some of the commonly used galactomannans include Locust bean (carob), Tara, and guar gum, with a mannose-to-galactose ratio of 4.5:1, 3:1, and 2:1, respectively (Kaur and Singh 2009).

A Guar gum molecule is made up of about 10,000 residues, which are non-ionic poly disperse rod-shaped polymers (longer than found in Locust bean gum). The highly branching nature results in its high solubility in water. The high viscosity of Guar gum results from both its high molecular weight and long chain structure. Guar gum is catalogued as a "well-fermentable" fiber type which includes pectin, acacia (gum Arabic), polydextrose, inulin and oligosaccharides (Tungland and Meyer, 2002). The Short Chain Fatty Acids (SCFA), resulting from the fermentation process are the prime substrates for the energy metabolism in the colonocyte where they act as growth factors to promote a healthy epithelium. Guar gum was reported to promote propionate and butyrate-rich fermentation as stated by Velazquez et al., (2000) and Henningsson et al., (2002).

Locust bean gum (LBG) known as carob bean gum is a galactomannan vegetable gum extracted from the seeds of the carob tree, and it is soluble in hot water. It is used as a thickening and gelling agent in food technology.

Pectin consists of a complex set of polysaccharides that contain 1, 4-linked α- D- galactosyluronic acid residues. Pectin is a natural part of human diet, as the daily intake of pectin from fruits and vegetables was estimated to be around 5 g per day. In human digestion, pectin goes through the small intestine more or less intact, and it has been reported that, the consumption of pectin reduces blood cholesterol levels (Buchanan et al., 2000).

This study was designed to evaluate the effect of the administering soluble indigestible polysaccharides fiber individually and in combinations on body weight, serum lipids and liver histopathological changes in experimental animals.

Materials and methods

Materials:

Guar gum, LBG, Pectin were obtained from local market in Cairo-Egypt. Arginine, casein, vitamins, minerals, cellulose and choline chloride were purchased from El- Gomhuria company. Cairo, Egypt. Corn oil and corn starch were obtained from local market. Kits used to determine serum biochemical parameters were purchased from Gama-Trade Comp. Cairo, Egypt.

Methods:

Diet:

Standard diet was prepared to give the efficiency for normal growth and maintenance of experimental animals .It was prepared from fine ingredient per100 gm diet according to AIN(1993).

Animals:

Adult male albino rats of Sprague Dawely strain weighing 90 ±10 gm, were purchased from animal house of Egyptian Organization for Biological Products and Vaccines. (VACSERA) Cairo, Egypt. Animals were kept in wire cages with wire bottom .The diet was introduced to the rats in special food cup that kept food spilling to a minimum .Water was provided to the rats by means of glass tube projecting through wire cage, an inverted bottle supported one side of the cage.

Experimental design:

Thirty six rats were divided into six groups (six rats each) and were fed as the following: group (A) on basal diet, group (B) on basal diet supplemented with 5% guar gum, group (C) on basal diet supplemented with 5% pectin, group (D) on basal diet supplemented with 5% locust bean gum (LBG), group (E) fed on basal diet supplemented with(2.5% guar gum + 2.5 % pectin) , group (F) on basal diet supplemented with (2.5% LBG gum + 2.5 % pectin). Rats were matched for body weight and were housed individually in wire cages. All groups were fed the experimental diet for six weeks. At the end of experiment, animals were sacrificed under ether anesthesia and blood samples were drawn from hepatic portal vein into centrifuge tubes. The livers were cleaned and kept in formaldehyde for Histopathological investigation.

Biochemical analysis:

Serum total cholesterol was determined using enzymatic kit according to the method reported by Stein, (1986).Triglycerides in serum were determined using enzymatic kit according to method reported by (Scheletter and Nussel, 1975). HDL-C was determined according to Wieland and Seidel (1981) after separation of HDL-c and determination of cholesterol bound to these fraction. LDL-c was determined according to Frunchart, (1982), after separation of LDL-c and determination of cholesterol bound to this fraction. The concentration of VLDL was estimated according to the following equation:

VLDL- c = Triglycerides/ 5 (Fniedewald et al., 1972).

Histopathological Evaluation:

After the animals were scarified, small pieces of the liver were taken and fixed in 10% neutral formalin; the sections were stained with hematoxylin and eosin before being examined under a light microscope (Degertekin et al., 1986).

Statistical analysis:

The results were expressed as (mean$\pm$ S.E). The statistical analysis of different groups was carried out using one-way analysis of variance technique (ANOVA) by using SPSS statistical software package, version (16.0), the significant difference among means was evaluated by least significant difference (L.S.D) method at levels of probability $P \leq 0.05$ and $P \leq 0.01$.

Results and discussions

From table (1) ,fig. (1) and fig.(2), it could be noticed that, there were a significant reductions in weight (P<0.05) of both groups fed on pectin and LBG groups individually. However, the groups fed on combinations of either (LBG+P) or (GG+ P) showed the lowest significant weight gain values (P<0.01) compared with the control group. The effect of soluble dietary fibers on weight loss was often due to their effect on satiety (Pasman et.al,1997) . Moreover, since obesity is the major modifiable risk factor for the development of CHD and hypertension, a small weight loss can make huge improvements and reduces the risk of these diseases, thereby reducing the risk of long term complications (Mokhdad et al., 2003 and Klein et al., 2004).

Table (1): Effect of supplemented different types of soluble dietary fiber and their combination on weight gain (g/day), FER and daily food intake (g/day) (Mean + S.E.).

Parameter / Groups	weight gain g/day	Sig.	FER	Sig.	Food intake g/day	Sig.
Control	5.25±0.40 ^{a}	.....	0.37±0.02 ^{a}	....	14.04±0.59 ^{a}	....
Pectin 5%	1.00±1.64 ^{ab}	0.038 *	0.12±0.18 ^{a}	0.281	08.98±0.68 ^{ab}	0.000 **
LBG 5%	1.00±1.48 ^{ab}	0.038 *	0.02±0.14 ^{a}	0.145	11.32±1.35 ^{ab}	0.037 *
LBG 2.5 % + Pectin 2.5%	-0.20±1.36 ^{ab}	0.009 **	-0.06±0.17 ^{a}	0.078	07.86±0.49 ^{ab}	0.000 **
Guar 5%	1.30±0.99 ^{a}	0.052	0.05±0.22 ^{a}	0.177	05.12±0.70 ^{ab}	0.000 **
Guar 2.5% + Pectin 2.5%	-0.40±1.81 ^{ab}	0.007 **	-0.11±0.18 ^{ab}	0.047 *	10.16±1.09 ^{ab}	0.004 **

Different superscript within column indicate a significant difference from control group,
(* The mean difference is significant at the 0.05 level.)
(** The mean difference is significant at the 0.01 level.)

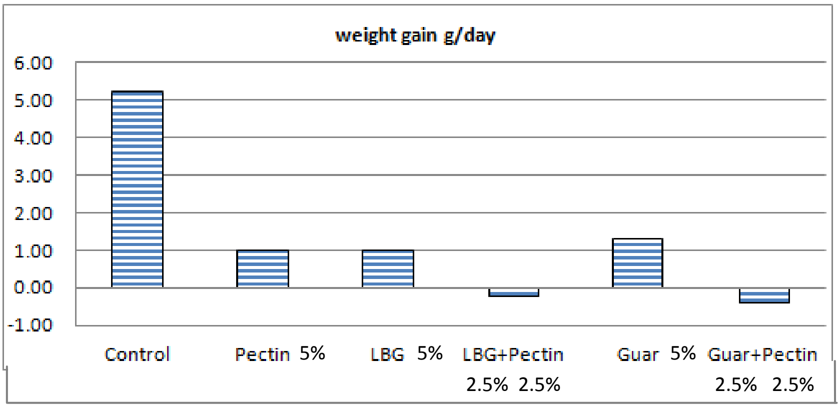

Fig. (1): Effect of different types of soluble dietary fiber and their combination on weight gain

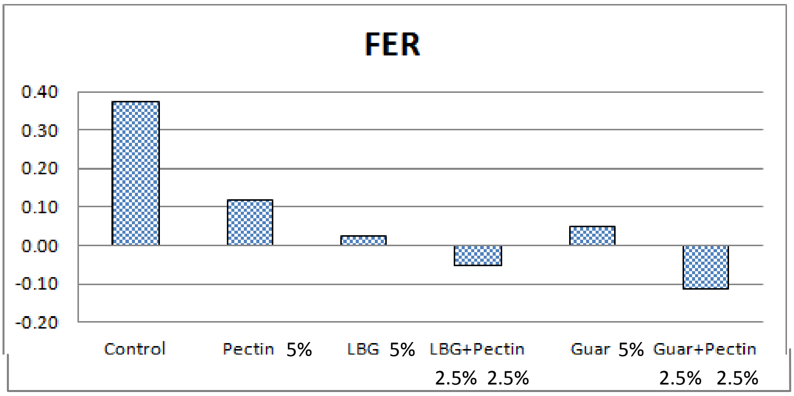

Fig. (2): Effect of different types of soluble dietary fiber and their combination on Food Efficiency Ratio (FER).

As reported by Mattes and Rothacker (2001) and Mattes (2007) dietary supplementations of viscous fibers such as guar and locust bean have been reported to slow gastric emptying and lower nutrient absorption. Slowed gastric emptying causes a feeling of fullness and suppresses appetite, which can help reducing weight loss .Guar gum has also been suggested to act in the intestine to boost release of gastrointestinal satiety hormones and reduce nutrient absorption. The swelling in the stomach can also help reducing stomach acid reflux as well. However, when guar gum is used in higher levels (3-5 %) in clinical efficacy studies, it often gives inferior sensory characteristics. Because oral perception of viscous foods can contribute to satiation, part of guar gum's effect on this sensation may be due to its high viscosity.

Furthermore, dietary fiber has a range of metabolic health benefits, through a variety of mechanisms. These mechanisms include: dietary fiber and the viscous variety in particular slows down intestinal transit, decreases the rate of intestinal carbohydrate absorption, and increases faecal bile acid excretion. Therefore, consumption of some types of soluble fiber can enhance satiety, which is associated with a lower body mass index (Salas-Salvado et al., 2006).

According to Freed (2000), fiber consisted of guar gum, gum Arabic, locust bean gum, pectin, and oat fiber reduced body weight by 6 pounds. This could be due to the fact that, Soluble fiber and soluble fiber-containing foods encourage gel formation in the stomach, which can increase gastric distention and reduce the rate of gastric emptying (Edward et.al,2001)

Hoad et al. (2004) examined gastric emptying and satiety in human subjects. They compared alginates with different viscosities and guar gum, whose viscosity is not affected by acid. Gastric emptying did not vary among the fiber source, but satiety was greater with the more viscous fiber. They hypothesis that more viscous fibers exert their effect owing to distention in the gastric antrum and/or altered transport of nutrients to the small intestine.

Dikeman et al.(2006) measured viscosity of different fiber sources in solutions and in simulated human gastric and small intestinal digesta. Rice brans, soy hulls and wood cellulose had the lowest viscosities, whereas guar gum, had the highest viscosities, regardless of concentration. The more viscous fibers appear most successful in promoting satiety, while other soluble fibers, such as inulin, that are less viscous appear to have minimal effects on satiety, even if consumed in very large doses. Yet, there is ample evidence that increasing consumption of high- fiber foods and the addition of viscous fibers to the diet may decrease feelings of hunger by inducing satiation and satiety(Slavin and Green 2007)

Masood et.al,(2011) proved that, the addition of guar gum in the diet is supportive to diminish the gain in body weight, which is ultimately helpful to control overall body weight. It has already been established from the various studies that dietary fiber may have some potential in the management of weight loss.

Chow et al., (2007) studied the satiety-promoting effect of a viscous fiber-containing nutrition bar (containing guar gum) in overweight and obese adults with type 2 diabetes, they concluded that these bars promoted greater postprandial satiety and can be helpful in weight management of people with type 2 diabetes. The satiety-promoting effect of these bars could be due to the presence of fermentable carbohydrates and sugar alcohols in the bar formulation through the production of fermentation products in the colon.

Dietary fiber also acts as a substrate for colonic fermentation, which produces bloating and a sense of fullness (Levine et al., 1989). SCFA, mainly propionate and acetate are absorbed in the colon and utilized as an energy source. Lavin and Read (1995) observed an increase in satiety and a decrease in hunger in healthy non-obese subjects, when consumed a glucose drink with addition of 2% guar gum. Guar gum increased satiety scores, they assumed that, the satiating effect of glucose to be due to increased contact of the glucose with receptors in the small intestine and consequent improved release of assumed satiety peptides, such as GIP, GLP or insulin. For the LBG group the reduction in weight could be due to the fact that, Carob bean gum has been noted to contain tannins which depress growth, and trypsin inhibitors which are also growth inhibitory (LSRO/FASEB, 1972).

From Table (2), it could be noticed that, there was no significant decrease in serum total cholesterol in both Guar and Pectin groups when compared with the control group. However, there were a highly significant decreases in serum triglycerides of rat groups fed on guar and pectin ($P \leq 0.01$ and $P \leq 0.05$), respectively. These results were in line with that of a recent study done by Butt et al., (2007), who reported that wheat flour were supplemeted with 3% pectin, 3% guar gum, a combination of pectin and guar gum 2% of each .Guar gum group showed the highest reduction in triglyceride level followed by pectin.

HDL-c in groups fed on Pectin and LBG, showed the highly significant increases ($P \leq 0.01$), however guar gum group showed a non significant increase in HDL-C. The present results of guar group was in agreement with the study of Blake et al., (1997) who reported that, ingestion of guar gum in healthy volunteers for 3 weeks, there was a significant reduction (10%) in total plasma cholesterol concentration after the guar treatment ($P < 0.001$), mainly because of a reduction in the low-density-lipoprotein-cholesterol fraction. No changes in plasma high-density-lipoprotein-cholesterol were detected.

Table (2) showed that, there were a highly significant decreases ($P \leq 0.01$) in VLDL-C levels in both rats group fed on guar gum and pectin. It was cleared that, in comparison with the control group, there were a highly significant increases ($P \leq 0.01$) in serum total cholesterol in rats groups fed on combination of (guar gum+ pectin) and/or (LBG+ pectin). The same results were observed in serum triglycerides, LDL-C and VLDL-C.

On the other hand, serum HDL-c level was decreased significantly ($P<0.01$) in rats group fed on mixture of (LBG+ pectin). It can be concluded from the present study that dietary fibers from guar gum and pectin may be helpful in reducing serum triglycerides levels. It was further suggested that guar gum is more effective than pectin in controlling the high level of lipid parameters values. For this reason, wheat flour should be supplemented with dietary fiber sources to combat the existing hypercholesterolemia. This could be explained on the basis that recent study administering mixture of soluble fiber for only 6 weeks.

Table (2): Serum lipids concentrations (mg/dl) of Male Albino Rats fed different types of soluble dietary fiber (at level 5%) and their combinations (Mean $\pm$ S.E.).

Parameter / Group	T. Cholesterol *mg/dl*	Sig.	Triglyceride *mg/dl*	Sig.	HDL-C *mg/dl*	Sig.	LDL-C *mg/dl*	Sig.	VLDL-C *mg/dl*	Sig.
Control	77.38$\pm$0.59 [a]		98.22$\pm$1.20 [a]		35.38$\pm$0.78 [a]		22.17$\pm$0.16 [a]		19.81$\pm$0.18 [a]	
Guar 5%	74.52$\pm$2.10 [a]	0.395	83.08$\pm$4.90 [ab]	0.000**	37.16$\pm$1.15 [a]	0.390	19.76$\pm$3.05 [a]	0.501	17.50$\pm$0.20 [ab]	0.000**
Pectin 5%	75.00$\pm$3.60 [a]	0.477	89.89$\pm$1.47 [ab]	0.038*	49.58$\pm$2.18 [ab]	0.000**	11.93$\pm$0.97 [ab]	0.007**	17.97$\pm$0.29 [ab]	0.001**
LBG 5%	88.90$\pm$2.60 [ab]	0.002**	103.70$\pm$1.66 [a]	0.160	45.09$\pm$1.70 [ab]	0.000**	23.07$\pm$3.70 [a]	0.800	20.75$\pm$0.33 [a]	0.079
LBG 2.5%+ P 2.5%	97.62$\pm$1.70 [ab]	0.000**	122.30$\pm$3.16 [ab]	0.000**	25.11$\pm$1.20 [ab]	0.000**	48.03$\pm$2.10 [ab]	0.000**	24.50$\pm$0.63 [ab]	0.000**
Guar 2.5%+ P 2.5%	94.60$\pm$2.30 [ab]	0.000**	107.50$\pm$1.80 [ab]	0.022*	36.30$\pm$1.23 [a]	0.662	36.90$\pm$3.03 [ab]	0.000**	21.50$\pm$0.36 [ab]	0.003**

Different superscript within column indicate a significant difference from control group,
(*. The mean difference is significant at the 0.05 level.)
(** . The mean difference is significant at the 0.01 level.)

According to Jensen et al., (1997) a daily dose of (15 g/day) supplemental water-soluble dietary fiber mixture (psyllium, pectin, guar gum and locust bean gum), showed reductions in plasma cholesterol and LDL-c after 8 weeks, which were sustained at (16 and 24 weeks) in humans.

It was also observed that significant and sustained reductions in LDL-c without reducing HDL-c or increasing triglycerides, over the 51-week consumption of soluble dietary fiber supplement (15 g/day; mixture of guar gum and pectin) as stated by Knopp et al., (1999). Moreover, Carter et al., (1998) reported that, there was a decrease in serum cholesterol level by 20 to 30% with long-term consumption of food with soluble dietary fiber. Furthermore, Behr et al., (1998) reported that, food bars containing guar galactomannan fiber have a lowering effect of LDL-c. These observations were also supported by Aller et al., (2004) who observed a similar effect of soluble dietary fiber in healthy subjects.

The other beneficial effects of soluble dietary fiber are related to the fermentation of gums by microflora in the large intestine. Guar gum increases the activity of 7ά- hydrolase, which is the rate limiting step in the conversion of cholesterol to bile acids in the liver; and at the same time there is also an increase in faecal bile acid excretion. One of the hypothesis indicated that, the inhibition of cholesterol synthesis in hepatocytes was via the fermentation products SCFAs, especially propionate (Khattak, 2002 and Edwards, 2003).

The high viscosity of guar gum depressed LDL-c and HDL-c. This confirms that a soluble polysaccharide that promotes large-bowel fermentations and that does not enhance bile acid secretions may not have significant impact on plasma cholesterol, if its viscosity is low. The decreased efficiency of low viscosity guar gum was explained on the basis of a decreased stimulation of hydroxymethylglutaryl coenzyme A (HMG CoA) reductase. High levels of LDL-c build up on the interior of blood vessels resulting in hardened arteries, narrowing of the blood vessels and CHD. High Levels of HDL-c have been observed to reduce some of the harmful effects of LDL-C. HDL-c picks up and transports cholesterol in the blood back to the liver, which leads to its removal from the body. HDL-c can help to keep LDL-c from building up in the walls of the arteries (FDA, 2005 and Shahzadi et al., 2007). In a study by Roy et al., (2000) a reduction of 44% in LDL-c and 22% in triglycerides were observed by feeding soluble fiber diet containing 2.5/100g of guar gum , 5g/ 100g of pectin and 5g/ 100g of psyllium diet. While Brown et al., (1999) reported that, there were no significant changes in HDL-c levels on feeding of 2-10 g/ day of soluble fiber.

The data from Table (2) illustrated that there was a highly significant increases in all parameter in both two combination groups (GG+ P and LBG+ P); this could be due to the interaction between two polysaccharides to give weak or rigid gel properties to the aqueous phase. Soluble 1, 4-linked 0-D-glycans, in particular the galactomannans, play a central role in these interactions. Under conditions where they do not exhibit rigid or weak gel properties, they can enhance the novel rheological properties of certain other polysaccharides when added at low levels (Dea, 1987). Key examples of this gelation mechanism are the interactions of agars, carrageenans and xanthan with the galactomannans. Thus, the addition of low levels of locust bean gum, in which approximately 30% of the mannose residues in the mannan chain are substituted by a-D-galactose residues (23 % galactose, 77 % mannose), causes non-gelling concentrations of agarose (0.05%) and K-carrageenan (1%) to form firm rigid gels.

Other mechanism that might explain the effects of soluble fiber combinations could be that the electrostatic forces are usually the major driving force for the interaction of charged biopolymers in aqueous solutions (Ducel et al., 2004). Galactomannans are neutral while citrus pectin are negatively charged polysaccharides, thus in aqueous solutions of mixed biopolymers, they are susceptible to phase separation by one of two alternative mechanisms—complex coacervation (associative phase separation) or thermodynamic incompatibility (segregative phase separation) (Tolstoguzov ,2003). Complex coacervation occurs when two biopolymers are strongly attracted to each other, which usually occurs because they have opposite electrical charges. This leads to the formation of a two-phase system that consists of a mixed biopolymer complex phase suspended in a solvent phase depleted in both biopolymers. This complex may be either soluble or insoluble depending on the electrical characteristics of the biopolymers involved and the solution composition.

On the other hand, thermodynamic incompatibility tends to occur when the biopolymers are uncharged or similarly charged so that there is a relatively strong steric or electrostatic repulsion between them. In this situation, the two biopolymers may co-exist in a single phase (miscibility) in domains in which they mutually exclude one another or, above a critical concentration, segregate into two different phases. Each of the phases formed is rich in one type of biopolymer and depleted in the other type. Previous studies have shown that globular proteins can interact with anionic polysaccharides (e.g. gum arabic, carboxymethycellulose, pectin, and carrageenan) to form either soluble or insoluble complexes (De Kruif et al., 2004; Ducel, et al., 2004; Girard, et al., 2003 and Weinbreck,et al., 2004). An improved understanding of the origin and nature of these interactions would lead to the design of foods with improved nutritional, physicochemical, and sensory properties. At pH 4 and 5, there were relatively large insoluble complexes in the mixed biopolymer solutions that would be expected to scatter light much more strongly than any soluble biopolymers (Harnsilawat et al., 2006).

Histopathological results:

From (Fig.3a) it could be noticed that, microscopically the liver of control rats group revealed the normal histological structure of hepatic lobule. Furthermore, (Fig.3 b and c) revealed that, the liver of rats groups fed 5% guar or pectin, showed no histological changes. On the other hand (Fig. 3 d) showed the liver of rats group fed 5% LBG, which had a vacuolar degeneration of hepatocytes. (Fig. 3 e) showed that, liver of rat group (2.5% LBG+ 2.5% P), had congestion of central vein. While (Fig.3f) cleared that, liver of rat group

(2.5% GG+ 2.5% P) showed congestion of central vein and vacuolations of hepatocytes.

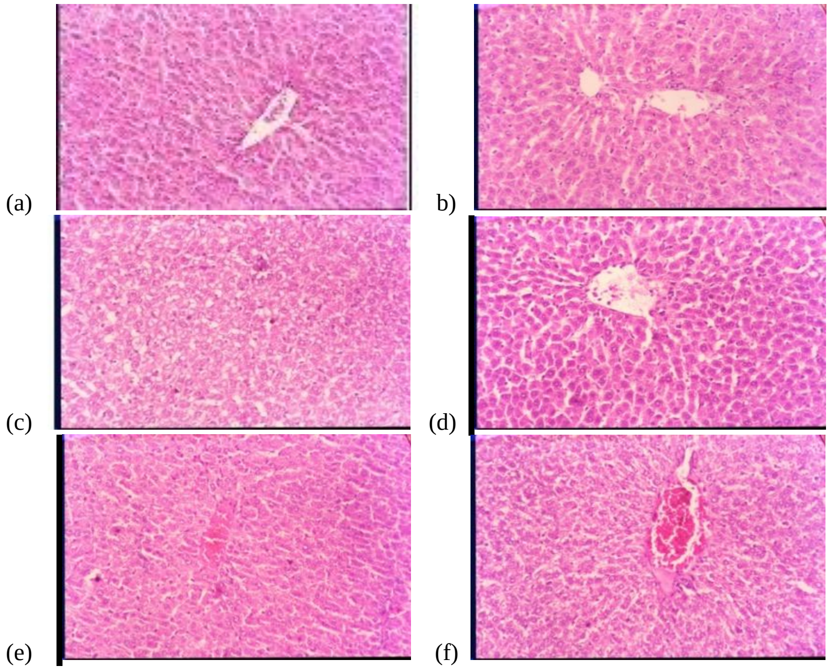

Fig. (3): Histopathological effect of different types of soluble dietary fiber individually and in combinations on rats.

Carlson and Domanski (1980) stated that, in groups of 50 male and 50 female albino rats fed on diets containing 5% alpha cellulose (control) or 2 or 5% carob bean gum (CBG) for 24 months, there were no significant treatments-related effects on gross or microscopic pathology. Diets containing 25,000 (2.5%) or (5 %) of agar, guar gum, gum Arabic, locust-bean gum or tara gum were fed to groups of 50 male and 50 female rats and mice for 103 wk, and there were no histopathological effects associated with the administration of the tested materials (Melnick et al., 1983).

From the results of current study it might be concluded that, the effects of soluble dietary fiber could be more effective when used individually rather than in combinations, especially with regards to their effects on lipids' pattern and liver` histopathological results. It is important to note that mixed biopolymer should be carried out under caution, since different types of molecular species present in solution. These types of soluble dietary fiber might be of greater beneficia effect in case of obesity and incidence of hyperlipidemia.

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التأثير الفسيولوجى لانواع مختلفة من الالياف الغذائية القابلة للذوبان (صمغ الجوار، صمغ الخروب و البكتين) على دهون مصل الدم وعلي انسجة الكبد في الفئران

المستخلص العربي

تم تصميم هذه الدراسة بغرض قياس اثر تدعيم الوجبات الغذائية بالالياف القابلة للذوبان بصورة منفرده او في صوره خليط على: وزن الجسم، دهون مصل الدم و التغيرات بانسجة الكبد في الفئران. تم استخدام عدد ثلاثون فارا من نوع سبارجو داولي تم تقسيمهم إلى ستة مجموعات، وتغذيتهم لمدة ستة أسابيع على الوجبات التالية: (ا) وجبة ضابطة، (ب) وجبة ضابطة مدعمة بنسبة ٥% صمغ الجوار، (ج) وجبة ضابطة مدعمة بنسبة ٥% بكتين، (د) وجبة ضابطة مدعمة بنسبة ٥% صمغ الخروب، (هـ) وجبة ضابطة مدعمة بخليط من صمغ الجوار و بكتين بنسبة ٢,٥% من كل منهما ، (و) وجبة ضابطة مدعمة بخليط من صمغ الخروب و بكتين بنسبة ٢,٥% من كل منهما . تم قياس ما يلي: التغيرات في كميه الغذاء المتناول ، وزن الجسم، معامل كفاءة الطعام، مستوى الكوليستيرول الكلي بمصل الدم، الجلسريدات الثلاثية، الدهون البروتينية عالية الكثافة، الدهون البروتينية منخفضة الكثافة، الدهون البروتينية المنخفضة جدا في الكثافة والتغيرات الناتجة بانسجة الكبد. وقد أظهرت نتائج الدراسة انخفاض معنوي ($P\leq0.05$) في وزن جسم الفئران في مجموعتي البكتين وصمغ الخروب، ولكن مجموعات الفئران التي تغذت على خليط من الألياف أظهرت اقل تأثيرا على الانخفاض في وزن للجسم وذلك عند مقارنتها بالمجموعة الضابطة عند مستوى معنوي ($P\leq0.01$). وكذلك كان الارتفاع معنوي ($P\leq0.01$) في مستوى الدهون البروتينية المنخفضة جدا في الكثافة في المجموعات

التي تغذت على وجبات مدعمة بنسبة ٥% من صمغ الجوار او البكتين عند مقارنتها بقيم الدهون البروتينية في المجموعة الضابطة. ولم تلاحظ اية تغيرات في انسجة الكبد بمجموعات الفئران التي تم تغذيتها على وجبات مدعمة بنسبة ٥% من صمغ الجوار او البكتين. أظهرت نتائج هذه الدراسة ادلة على ان تدعيم الوجبات الغذائية بنوع منفرد من الالياف القابلة للذوبان قد يكون أكثر فاعلية من تلك التي دعمت بخليط من نوعين من الالياف القابلة للذوبان. توصى نتائج هذه الدراسة بدعم الوجبات الغذائية بهذه الالياف القابلة للذوبان بصورة منفردة فقط لما لها من تأثير مفيد وخاصة في حالات السمنة وارتفاع دهون الدم.

الكلمات المفتاحية: صمغ الجوار- صمغ الخروب- البكتين- دهون السيرم- الجلسريدات الثلاثية- الدهون البروتينية عالية الكثافة والدهون البروتينية المنخفضة جدا في الكثافة- وهيستوبيولوجى الكبد.