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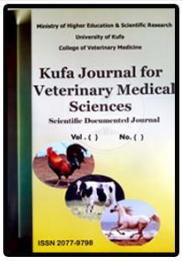

# Ameliorative effect of soybean lecithin on the liver enzymes of rats supplemented with high cholesterol

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**Abstract**

The present experiment was investigated to study the ameliorative role of soybean lecithin specially phosphatidylcholin on liver enzymes (ALT) and (AST) in intact and hypercholesterolemic infected rats.Thirty two adult male rats have been used in this study, were randomly selected and equally divided in to four groups as follows C, T1 , T2, T3.They were treated orally (daily) for 42 days as follows; C:control group, were given distilled water by gavage needle, T1: rats of this group were given *soybean lecithin* only (430mg\kg\day) orally; T2:rats of this groups were given only cholesterol (10gm\day) orally; T3: rats of this groups were given *soybean lecithin* (430mg\kg\day) orally, and supplemented with high cholesterol (10gm\day) orally within diet.The daily supplementation of soybean lecithin induces a significant decrease ($p < 0.05$) in liver enzymes (ALT & AST) as compared with (T2) group which has seen remarkable rise in these enzymes respectively. Moreover, the histopathological examination showed results referred that cholesterol effects significantly on the liver cells by causing sever fatty changes characterized by variable size round clear spaces in the hepatocytes. Also, there is a mononuclear cells aggregation in liver parenchyma and congested blood vessels without any fatty vacuoles in (T2)..In conclusion, the results from this experiment confirm that soybean lecithin supplementation to rats has an important protective role on hepatic portal system in hypercholesterolemic infected rats.This supplementation can overcome the deleterious effect of hypercholesterolemia on liver basically.

**Keywords: Soybean lecithin, Cholesterol, Hypercholesterolemia, ALT, AST**

# التأثير الايجابي للسيثين فول الصويا على انزيمات الكبد للجرذان المعرضة لتركيز عال للكوليسترول

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**الخلاصة:**

تم اختبار هذه التجربة لدراسة الدور التحسيني للـ ليسيثين فول الصويا خاصة الفوسفاتيديل كولين على إنزيمات الكبد (ALT) و (AST) في الجرذان المصابة بـ فرط كوليستيرول الدم. تم استخدام اثنان وثلاثين من ذكور الجرذان البالغة في هذه الدراسة ، تم اختيارهم عشوائياً ومقسمة بالتساوي في أربع مجموعات على النحو التالي C، T1، T2, T3 كانت تعامل فمويا (يوميا) لمدة 42 يوما على النحو التالي ؛ C: مجموعة السيطرة، أعطيت الماء المقطر بواسطة انبوب التجريع، T1: أعطيت الجرذان من هذه المجموعة الليسيثين فول الصويا فقط (mg \ kg \ day430) فمويا. T2: أعطيت الفئران من هذه المجموعات فقط الكولسترول (gm \ day10) فمويا. T3: أعطيت الجرذان من هذه المجموعة الليسيثين فول الصويا

(mg \ kg \ day430) فمويا ، مع كوليسترول عال (gm \ day10) عن طريق الفم .ويضيف الليسيثين المجرع يوميا من فول الصويا انخفاضا كبيرا ($p> 0.05$) في الكبد الانزيمات (ALT & AST) بالمقارنة مع مجموعة (T2) التي شهدت زيادة ملحوظة في هذه الانزيمات على التوالي. وعلاوة على ذلك ، أظهر الفحص النسيجي المرضي نتائج تشير إلى أن الكوليسترول يؤثر بشكل كبير على خلايا الكبد عن طريق التسبب في تغيرات دهنية شديدة تتميز بمساحات واضحة مستديرة ذات حجم متغير في خلايا الكبد. أيضا ، هناك تجمع خلايا وحيدة النواة في حمة الكبد والأوعية الدموية المزدحمة دون أي فجوات دهنية في (T2) .. وفي الختام ، تؤكد نتائج هذه التجربة أن مكملات الليسيثين لفول الصويا للجرذان لها دور وقائي مهم على نظام البوابة الكبدية في الفئران المصابة بافرط كوليستيرول الدم. يمكن لهذه المكملات التغلب على الآثار الضارة للفرط كوليسترول الدم على الكبد في الأساس.

## 1.Introduction

Cardiovascular disease (CVD), a leading cause of death in developed countries, is a chronic disease that remains asymptomatic for decades. Its incidence rate is increasing in the world. Although the development of CVD is multifactorial, hypercholesterolemia is believed to play an important role in the pathogenesis and progression of it [1]. The modern lifestyle with high-cholesterol diet (HCD) and less physical activity contribute to hypercholesterolemia which increases the prevalence of CVD [2] .In addition, hypercholesterolemia can result in nonalcoholic fatty liver disease (NAFLD), which is a pathological condition of emerging clinical importance and considered as the most common cause of abnormal liver function. NAFLD is characterized by a wide spectrum of liver damage, such as simple steatosis, fibrosis and cryptogenic cirrhosis [3].Thus, controlling plasma cholesterol or preventing hypercholesterolemia is a common approach to control the development of CVD and NAFLD. Notwithstanding the fact that there are drugs available clinically for treating hypercholesterolemia, the consumption of dietary supplements/functional foods in lowering/controlling serum cholesterol levels and risk of CVD and NAFLD has gained global acceptance over the years by the public [4] .

Lecithin enriched diet can customize the cholesterol homeostasis and lipoprotein metabolism. Lecithin diet modifies the cholesterol homeostasis in the liver, increasing the activity of HMG-CoA reductase and cholesterol 7 alpha-hydroxylase, and decreasing the microsomal ACAT activity [5] .One of the most marvelous properties of lecithin is its capacity to reduce the excess of LDL cholesterol. It also endorses the synthesis in the liver of great amount of HDL, the beneficial cholesterol.Bile acid secretion with high levels of cholesterol and phospholipids is encouraged by lecithin-rich diets when compared with diets without lecithin [6] .

In accordance with this, the recent study was focused to investigate the possible treatment role of soybean lecithin to hypercholesterolemia induced by high cholesterol in adult male rats**.**

## 2. Materials and methods

### 2.1 Experimental animals and care

Healthy local Thirty two male Albino Wistar rats their ages between (3 -4) months old and there weights between 190 –200 gram (g) were obtained from the drug control center /ministry of health and reared in the animals house of the Veterinary Medicine College /Green AL.Qassim University during the period extended from February to April,2017**.** They were reared in suitable condition of 20-25 °C in an air conditioned room and photoperiod of 12 hours daily.The animals were housed at least two weeks for acclimatization before beginning the experiment**.**Anticoccidiosis (Amprolium)

was given via drinking water (1g/litter) for three days during acclimatization period.

**2.2 Preparation of soybean lecithin:**

After the pilot study ,One softgel capsule of soybean lecithin (1200gm) was dissolved in in 4ml olive oil orally administered to male rats at a dose of (150mg/rat/day) by using gastric intubation [7].

**2.3 Preparation of cholesterol:**

Hypercholesterolemic diets were supplemented with 10 g of powder cholesterol per kg of diet [10].

**2.4 Blood samples collection**

At the end of the (42 day) of the experiment, fasting blood was obtained via cardiac puncture from each rat. Samples for serum collection was isolated after centrifugation at a speed of 3000 revolution/minute (rpm) for 20 minutes. Serum samples were stored in a freezer at -18 °C until use [11].

**2.5 Experimental design for the experiment**

After acclimatization for two weeks the rats were divided equally into four groups, (C) control group which received distilled water daily, (T1) rats of this group were given *soybean lecithin* only (430mg\kg\day) orally; (T2) rats of this group were given only cholesterol (10gm\day) orally; (T3) rats of this group were given *soybean lecithin* (430mg\kg\day) plus high cholesterol (10gm\day) orally.

**2.7 Statistical analysis**

The statistical analysis of the data of the experiment was performed by using one-way ANOVA and Least significant differences (LSD) to assess significant differences among means of the groups by using the SAS [8].

**3. Results and Discussion**

**3.1 Effect of cholesterol and soybean lecithin on ALT and AST enzymes :**

Table (1) indicated that mean values of serum ALT concentration after (42) days of experiment significantly ($P<0.05$) decreased after oral intubation of soybean lecithin (T3) comparing to (T2) and control group, this indicating hypocholesterolemic effect of soybean lecithin. At the end of the experiment, the mean values of this parameter were (57.40±0.93) for (T2) group, (23.91±0.17) for (T3) group, and (22.18±0.37) ,(23.13±0.24) for(T1) and control group respectively.

The effect of oral intubation of soybean lecithin (T3) and (T2) on mean value of AST clarified in table (2).Depending on statistical analysis there were significant ($P>0.05$) decreased in AST concentration in (T3) group with mean values (64.44±0.39) as compared with (T2) (95.47±0.84).

In significant hyperlipidemia elevation of ALT, AST, GGT occure [9]. Adeniran et al. investigated that increased ALT and AST with hypercholesterolemic patient [10]. We observed ALT and GGT show significant positive association with FBS, PPBS, HbA1C, TC, TG, LDL-C and negative correlation with HDL-C in diabetes, Our findings agree with Idris et al.Marchesinia reported association between ALT activity and hyperlipidemia, insulin resistance in T2DM [11]. One study has also correlated ALT activity with increased hepatic fat [12].Being a marker of hepatocellular health AST is less specific than ALT and GGT [13]. Hultcrantz et al. showed that in asymptomatic individuals with mild elevations of ALT and AST 98% has liver disease commonly fatty liver disease [14].

When the greater dose of soybean lecithin is given, then the enzyme levels in the serum AST and ALT decline and the number of necrotic cells decreased (David,2001), and this corresponding with the results of our present study, as we found significant decline in the concentration of

AST and ALT of (T3) as compared with (T2) group.

### 3.2 Effect of cholesterol and soybean lecithin on histopathology of liver:

Our present study has been confirmed in cholesterol-fed rats, showing apparent contractile dysfunction characterized by decreased maximum rate of shortening, decreased rate of relaxation, and increased left ventricular end-diastolic pressure [15] .Dyslipidemai, insulin resistance, low adiponectin, and postprandial dyslipidaemai and hyperglycaemia are main factors lead to NAFLD and further aggravate the course of NAFLD as well as accelerate the progress of atherosclerosis and development of CVD [16].

The antihepatotoxic effect of lecithin was observed in freshly isolated rat hepatocytes [17]. Mechanism of lecithin protection against hypercholesterolemia is its role as an antioxidant [18].The antioxidant activity in inhibiting free radical exposure is very important in protecting liver damage [19]. In previous studies it is known that lecithin from soy beans turned out to be a substance that has antioxidant effects [20] [21] .And in a study of the results obtained in vitro, that the soybean oil (soybean oil) contain the highest levels of antioxidants among plant oils derived from seeds [22]. In addition, Semra Demirbilek and colleagues (2004), has been conducting research to determine the effect of lecithin treatment on levels of Malondialdehyde (MDA) were made septic rat liver, lecithin shown to lower hepatic MDA concentration. MDA is a metabolite produced by lipid peroxidation. With its role as an antioxidant, lecithin can prevent, or reduce the occurrence of lipid peroxidation process. As we know, the main content of lecithin is phosphatidylcholine. Phosphatidylcholine is the main constituent component of cell membranes and play an important role in regulating the homeostasis of membrane fluidity. Resulted in the disruption of lipid peroxidation of cell membrane function. With that contains phosphatidylcholine, lecithin can improve the function of the cell membrane are disturbed by improving the integrity of the membrane, so that the liver cell membrane dysfunction can be prevented, and necrotic cells can be inhibited. With the advance of lecithin therapy, the expected damage of liver cells that have occurred previously can be repaired [23] .

**Table 1 Effect of cholesterol and soybean lecithin on ALT (U\L) concentration :**

| Groups / Parameter | C<br>Intact Rats Received distilled water | T1<br>Rats received soybean lecithin only | T2<br>Rats received pure cholesterol only | T3<br>Rats received soybean lecithin+pure cholesterol | LSD |
|---|---|---|---|---|---|
| ALT (U\L) | 23.13±0.24<br>BC | 22.18±0.37<br>C | 57.40±0.93<br>A | 23.91±0.17<br>B | 1.4069 |

Values represent mean ± SE (N=8).
Different capital letters denote a significant difference between groups ($p \leq 0.05$).

**Table 2 Effect of cholesterol and soybean lecithin on AST (U\L) concentration :**

| Groups / Parameter | C Intact Rats Received distilled water | T1 Rats received soybean lecithin only | T2 Rats received pure cholesterol only | T3 Rats received soybean lecithin+pure cholesterol | LSD |
|---|---|---|---|---|---|
| AST (U\L) | 63.98±0.35 C | 62.20±0.29 D | 95.47±0.84 A | 64.44±0.39 C | 1.4047 |

Values represent mean ± SE (N=8).
Different capital letters denote a significant difference between groups ($p \leq 0.05$**).**

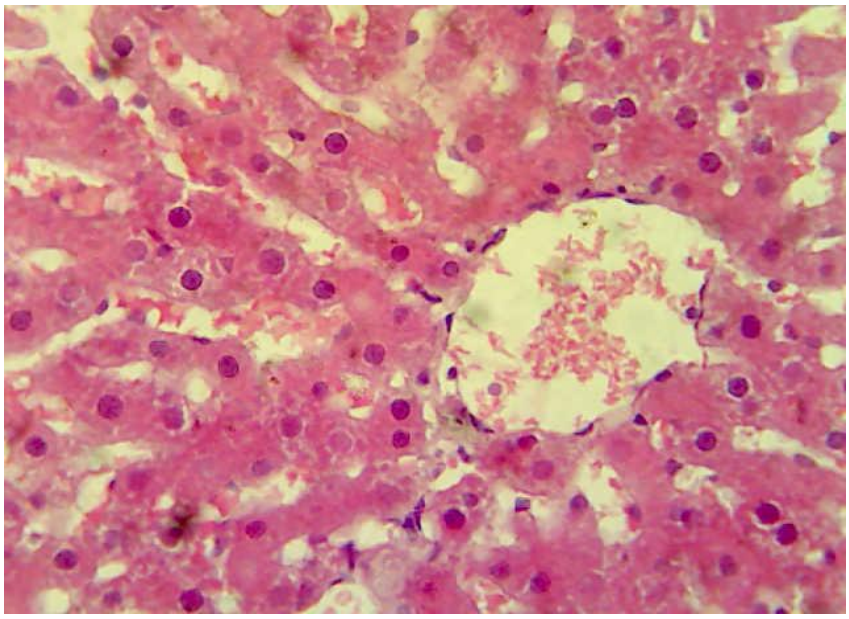

**Fig 1** Cross section of the liver of normal rat shows no clear lesions (H and E stain 400X).

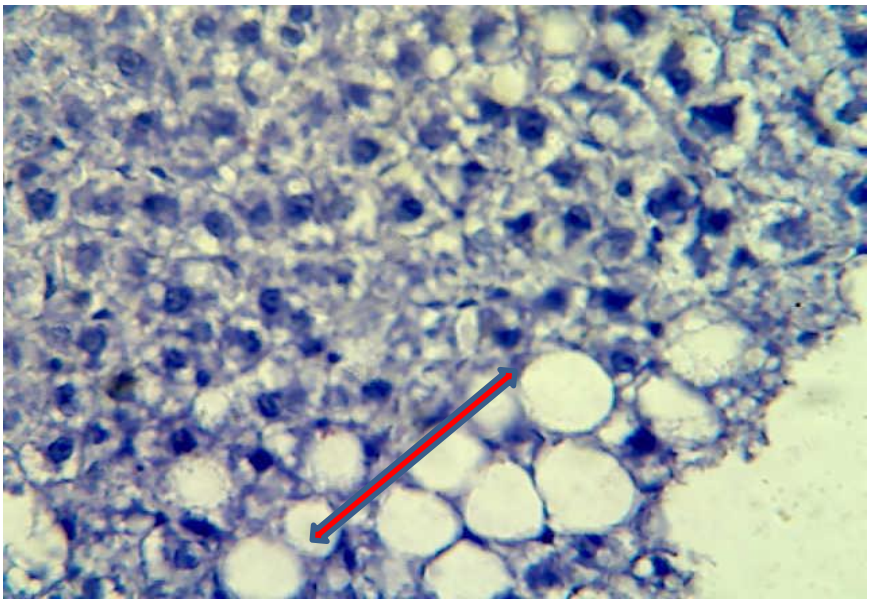

Fig.2 Cross section in the liver of animals adminstrated with pure cholesterol 10 g/kg.B.W shows large clear round vacuales in the hepatiocytes (fatty changes )

⟷ (H and E stain X400).

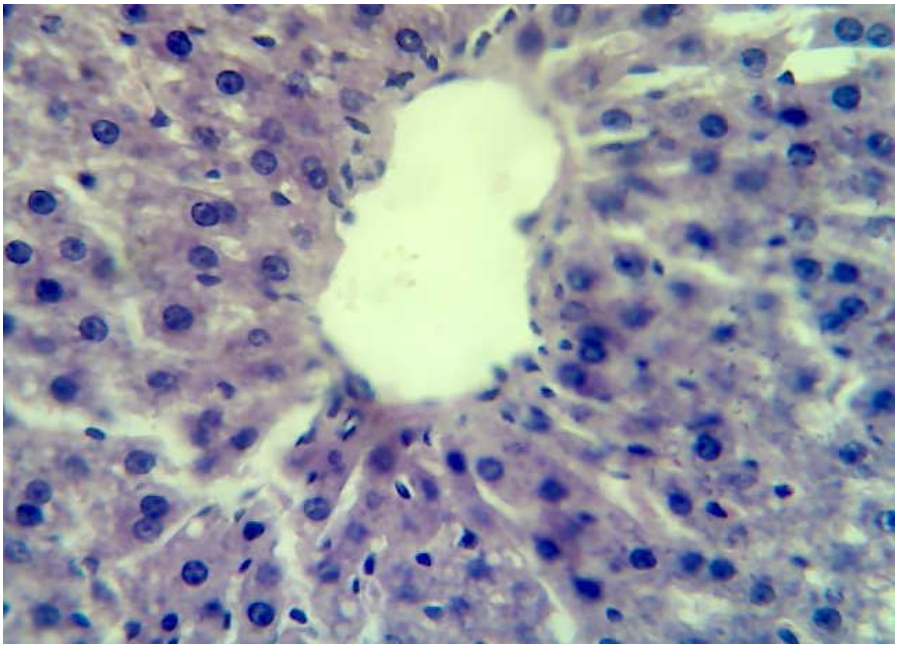

**Fig.3** Cross section in the liver of animals adminstration with lecithin 430mg/kg/day + Pure cholesterol (10g/kg/day) shows no clear lesions (H and E stain 400X).

## 4. Conclusion

This work suggests that soy lecithin-rich diets can be used as an adjunct in the treatment of hypercholesterolemia. Lecithin-rich diets can stimulate the fatty acid secretion with high levels of cholesterol and phospholipids when compared with diets without lecithin, considering the lecithin performance as phytotherapic, with a large spectrum of activity. The results showed significant reduction in the concentration of total cholesterol, suggesting that the daily administration of lecithin could be used as an adjuvant treatment in hypercholesterolemia, possibly by reducing the intestinal absorption or by the increased secretion of bile acids with high levels of cholesterol and phospholipids,and this will protect the body against Liver disease.

## 5. Acknowledgments

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