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Abstract

Purpose: Hypercholesterolemia poses a significant challenge for numerous communities and healthcare professionals because of the association between cardiovascular conditions and dyslipidemia. The objective of this research was to assess the impact of prebiotics, probiotics, as well as a diet incorporating Bacillus coagulants and gum Arabic on blood lipid levels in hypercholesterolemic rats.

Methodology: In order to create an antiseptic solution, acquire the organic substance known as gum Arabic. Thirty-five male Albino rats (170 ± 5 g) were feeding a prepared diet includes supplemented cholesterol to raise the levels of cholesterol. Mice were divided to 5 groups (n = 7). Group 1: simple diet (negative control), the other 4 groups were assigned for a hypercholesterolemia diet comprising 25% lard and 2% cholesterol for 6 weeks in order to increase fat cholesterol in rats. Group 2: (positive control), Group 3: fed with a supplement including 5% gum Arabic (prebiotic), Group 4: fed with a dietary supplement comprising coagulase spores, Group 5: assigned for a simple meal. It was supplemented with 5% daily gum Arabic and Bacillus coagulants spores (symbiotic).

Results: Triglyceride levels and total cholesterol (mg/dL) were improved ($P<0.05$). In (advantageous manipulate) fed a simple diet (B.D.), compared with (poor manipulate).

Unique Contribution to theory, Practice and Policy: The Anti-Inflammatory Theory and the concept of prebiotics usage to decrease cholesterol and minimize its absorption. This shows that the concept used has been validated. The satisfactory results which confirmed the extreme spread variations with the poor manipulate organization had been done within side the hypercholesterolemia organizations include with Gum Arabic (GA5%), where the best indicated a fee recorded (28.54 ± 3. seventy one mg/dL), which transferred into the poor manipulate (36.33 ± 5.00 mg/dL). As for the organizations that took B. coagulants and GA 5% + B. coagulants, a lower in LDL-c, (VLDL-c), levels of AST and AST, and the satisfactory outcome documented and directed within side of the organization GA 5% + B.Coagulants. Histological checkups furthermore confirmed that the liver sections inside the 5th organization established a regular structure, also the liver cells mild degeneration. CONCLUSION: The satisfactory final outcome indicated within side the organization of GA 5%+ B. coagulants remedy organization compared with the opposite organizations.

Keywords: *Bacillus Coagulants Bacteria - Gum Arabic- Hypercholesteremic Rats*

INTRODUCTION

Hypercholesterolemia is a metabolic disorder of lipoprotein characterized by elevated levels of low-density lipoprotein and cholesterol in the bloodstream. Rerkasem et al. (2008) have reported it as a significant risk factor in the development and progression of atherosclerosis, which ultimately leads to cardiovascular diseases (CVDs). The correlation between cardiovascular diseases and lipid abnormalities makes hypercholesterolemia a major concern for both societies and healthcare professionals (Matos et al. 2005; Ramachandran et al., 2003). Clinical trials have shown that intensive reduction of plasma LDL-C levels can reverse atherosclerosis. It is widely believed that high amounts of saturated fats and cholesterol directly contribute to the development of hypercholesterolemia and susceptibility to atherosclerosis (Asashina et al., 2005). Moreover, studies on diet have shown that serum cholesterol levels can be influenced by the type and source of proteins consumed (Serounge et al., 1995; Forsythe, 1995). The lipid profile in the blood plasma is also thought to be impacted by factors such as lipid structure, composition, configuration, as well as high intake of fat and cholesterol (Zulet et al., 1999). Animal models with high cholesterol levels are valuable for research on cholesterol regulation, drug testing, and gaining insights into disorders related to cholesterol metabolism, atherogenesis, and potential treatments to lower cholesterol levels in the bloodstream (Pellizon, 2008; Jang and Wang, 2009).

The World Health Organization (WHO) has predicted that cardiovascular diseases will remain the leading causes of death by 2030, affecting approximately 23.6 million people worldwide (WHO; 2010). According to a study conducted by Yusuf et al. (2004), hypercholesterolemia was found to contribute to 45% of heart attacks in Western Europe and 35% in Central and Eastern Europe between 1999 and 2003. Individuals with hypercholesterolemia are three times more likely to experience a heart attack compared to those with normal blood lipid profiles. The WHO has identified unhealthy diets, characterized by high fat, salt, and free sugar intake, and low consumption of complex carbohydrates, fruits, and vegetables, as factors that increase the risk of cardiovascular diseases (WHO; 2003). Individuals affected by hypercholesterolemia may be able to avoid the use of cholesterol-lowering medications by practicing dietary control or incorporating probiotics and/or prebiotics into their supplementation. Probiotics are living microbial supplements that have a positive impact on the balance of intestinal microorganisms in host animals, as defined by the Food and Agriculture Organization (FAO) and WHO (2001).

On the contrary, prebiotics are fermented food substrates that cannot be digested and they have the ability to selectively stimulate the growth, composition, and activity of microflora in the gastrointestinal tract. This ultimately leads to an improvement in the health and well-being of the hosts, as explained by Roberfroid (2007). When probiotics and prebiotics are used in combination, they are referred to as "synbiotics". Although the scientific recognition of probiotics and prebiotics is relatively recent, their use as functional foods has been well-established for many generations. Due to their promising effects on health and well-being, probiotics and prebiotics are increasingly being recognized as supplements for human consumption. In addition to their positive impact on gut health, probiotics have also been found to have other beneficial effects on health, such as boosting the immune system (Galdeano et al., 2007). The effects of probiotics have been extensively studied and have shown various health benefits. These include their ability to lower blood pressure (Yeo and Liong;2010), prevent cancer (Hirayama and Rafter;2000), act as antioxidants, reduce symptoms of dermatitis (Weston et al,.2005), enhance mineral absorption (Scholz et al,.2007), improve arthritis (Baharav et al,.2004), alleviate allergic symptoms (Ouwehand;2007), and treat vulvovaginal candidiasis in women (Falagas et al,.2006). Additionally, probiotics have been investigated for their potential to lower cholesterol levels (Pereira and Gibson;2002). While there have been conflicting findings regarding the cholesterol-lowering effects of probiotics, prebiotics, and symbiotic in both animals and humans, there is limited information available on the cholesterol-lowering effects of B. coagulants spores. Gum Arabic, sometimes referred to as GA (Acacia Senegal), is a naturally occurring dietary supplement made from the tuber exudate or tears of some Acacia tree species. GA is recognized as a safe dietary fiber that is suitable for human ingestion by the US Food and Drug Administration. Because to its indigestible fiber content, which is composed of polysaccharides, neutral sugars (rhamnose, arabinose, and galactose), and glucuronic acid, GA is classified as a natural prebiotic. By means of fermentation in the cecum, these constituents specifically encourage the proliferation and motility of advantageous bacteria. GA also contains minerals, amino acids, and organic materials. Research from the past has shown that adding GA to broiler chicken feed at up to 6% of the feed can act as a prebiotic and improve gut health and growth (Jha and Kim ;2021).

This study was conducted to evaluate the in vivo effects of B. coagulants and Arabic gum, separately and in combination on lipid profile using a rats. Therefore, the aim of this study was conducted to determine the effect of prebiotic, probiotic bacteria and symbiotic diets containing Bacillus Coagulants and Gum Arabic on lipid profile in hypercholesterolemic rats.

Theoretical Framework

The Anti-Inflammatory Theory

According to this notion, eating foods high in anti-inflammatory compounds can help lower oxidative stress and inflammation linked to hypercholesteremic conditions and their aftereffects. With regard to the lipid profile in hypercholesterolemic rats, this hypothesis can be utilized to examine the effects of various prebiotic, probiotic, and symbiotic diets comprising Bacillus Coagulants and Gum Arabic on the inflammatory markers and oxidative stress (Mohammed et al., 2021).

The Theory of Using Prebiotics to Lower Cholesterol and Reduce Its Absorption

The hypocholesterolemia effect of prebiotics, like Gum Arabic, has been attributed to two possible mechanisms: selective fermentation by intestinal bacterial microflora leading to the production of short-chain fatty acids, and decreased cholesterol absorption by enhancing cholesterol excretion via feces (Abdulla et al., 2015).

MATERIALS AND METHODS

Preparation of Spore Suspension of Probiotic Bacteria

Probiotic B. coagulants that had been freeze-dried was acquired from the National Research Center in Cairo, Egypt. On Yeast Nutrient Salt Medium (NYSM) agar [10], it was grown aerobically for 24 minutes at 37°C. 500 milliliters of NYSM broth were infected with a single colony obtained from a NYSM plate. For 48 hours, they were incubated at 37°C with 250 rpm of shaking. Three pellets of the bacterial suspension were made. Centrifuged three times at 3,000 × g for twenty minutes, and then rinsed with sterile normal saline. Lastly, 100 milliliters of sterile normal saline were used to resuspend the pellet. Prior to the proper serial dilution and plating on NYSM agar, the solution was heated to 80 °C for 15 minutes in order to destroy the plant cells and determine the number of spores per milliliter suspension.

Chemical Composition Analysis

Gum Arabic or GA (Acacia Senegal) was purchased as a natural product from the Institute of Food Technology, Giza, Egypt. It was ground to a fine powder in the laboratory, and nutritional composition analysis of the GA powder samples was performed (Saleh et al,.2021), (Gashua et al,. 2015) and (El-Sayed et al,. 2020).

Biological Study

Preparation of Diets

The general food plan became formulated in keeping with AIN-93 (*Reeves et al., 1993*). The salt mixture was prepared according to *Viviani et al., (1964)*. The vitamin mixture was prepared according to *A.O.A.C. (1975)*.

Experimental design

35 male albino rats weighing 170 ± 5 g were acquired from the National Research Center located in Cairo, Egypt. Following the two-week adaption phase, meals enriched with cholesterol were designed to induce hypercholesterolemia. Rats were divided into four feeding groups (n = 7/group) and kept in groups under controlled lighting, with a temperature of 24 ± 2 °C and a relative humidity of 55 ± 10%. In order to establish hypercholestrimia in rats, the rats were split into five groups. Group 1 received a basic diet, which served as a negative control. The other groups were fed a hypercholesterolemic diet (HPC) supplemented with 25% lard and 2% cholesterol for six weeks. groups 2 and 4 were the positive control and basally supplemented diets, respectively, with 5% gum Arabic (a prebiotic).

Biochemical Analysis of Serum

Blood Collection and Serum Separation

Blood Sample will be withdrawn from each animal, on fasting state collected blood samples to determination the biochemical analysis as well as will be centrifuged to obtain the serum for biochemical analysis in National Research center, Dokki, Egypt.

Lipid Profile Determination

1-Determination of Blood Cholesterol.

2-Triglycride (TG) will determine in the Serum TG will calculate according Total Cholesterol (TC) Determination: Cholesterol was determined by the enzymatic colorimetric method described by Allain et al. (1974).

3-High Density Lipoprotein (HDL) will determine in the serum according to the method described by (Lopes et al., 1977)

4-Low Density Lipoprotein (LDL) will determine in the Serum LDL will calculate according to (Fiedwald*et al*., 1972)

5-Very Low Density Lipoprotein (VLDL) will determine in the Serum VLDL will calculate according to (Fiedwaldet al., 1972)

Liver Function

The serum's levels of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) will be measured using the protocol outlined by Reitman and Frankel (1957). Histopathological examination: According to Bancroft et al. (1996), a histopathological examination of liver tissues can be conducted at Cairo University's Pathology Department, Faculty of Veterinary Medicine, in order to detect any alterations. Analytical Statistics: The result obtained can be given as implied ± standard deviation. Data may be evaluated using the SPSS statistical laptop application in at least one way using an analysis of variance (ANOVA). The mean difference became significant at the ($p<0.05$) level, per (SPSS; 2007).

RESULTS

Table (1) presents the chemical composition of 100g of Gum Arabic. Calculation of Acacia Senegal's approximate principles and macronutrient contents . nutrients in 100 grams 14.5 g of moisture, 347.33 kcal of energy, and 81.87 g of carbohydrates. Ash weighed 2.8 g, protein 0.51 g, lipids 0.15 g, and crude fiber 0.17 g.

Table 1: Chemical composition of Gum Arabic /100g

Nutrients (%)	Amounts
Moisture (g)	14.5
Protein (g)	0.51
Energy (Kcal)	347.33
Lipids (g)	0.15
Total carbohydrates (g)	81.87
Crude Fiber (g)	0.17
Ashe (g)	2.8

Effect of the Treatments on Lipid Profile of Hypercholesteremic Rats

Serum Total Cholesterol and Triacylglycerol

Table (2) illustrates the impact of remedies from Gum Arabic (GA5%), B. coagulants at the serum ldl cholesterol and triacylglycerol ranges of the hypercholesteremic rats. .

The information on this desk demonstrated that there had been a significant ($P<0.05$) increase in the general ranges of l dl cholesterol and triacylglycerol (mg/dl). The basal diet (B.D.) was ingested by untreated hypercholesteremic rats (great control), whereas healthy rats (poor control) also devoured B.D. (77.05 ± 2.64 and 156.17±1.36) vs. (59.00 ± 1.00 and 11.14 ± 0.50). In hypercholesteremic rat businesses fed a basal diet supplemented with dietary treatments, the suggested values of blood cholesterol and triacylglycerol gradually decreased with intake. The effects of Gum Arabic (GA5%), B. coagulants, and GA 5%+B. coagulants therapies on the suggested serum ldl cholesterol values of hypercholesteremic rats confirmed a significant improvement in the overall cholesterol stage when compared to the extremely well-managed group. In contrast to unmanaged hypercholesteremic institutions (exceptional manage), there has been a gradual full-size decline ($P<0.05$) observed in the values of triacylglycerol in all managed hypercholesteremic organizations. The high-quality results that validated the non-extensive differentiation with poorly managed institutions were conducted in conjunction with hypercholesteremic organizations that handled B. coagulants, GA 5%+B. coagulants, and gum Arabic (GA5%).

Serum Lipoprotein Cholesterol

The results of Gum Arabic (GA5%), B. coagulants, and GA 5%+B. coagulants on cholesterol characteristics, such as high-density lipoprotein (HDL-c), low-density lipoprotein (LDL-c), and very low-density lipoprotein (VLDL-c), are well-known and may be found in Table 2.

High Density Lipoprotein Cholesterol (HDL-c)

The results in Table (2) demonstrated that there was a significant difference between the serum HDL-c of the great manipulate (hypocholesteremia rats not treated) that consumed the basal weight-reduction plan and the poor manipulate (regular rats) that also consumed B.D. Significant differences in high-density lipoprotein cholesterol (HDL-c) were found in all treated organizations. Differences were also found between the manipulation organizations and all treated organizations. This table shows that the hypercholesteremic rat groups treated with GA 5%+B. coagulants had the best mean value (28.54 ± 3.71 mg/dl), which was quite near to the poor group (36.33 ± 5.00 mg/dl).

Low Density Lipoprotein-Cholesterol (LDL-c)

The data demonstrated a significant difference in the organization of serum low density lipoprotein cholesterol (LDL-c) between (+) and (−) manipulation. The results also showed that there were significant differences in the serum LDL-c stages of all groups that consumed the basal weight-reduction plan with Gum Arabic (GA5%), B. coagulants, and GA 5%+B. coagulants. Additionally, the mean values of serum LDL-c of the groups of treated hypercholesteremic rats decreased gradually as they consumed the remedies. Furthermore, differences existed between the manipulation organizations and the all dealt with organizations. Based on the data shown in Table (2) and the previously mentioned sources, it can be inferred that the optimal treatment of hypercholesteremic rats with B. coagulants and GA 5%+B. coagulants completed the good results.

Very Low-Density Lipoprotein-Cholesterol (VLDL-c)

Table (2) suggests the suggest that the hypercholesteremic rat animals that consumed B.D. with gum Arabic (GA5%), B. coagulants, and GA 5%+B. coagulants had serum values of very low-density lipoprotein-cholesterol (VLDL-c). The data on this desk shown that, in comparison to the bad manipulate group (healthy rats) (3.07 ± 0.10), which also consumed B.D., the superb manipulate group (untreated hypercholesteremic rats) had a substantially faster suggest cost of VLDL-c ($P<0.05$). The results showed that, when compared to excellent manipulation, all hypercholesteremic rats treated with gum Arabic (GA5%), B. coagulants, and GA 5%+B. coagulants significantly reduced serum VLDL-c. The obtained results verified that significant changes were found in the levels of serum VLDL-c in Gum Arabic (GA5%), B. coagulants.

Table (2): Effect of Gum Arabic (GA5%), B. Coagulants and GA 5%+B. Coagulants on Serum Lipid Profile (mg/dl) in Hypercholesteremic Rats

Lipid profile / Animal groups	Total cholesterol Mean ± SD	Triacylglycerol Mean ± SD	HDL-c Mean ± SD	LDL-c Mean ± SD	VLDL-c Mean ± SD
Negative control (-)	59.00 ± 1.00^{B}	11.14 ± 0.50^{AB}	36.33 ±5.00^{A}	7.22 ± 1.00^{C}	3.07 ± 0.10^{C}
Positive control (+)	77.05 ± 2.64^{A}	156.17 ± 1.36^{A}	22.50 ± 0.50^{D}	34.55 ± 0.61^{A}	29.81 ± 0.28^{A}
GA 5%	65.57 ± 18.58^{AB}	121.90 ± 1.00^{AB}	25.50 ± 0.51^{D}	30.56 ± 7.03^{B}	24.71± 1.00^{AB}
B. coagulants	64.33 ± 1.00^{B}	116.20 ±79.42^{AB}	27.23 ± 1.00^{DBC}	19.05 ± 5.07^{C}	22.90±15.73^{AB}
GA 5%+B. coagulants	62.66 ± 5.81^{B}	71.65 ± 4.78^{CB}	28.54 ± 3.71^{B}	11.63 ± 0.45^{C}	13.15± 0.93^{CB}
L.S.D	15.18	60.33	4.96	8.65	13.01

* Non significant differences between the values had the same letter.
* LSD: Least Significant Difference at level 0.05

Effects on the hepatic characteristics of hypercholesteremic rats of Gum Arabic (GA5%), B. coagulants, and GA 5%+B. coagulants. Table 3 provides the results of aspartate amino transferase (AST) and alanine amino transferase (ALT). As compared to healthy rats (NC) fed baseline diet, the results showed that feeding hypercholesteremic rats on basal diet (PC) caused a significant increase in serum AST and ALT (336 ± 6.71& 135.70 ± 1.03 vs. 91.53 ± 11.31& 51.63 ± 16.22 U/L), respectively. This institution confirmed a massive extrude in AST enzyme activity, as in table (3), which led to the fine end result being recorded at GA 5%+B. coagulants. The data also confirmed that serum AST tiers found out massive slow lower with consumption the remedy with Gum Arabic (GA5%), B. coagulants, and GA 5%+B. coagulants.

Alanine amino transferase (ALT) in all handled hypercholesteremic rat companies with Gum Arabic (GA5%), B. coagulants and GA 5%+B. coagulants, prompted marked discount toward the ordinary value, meanwhile, the bottom degree of ALT enzyme become determined in institution of rats that take GA 5%+B. coagulants. From the above stated data, it is able to be concluded that, treating hypercholesteremic rats with GA 5%+B. coagulants significantly (P<0.05) Normalized liver characteristic on the quilt of the experiment.

Table (3): Effect of Gum Arabic (GA5%), B. Coagulants and GA 5%+B. Coagulants on Liver Functions in Hypercholesteremic Rats

Liver function / Animal groups	AST (U\L) Mean ± SD	ALT (U\L) Mean ± SD
Negative control (-)	91.53 ± 11.31^{C}	51.63 ± 16.22^{C}
Positive control (+)	336 ± 6.71^{A}	135.70 ± 1.03^{A}
GA 5%	172.66 ± 6.91^{B}	113.27 ± 1.33^{B}
B. coagulants	168.91 ± 1.56^{BC}	71.88 ± 5.39^{C}
GA 5%+B. coagulants	152.65 ± 92.29^{BC}	58.76 ± 53.31^{C}
L.S.D	67.922	28.165

* Non significant differences between the values had the same letter.
* LSD: Least Significant Difference at level 0.05

Histopathology Examinations

Impact of B. coagulants, GA 5%, and GA 5%+B. coagulants on the histopathology of the liver Hepatocytes in the livers of rats in group 1 (control negative) were normal (Photo 1). The control group's liver slices displayed significant hepatocyte vacuolar degradation along with inflammatory cell infiltrations surrounding blood arteries (Photo 2). (Image 3) With the exception of a minor vacuolar degradation of the hepatocytes and pericentral inflammatory cell infiltrations, the liver sections of group 3 Gum Arabic (GA5%) animals appeared to have normal structure (Photo 4). Rats in group 4 (B. coagulants) had liver sections that revealed hepatocyte vacuolar degradation and inflammatory cell infiltrations surrounding the blood vessels (Photo 5). Group 5 (GA 5%+B. coagulants) rats' liver slices revealed normal structure aside from a minor hepatocyte degradation.

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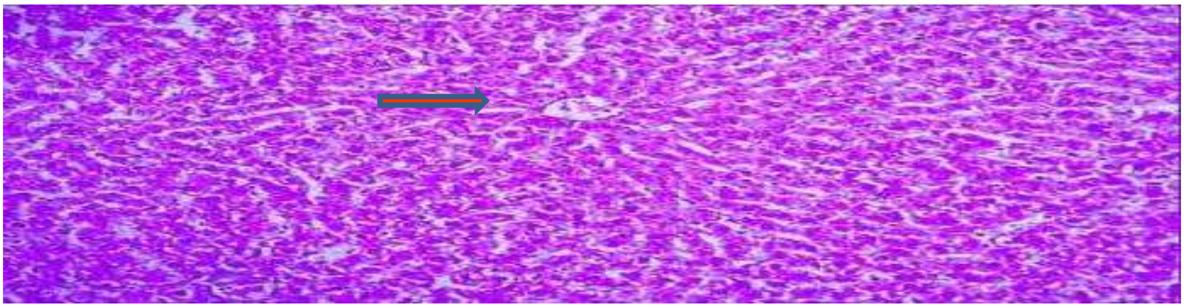

Figure 1: Liver Section of a Rat from Control Negative Group Showed Apparently Normal Hepatocytes and Portal Vein (Arrow) (H & E x 200).

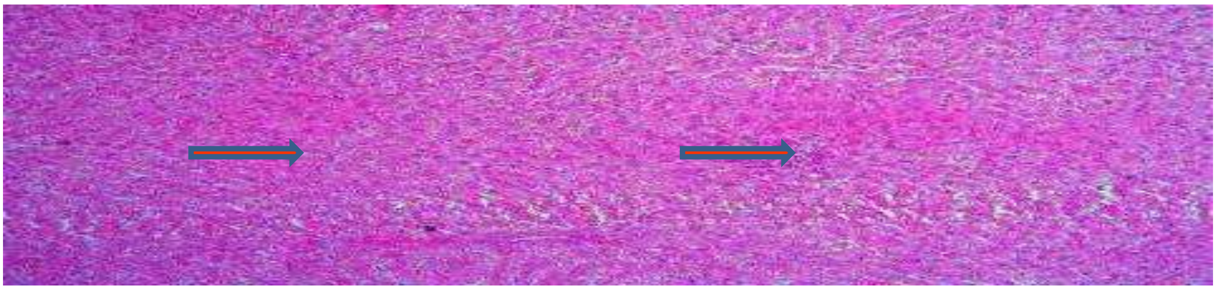

Figure 2: Liver Section of a Rat from Control Positive Group Showed Severe Vacuolar Degeneration of Hepatocytes (Arrows) With Inflammatory Cells Infiltrations around Blood Vessel (H & E x 200).

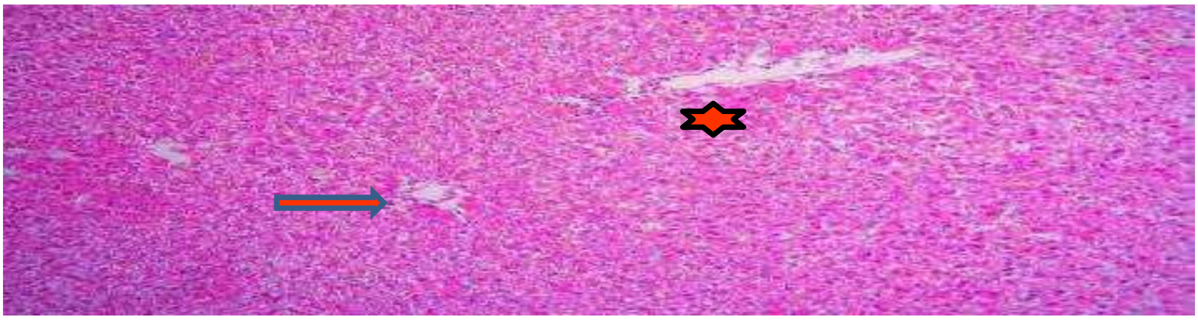

Figure 3: Liver Section of a Rat from (Gum Arabic (GA5%), Group Showed Apparently Normal Structure except Slightly Vacuolar Degeneration of Hepatocytes (Arrow) With Mild Pericentral Inflammatory Cells Infiltrations (Star) (H & E x 200)

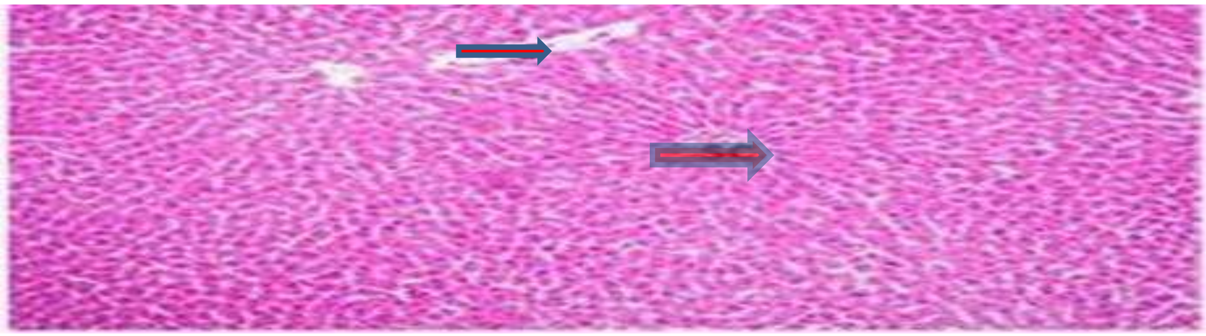

Figure 4: Liver Section of a Rat from (B. Coagulants) Group Showed Vacuolar Degeneration of Hepatocytes (Arrow) With Inflammatory Cells Infiltrations around Blood Vessel (Star) (H & E x 200).

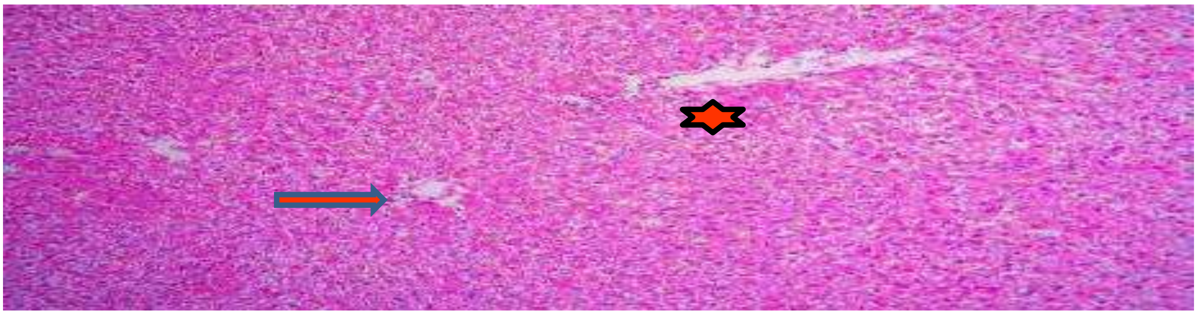

Figure 5: Liver Section of a Rat from (GA 5%+ B. Coagulants) Group Showed Apparently Normal Structure except Slight Degeneration of Hepatocytes (Arrow) (H & E x 200).

Discussion

Gum Arabic was found by Alasdair and colleagues (1984) to have a reducing effect on serum cholesterol levels. A bacteria like Prevotellaruminicola was found by Kishimoto and colleagues (2006) to be the primary organism in charge of digesting gum Arabic into propionate. In a 2009 study, El-khier and colleagues discovered that giving hens gum Arabic as part of their food lowered their serum cholesterol levels over time. Similarly, Eyibo and colleagues (2018) used oral administration of varying doses of gum Arabic to induce a significant reduction in triglyceride and total cholesterol levels in Albino rats. These results are consistent with those of Topping et al. (1985), who observed that rats given gum Arabic had plasma triacylglycerol levels that were considerably lower than those of the control group (Ahmed et al 2015). revealed that a decrease in total cholesterol and LDL was seen in rats given a normal diet and treated with a 0.5% aqueous solution of GA for seven days, followed by a 10% aqueous solution for six more weeks. According to Fedail et al. (2016), compared to the diabetic rat group, treatment with GA significantly ($P < 0.05$) reduced plasma TG and LDL-c concentrations. As opposed to the diabetic rat group, the GA therapy markedly raised the plasma HDL-c levels.

The study's findings indicate that gum Arabic was crucial in successfully altering the lipid profile. On all sampling days, there was a noticeable drop in the serum levels of LDL-cholesterol and total cholesterol in the rats fed gum arabic in both the prebiotic and symbiotic groups. Rats given gum Arabic also revealed increased concentrations of HDL cholesterol;

however, probiotic and control fed rats did not exhibit a significant change in this value. The hypocholesterolemic effect of prebiotics, like Gum Arabic, has been attributed to two possible mechanisms: selective fermentation by intestinal bacterial microflora leading to the production of short-chain fatty acids, and decreased cholesterol absorption by enhancing cholesterol excretion via feces (Abdulla et al., 2015). Results of this study concerning hypocholesterolemia effect of Gum Arabic are in agreement with several studies conducted in vivo trials. (Kim and Shin: 1998).

Only a small number of studies have examined the effects of giving B. coagulants capsules (each containing 360 million spores) daily to hyperlipidemic patients for three months. These studies found significant reductions in total serum cholesterol, LDL cholesterol, and the ratios of total cholesterol to HDL cholesterol and LDL cholesterol to HDL cholesterol. They also discovered a little increase in HDL cholesterol.

(Mohanet al,.1990). (Panda et al,.2006) further said that this probiotic can lower triglycerides, VLDL, and total cholesterol in broiler chickens. The study's findings indicate that B. coagulants was a factor in the changes in lipid profiles. Probiotics have been shown in numerous studies to lower cholesterol in both humans and animals, however there have also been conflicting findings on a specific strain of probiotic bacteria's incapacity to modify lipid profiles. A study by Hatakka et al.,(2008) found that following a 4-week course of treatment, the administration of L. rhamnoses LC705 (1010 CFU/g per capsule; two capsules daily) had no effect on the blood lipid profiles of thirty-eight men. The effects of L. acidophilus and L. fermentum (2 109 CFU per capsule; four capsules daily) on human lipid profiles were similarly denied by Lewis and Burmeister (2006) and Simons et al. (2006). The incorporation of cholesterol into cellular membranes by probiotic-growing cells and the deconjugation of bile-by-bile salt hydrolase are two potential pathways for the hypocholesterolemia effects of probiotics. Bile acids are more quickly excreted in the feces after being deconjugated because they are less soluble and absorbed by the intestines. Serum cholesterol is lowered as a result of the homeostatic response that uses cholesterol to synthesis new bile acids (Pereira).

In a review paper, Ooi and Liong (2010) ascribed these contentious results to a number of variables, including the type of probiotic used, the dosage administered, and the precision of the lipid analysis. Accepted Paper analysis, length of treatment term, subject clinical characteristics, insufficient sample sizes, and absence of appropriate placebo or control groups. Taking into account the theories put forth by Ooi and Liong (2010), the normolipidemic state of the rat model used in this investigation may account for the probiotic bacteria's inability to alter the lipid profile. In addition to everything mentioned above, it's possible that a substantial shift in the lipid profile won't be seen throughout the 30-day feeding period. But the bacterial strains utilized to lower cholesterol ought to be able to tolerate bile, have results of our previous study indicated that these bacteria are not able to colonize the intestine and are quickly eliminated in feces. Therefore, for probiotic supplements to have any kind of long-term impact on metabolism, daily use is required. According to (Babiker et al., 2017), Sprague-Dawley rats' liver antioxidant activity was considerably impacted by a daily Gum Arabic dose for twelve weeks. Additionally, in rats subjected to experimentally generated hepatotoxicity, Hamid et al. (2021) observed that the dietary administration of GA had a positive effect on liver apoptosis, oxidative stress, and the inflammatory response. According to reports, GA possesses strong antioxidant properties. In addition to its anti-inflammatory, antibacterial, antidiarrheal, anti-obesity, and antihypertensive properties, it has been shown to reduce lipid peroxidation and toxicity in the heart, kidney, and liver (Ali et al., 2009 and Elshama, 2018). Gum Arabic (GA) possesses potent antioxidant qualities; as a result, it may be one of the hepatoprotective mechanisms, according to Ahmed et al. (2015).

The enzymatic level (ALT + AST) of the treated mice improved, but it did not return to normal as it did in the control group. These findings suggest that AG may function as a protective factor to lessen liver damage. The two enzymes that most reliably indicate necrosis or hepatocellular injury are ALT and AST. Their levels are increased in several liver disorders.Since ALT is predominantly found in the cytosol of the liver and other tissues at low concentrations, it is thought to be more diagnostic for hepatic injuries than the other enzyme (Giboney, 2005). High concentrations of these enzymes result from hepatocyte destruction and increased cellular permeability (Sivakrishnan, and Kottaimuthu : 2014). The observed decrease in total enzyme activity could be a sign of normal destruction of hepatocytes; aspartate transaminase (AST), alanine transaminase (ALT), and alkaline phosphatase (ALP) and through decreasing the oxidative stress.

Impact of gum Arabic on the histological evaluation of inflammation and necrosis in the liver The liver histopathological examination of the treated rats showed substantial inflammatory cell infiltration, hepatocyte vacuolization, or fatty degeneration, together with severe cellular necrosis (Mohammed et al., 2021). According to the current study, gum Arabic dramatically reduced the activity of liver enzymes and may shield animals with hepatic dysfunctions (Khojah: 2017). Arabic gum (GA) has been shown to protect against hepatic and renal toxicities in mice and rats (Nemmar et al., 2019). Its anti-oxidant, anti-inflammatory, and cytoprotective qualities are probably responsible for these protective effects (Helal et al., 2011).

Conclusion: Giving rats an additional food supplemented with gum Arabic spore suspension of probiotic bacteria (B. coagulants) can lower high cholesterol and triglyceride levels. It can also enhance the lipid profile and liver enzymes in rats that are hypercholesteremic.

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