

## EFFECT OF GOJI BERRY (*LYCIUM BARBARUM*) AND HIGH FAT DIET ON LIVER STRUCTURE AND FUNCTION OF RABBITS

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### Abstract

**Introduction:** *Lycium Barbarum* is a Chinese herbal drug belongs to the *Solanaceae* family. *Lycium Barbarum* juice help with a variety of conditions, including cardiovascular effects such as blood pressure and pulse rate, neurological and psychological impacts, musculoskeletal issues and beneficial to increase the life span and it also lowers the risk of arteriosclerosis and arterial hypertension. **Aim:** The aim of the present study was to examine the effect of Goji Berry (*Lycium Barbarum*) and high fat diet on Liver Structure and Function tests Total Bilirubin, Bilirubin Direct, Bilirubin indirect, ALT/SGPT, enzymes test AST/SGOT, Alkaline phosphate, GGT, and total protein in different groups of Rabbits to check. **Methodology:** Rabbits were categorized into 4 groups. **Group 1** (Control group): Rabbits of group 1 were treated with normal feed with no dose. **Group 2** (Experimental group 1) (**Oil + Feed**) Rabbits of group 2 were treated with 2ml of oil along with normal feed including grass and bread. **Group 3** (Experimental group 2) (**Lycium Barbarum + Oil + Normal feed**) Group 3 rabbits were fed with 2ml of oil, 4ml of *Lycium Barbarum* juice and normal feed. The dose was given orally with the help of syringe pipes. **Results:** parameters of total, direct, and indirect bilirubin, no statistically significant differences were found. The characteristics of total protein, albumin, globulins, alkaline phosphate, and GGT rates were shown to differ significantly. **Conclusion:** *Lycium Barbarum* is the best and most affordable herb to treat a variety of conditions affecting both humans and animals, such as infertility, chronic and acute liver illnesses, ALDL, and NADNT disease.

**Index Terms:** *Lycium Barbarum*, Gogi Berries, Bioactive Compounds, Polyphenols, and Health Benefits.

## 1. INTRODUCTION

*Lycium Barbarum* is a Chinese herbal drug belong to *Solanaceae* family with a present day range across Asia and South east Europe. *Lycium Barbarum* fruits are 1 to 2 cm long and are brilliant orange red in colour. *Lycium Barbarum* polysaccharides is one the most active component of this plant and involve a lot of biological activities such as neuroprotection, ant fatigue, control of glucose, anti-tumor and anti-oxidant properties.

*Lycium Barbarum* juice help with a variety of conditions, including cardiovascular effects such as blood pressure and pulse rate, neurological and psychological impacts, and musculoskeletal issues [1] *Lycium Barbarum* polysaccharides are the most important water soluble chemical component of this plant and comprised approximately 5 to 8% of dried fruit.

*Lycium Barbarum* leaves find its usage in the form of spices and tea infusions. 0.03%-0-5% of this plant is composed of zeaxanth and esters. Other important components of *Lycium Barbarum* are alkaloids, glycoproteins, tocopherols, phenolic acids, sterols and beta in etc. *Lycium Barbarum* is beneficial to increase the life span and it also lowers the risk of arteriosclerosis and arterial hypertension [2]

Gojji berries or wolf berries has been used as a natural drug for improving the productive rate of rabbits. Negative balance of energy due to the lap over between the pregnancy and lactation period is the major reason for the less productive farm rates of rabbits. High costs of medicine and antibodies for curing disease are the other main reason for less productive rate [3]. Gojji berries effective to reduce infections, inflammations and thus act directly on the immune system, regulate secretions of hormones and improve oxidative status of organs [4].

A Gojji berry proved as anti-diabetic, plant and is used to treat diabetes in humans, man fertility, anti-cancer, anti-aging, laboratory and clinical animals. Peng along with his colleagues discovered five polysaccharides of *Lycium Barbarum* named as glycoconjugates (LbGp1-LbGp5) [5]. Wolfberry or Gojji berry and performs a lot of biological activity including antioxidant and immunomodulatory functions.

*Lycium Barbarum* acts as a natural oxidant against oxidative stress related liver pathogenesis. The positive effect of *Lycium Barbarum* in regulating antioxidant biomarkers is used for the protection of body against anti-oxidant stress [6].

LBP acts as antioxidant and regulate antioxidant biomarkers in human serum. LBP decrease the chances of oxidative stress in human cells due to excessive chemical toxicity induced due to exercise. In cancer cell line LBP is significant for treatment because it restricts cell development, triggers apoptosis, and stops the cell cycle in the S-phase [7].

This result indicated *Lycium Barbarum's* benefits in the management of NAFLD and the development of NASH in a rat model fed an orally high-fat meal. Results of this experiment revealed that LBP or Gojji berries is fruitful in prevention and cure of liver

disease [8]. In rats with hepatic injury caused by carbon tetrachloride, administration with water-extracted *Lycium barbarum* suppresses liver fibrosis by minimizing the effects of hepatic inflammation, according to earlier study [9] It has been proved that the traditional Tibetan medicine *Lycium ruthenicum*, which is used to treat heart disease, hypertension, and climacteric syndrome, serves as a prevention tool against the liver damage produced on by NASH [10].

## 2. RESEARCH DESIGN AND METHODOLOGY

Gojji berries or *Lycium Barbarum* is the Chinese plant and is found in cold regions. The plant was hard to find on the months of June and July in Pakistan. The leaves of the plant are not much beneficial but the berries are and the procedure depends on the juice extracted from the berries. I ordered Chinese Gojji berries from Daraz and then grind the berries into fine powder. The juice was dark purple in colors. 4ml of Lycium juice was given to group 3 and 4.

### 2.1 Physical Examination

Domestic and Angora Rabbits of the age of almost 2 months were selected and purchased from University of Veterinary and Animal Sciences (UVAS), Lahore Pakistan. Rabbits were kept in cages separately under proper observation in animal house of the Minhaj University Lahore and were examined on daily basis. The weight of the rabbits was measured initially and finally with the help of weight machine. All rabbits were approximately of the same weight with a minor difference weighing from 1kg-1.5kg.

### 2.2 Grouping of Animals

Rabbits were categorized into 4 groups on the following basis: **Group 1** (Control group): Rabbits of group 1 were treated with normal feed with no dose. **Group 2** (Experimental group 1) (**Oil + Feed**) Rabbits of group 2 were treated with 2ml of oil along with normal feed including grass and bread. Rabbits were examined properly throughout the experiment from day 1 of dose given to last day of dose given. **Group 3** (Experimental group 2) (**Lycium Barbarum + Oil + Normal feed**) Group 3 rabbits were fed with 2ml of oil, 4ml of Lycium Barbarum juice and normal feed. The dose was given orally with the help of syringe pipes. **Group 4** (Experimental group 3) (**Lycium Barbarum + Normal feed**) Rabbits of group 4 were treated with 4ml juice of Lycium Barbarum (gavages feeding) and normal diet of Bread, grass and vegetables once a day for 30 days.

### 2.3 Dissection of Animals

After completing the experimental procedure for 30 days, rabbits were dissected. Dissection was done group wise and the body weight of the rabbits were again measured finally just before dissection with the help of weight machine. The chemicals used for the preservation of samples are Formalin and distilled water. 90ml of distilled water was used to dissolve 10ml of formalin. The bottles were labeled separately according to the each group for the preservation of liver.

## 2.4 Blood Sample Collection

Blood sample were collected, after dissection from the branchial vein of each rabbit in anti-coagulating yellow colored tubes. The tubes were labeled according to the groups. The blood samples were centrifuged at 3000rpm for 15 minutes. After centrifugation serum was carefully isolated from the blood tubes with the help of pasture pipette and then stored at 1-2°C in eppendrof tubes for Liver Function test (LFT).

## 2.5 Organ Sample Collection

Liver and heart organs was carefully separated free from adhering tissues and stored during dissection. The weight of liver of each rabbit was measured accurately with the weighing machine. The organ were preserved in a solution of 10ml formalin and 100 ml of water.

## 2.6 Liver Function Test

The liver tests were performed by Calorimetric array substances tested (ALT, AST, SGOT, ALP, GGT, Globulins, Albumin, Total protein Albumin/Globulin ratio Diazo method for bilirubin direct. The liver markers will quantitatively estimate in the serum samples and processed further for test.

## 2.7 Statistical Analysis

Statistical analysis was done by software Graph Pad Prism version 5. Mean + Standard deviation, and p-value for each parameter were finding out by applied unpaired t-test statistics. Microsoft Excel was used for table & graphs. P-value gave the possible significance result of each parameter.

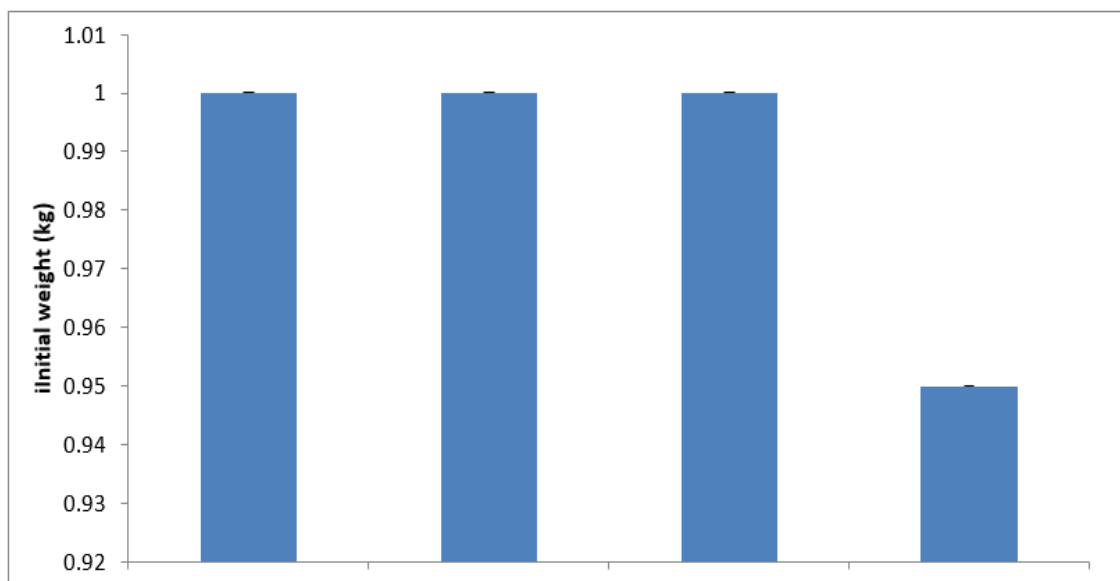
## 3. RESULTS

In this study domestic and Angora Rabbits of the age of almost 2 months were used for experiment and examined the Effect of Goji Berry (*Lycium Barbarum*) and High Fat Diet on Liver Structure and Function of Rabbits. Compare parameters to examine those statistically identifying similarities and differences among them.

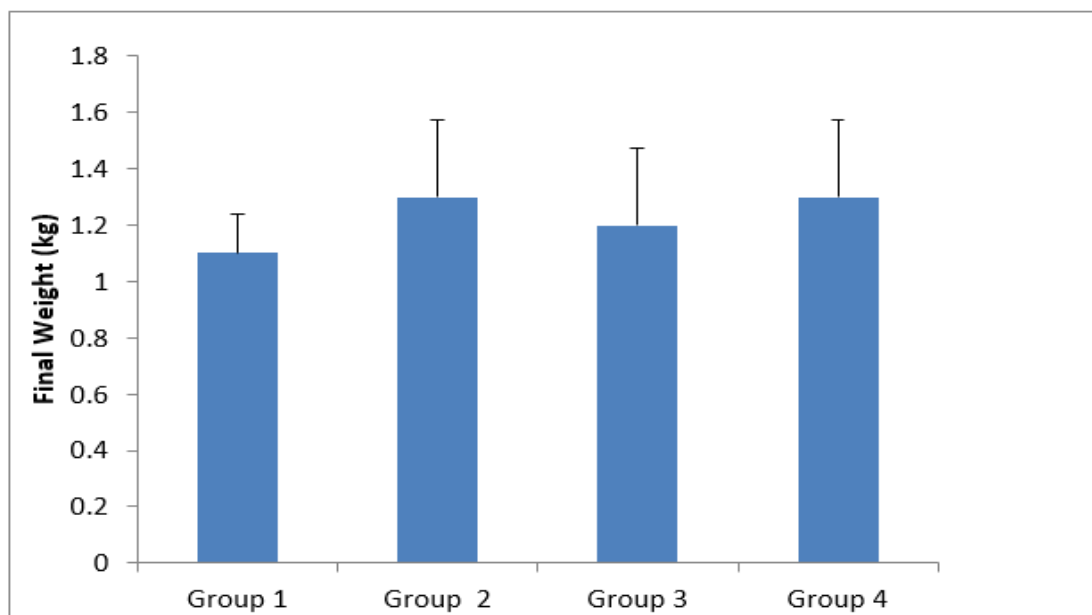
**Table 1: The average initial body weight, end weight, and weight growth in various groups of rabbits (Kg + SEM)**

Groups	Initial Weight	Final weight	Weight gain
Group 1	1 ± 0	1.1 ± 0.14	0 ± 0
Group 2	1 ± 0	1.3 ± 0.273	0.26 ± 0.25
Group 3	1 ± 0	1.2 ± 0.27	0.2 ± 0.27
Group 4	0.95 ± 0	1.3 ± 0.27	0.17 ± 0.20

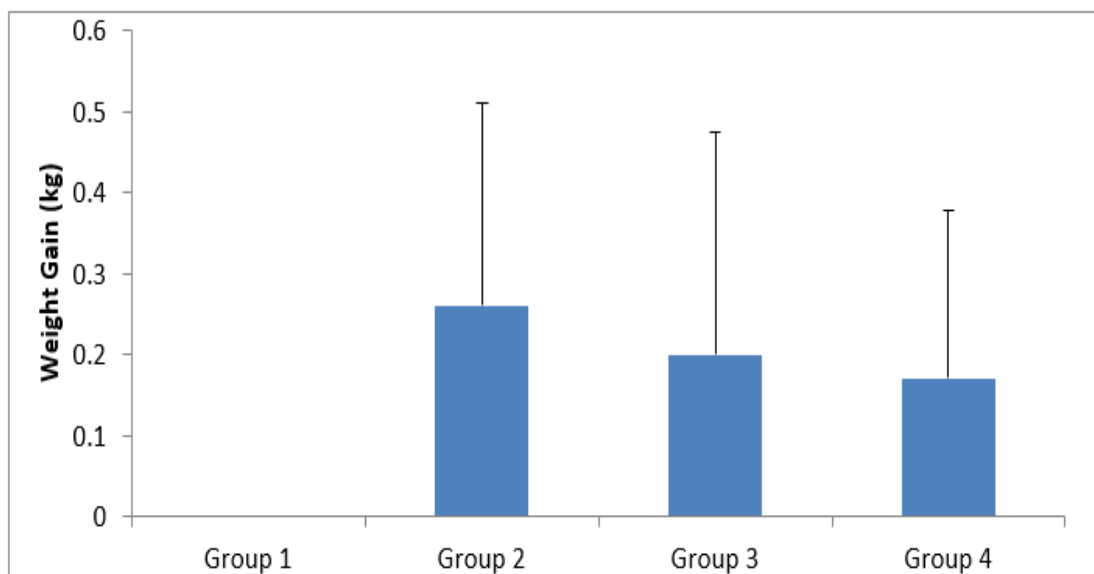
The initial weight, final weight, and rabbit weight gain mean values are not significantly different from one another.  $P > 0.05$  Values are expressed as Mean ± SEM



**Figure 1: The graph below displays the average initial weights (kg) for three experimental or treatment groups and one control group (group 2, 3 and 4).No significance (ns)  $P > 0.01$**



**Figure 2: The graph shows the average final weights (kg) for the three experimental groups and one control group (group 2, 3 and 4). No significance (ns).P value is 0.8116  $P > 0.05$**



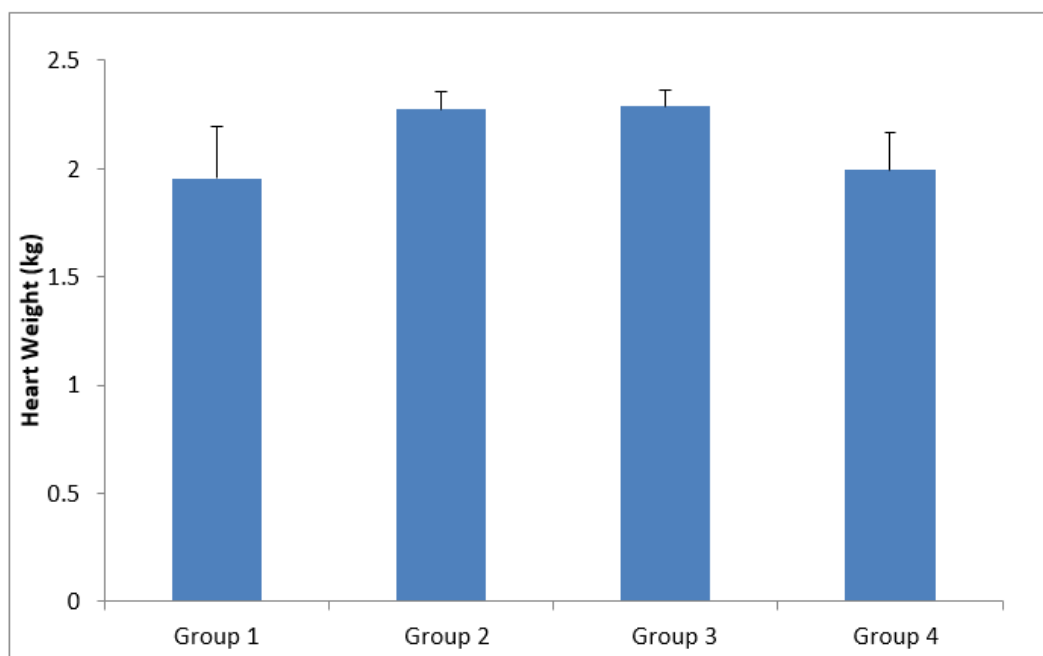
**Figure 3: Graph shows the mean value of the weight gain during experimentation between the rabbits of all groups (control and experimental) No significance (ns) P value is 0.0546  $P > 0.05$**

### Organs Weight:

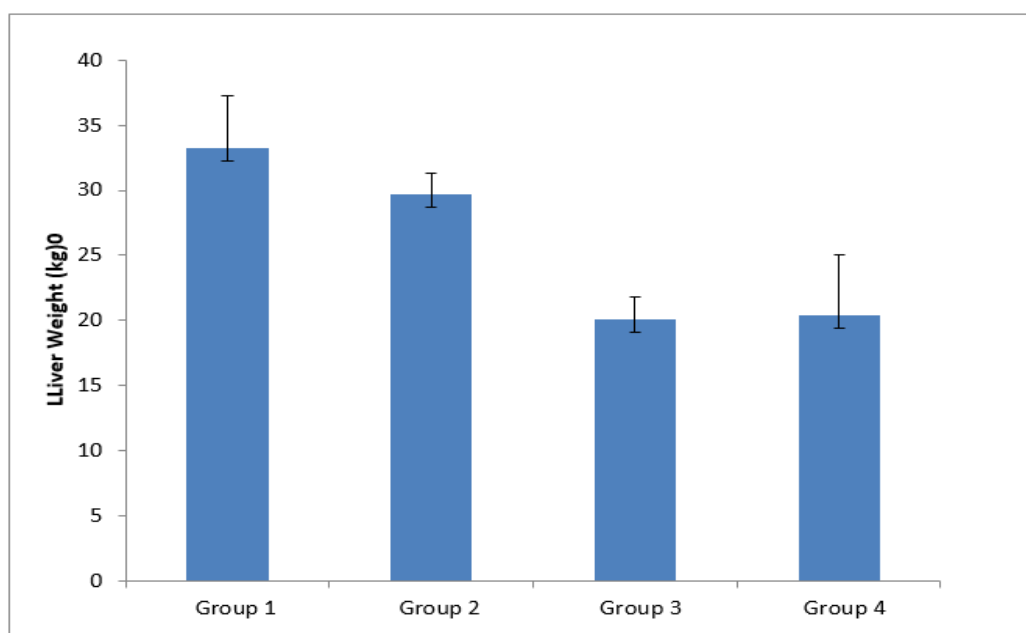
Organs like liver and heart of the rabbits were weighed after dissection with the help of weighing balance.

**Table 2: They mean body organ (Heart, Liver) weight (gm  $\pm$  SE) in different groups of rabbits**

Groups	Heart	Liver
Group 1	1.954 $\pm$ 0.243064	33.26 $\pm$ 3.994972
Group 2	2.274 $\pm$ .083546	29.65 $\pm$ 1.678318
Group 3	2.2882 $\pm$ 0.077014	20.132 $\pm$ 1.63755
Group 4	1.9948 $\pm$ 0.171246	20.38 $\pm$ 4.661454



**Figure 4: Graph represents the mean values of organ weight kg (heart) in all groups of rabbits including control and experimental group. No significance (ns) P value is 0.9378  $P > 0.05$**

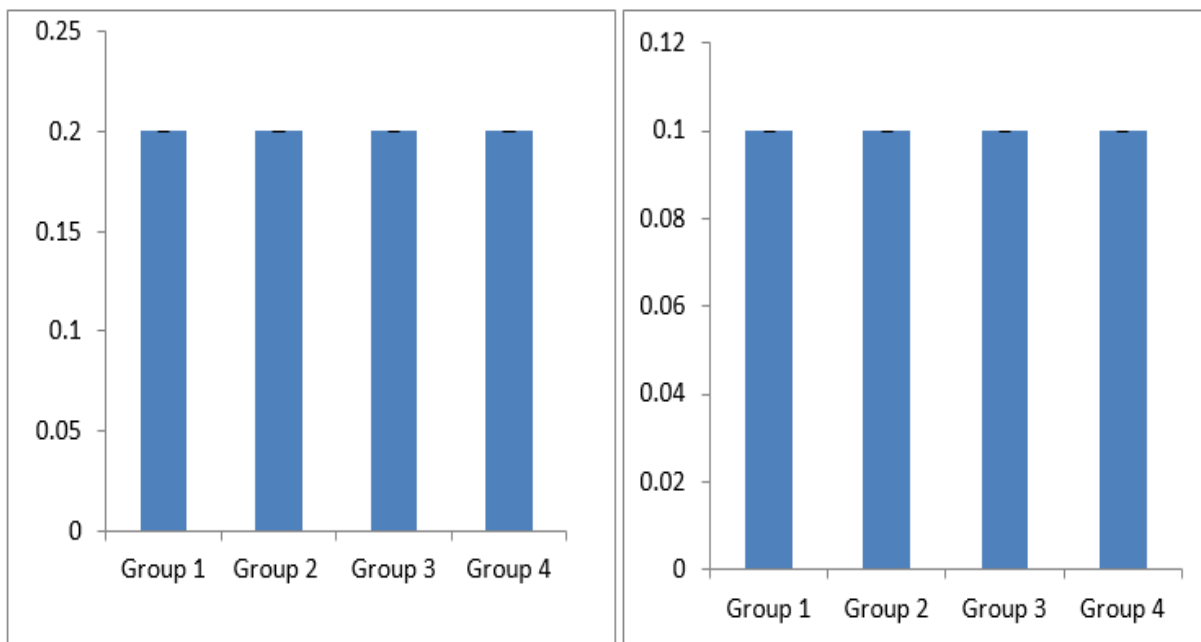


**Figure 5: Graph represents the mean values of organ weight kg (Liver) in all groups of rabbits including control and experimental group. No significance (ns), P value is 0.0741,  $P > 0.05$**

**Table 3: The mean of total Bilirubin (Direct and Indirect) and ALT/SGPT (gm  $\pm$  SE) rate in different groups of rabbits**

Groups	Total Bilirubin	Bilirubin Direct	Bilirubin indirect	ALT/SGPT
Group 1	0.2 $\pm$ 0	0.1 $\pm$ 0	0.1 $\pm$ 0	89.2 $\pm$ 8.074652
Group 2	0.2 $\pm$ 0	0.1 $\pm$ 0	0.1 $\pm$ 0	67.4 $\pm$ 8.354639
Group 3	0.2 $\pm$ 0	0.1 $\pm$ 0	0.1 $\pm$ 0	67.6 $\pm$ 5.412947
Group 4	0.2 $\pm$ 0	0.1 $\pm$ 0	0.1 $\pm$ 0	74.2 $\pm$ 3.834058

No significant difference occurs between the Bilirubin rate Direct and indirect bilirubin and ALT/SGPT rates in all groups of rabbits P value is 0.0741,  $P > 0.05$



**Figure 6: Graph shows the mean values of total bilirubin rate in all groups of rabbits including control and experimental group. No significance (ns) No significance (ns) P value is 1.000  $P > 0.05$**

**Table 4: The mean value of AST/SGOT, Alkaline phosphatase, GGT and total protein (gm  $\pm$  SE) in different groups of rabbits.**

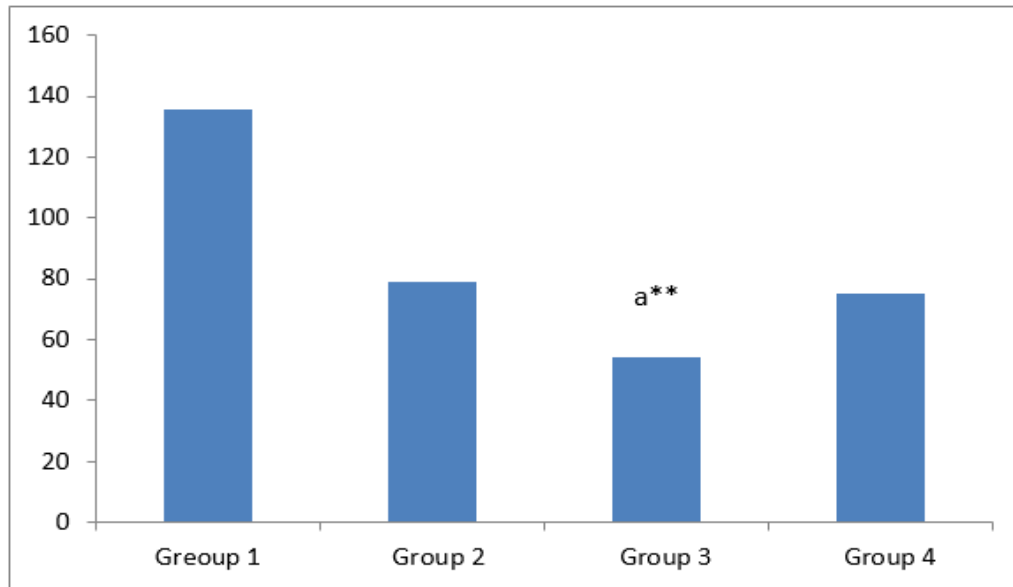
Groups	AST/SGOT	Alkaline phosphatase	GGT	Total protein
Group 1	164.6 $\pm$ 37.22633	135.4 $\pm$ 21.98409	14.8 $\pm$ 3.114482	5.8 $\pm$ 0.447214
Group 2	127.2 $\pm$ 46.35407	79 $\pm$ 28.74891	12.8 $\pm$ 1.30384	5.4 $\pm$ 0.547723
Group 3	127.6 $\pm$ 45.23605	54.2 $\pm$ 9.833616 a**	10.6 $\pm$ 1.67332	6.6 $\pm$ 0.547723
Group 4	109.6 $\pm$ 23.00652	75 $\pm$ 40.93287	11.6 $\pm$ 1.81659	5.4 $\pm$ 0.547723

Significant difference is present between the Alkaline Phosphatase rates in all groups of rabbits. Significant difference of two stars is present between control verses treated group alkaline phosphatase.



No significant difference occurs for AST/SGOT, GGT and total protein (gm  $\pm$  SE) in different groups of rabbits. P less than 0.05, Values are expressed as Mean  $\pm$  SEM

a = Control verses treated or experimental group \* = P less than 0.05 \*\* = P less than 0.01



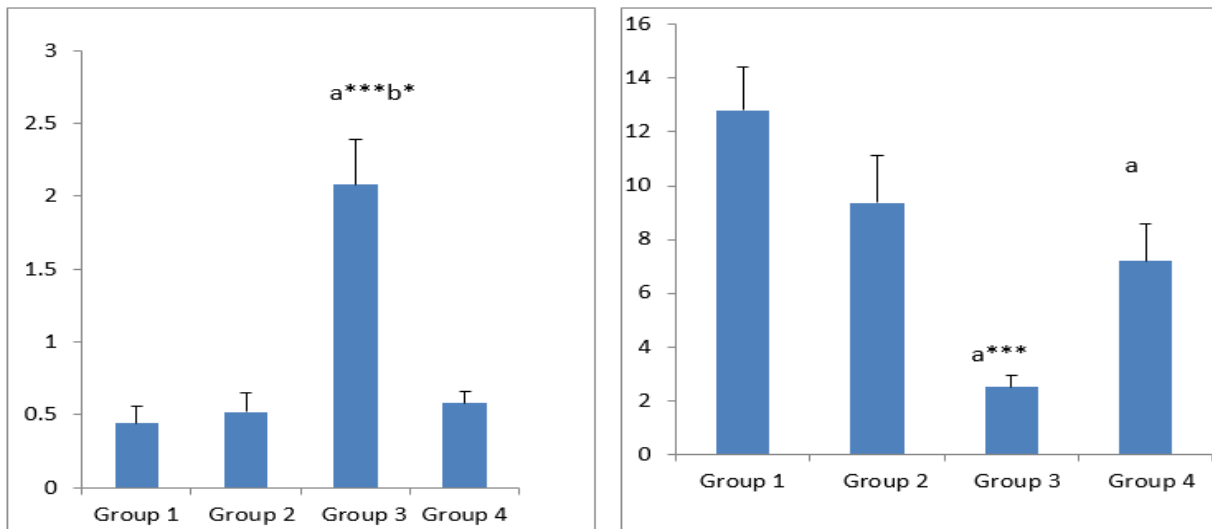
**Figure 7: Graph shows the mean values for alkaline phosphatase in all groups of rabbits including control and experimental group. Significant difference found. P value is 0.0057**

P less than 0.01, P value summary\*\*

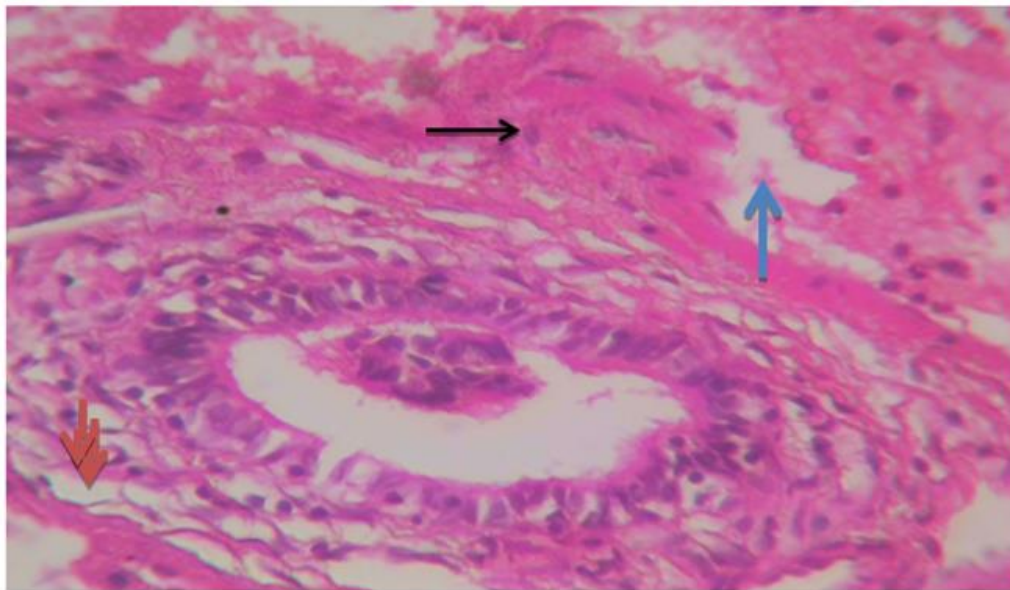
**Table 5: The mean value of Albumin, Globulins and A/G ratio (gm  $\pm$  SE) in different group of rabbits**

Groups	Albumins	Globulins	A/G ratio
Group 1	5.54 $\pm$ 0.114018	0.44 $\pm$ 0.114018	12.8 $\pm$ 1.643168
Group 2	5.06 $\pm$ 0.343511	0.52 $\pm$ 0.130384	9.36 $\pm$ 1.77426
Group 3	5.2 $\pm$ 0.339116	2.08 $\pm$ 0.311448 <b>a***b***</b>	2.5 $\pm$ 0.43589 <b>a***b**</b>
Group 4	5.14 $\pm$ 0.472229	0.58 $\pm$ 0.083666 <b>b***</b>	7.2 $\pm$ 1.398213 <b>a*</b>

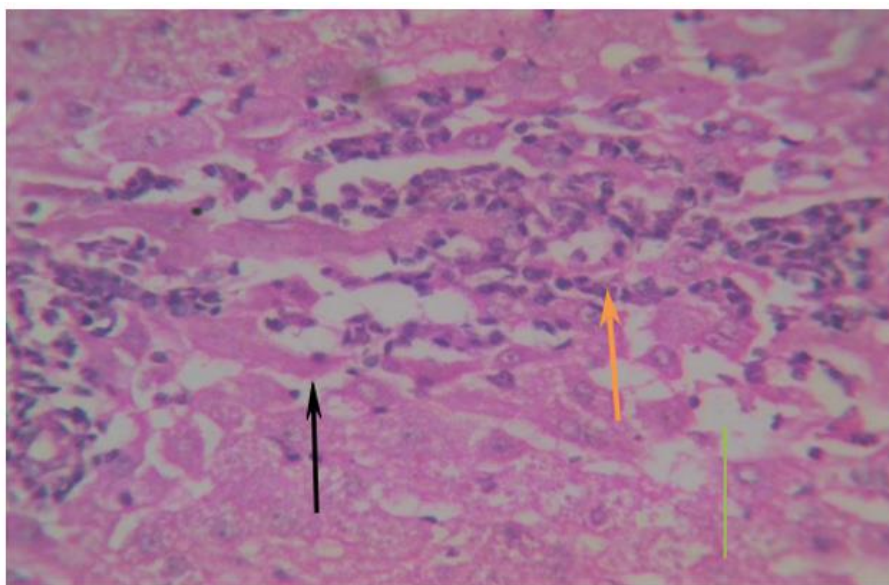
P greater than 0.05 Values are expressed as Mean  $\pm$  SEM Significant difference of Globulin rate in group 3 for 3 stars for a and 3 stars for b and I group 4 for 3 stars for b is observed. a = Control verses treated or experimental group, b = Treated verses treated groups, \* = significant difference, \* = P less than 0.05, \*\* = P less than 0.01, \*\*\* = P less than 0.001



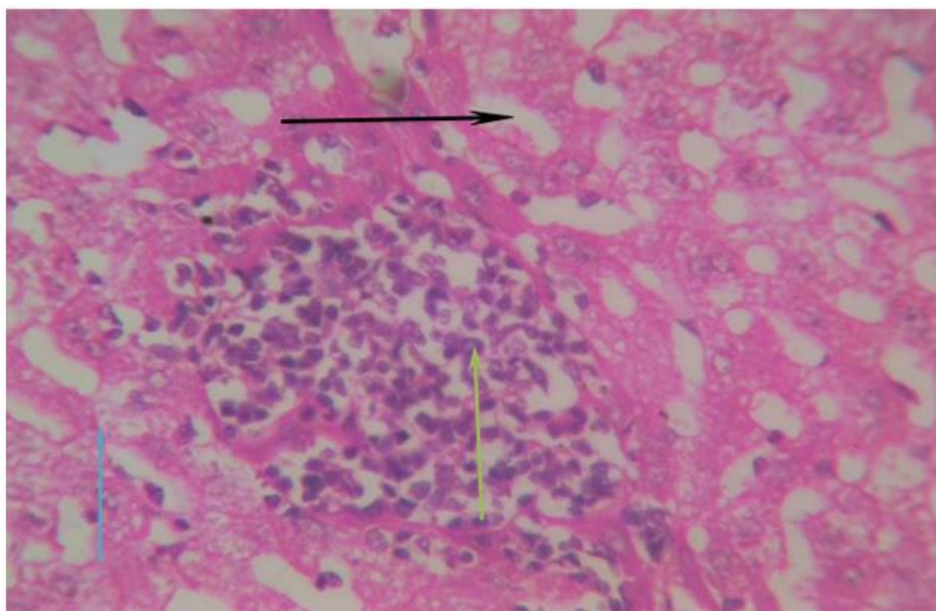
**Figure 8: Graph shows the mean values for Globulin rate, and A/G ratio in all groups of rabbits including control and experimental group. One-way analysis of variance, P value< 0.0001, P value summary\*\*\*\***



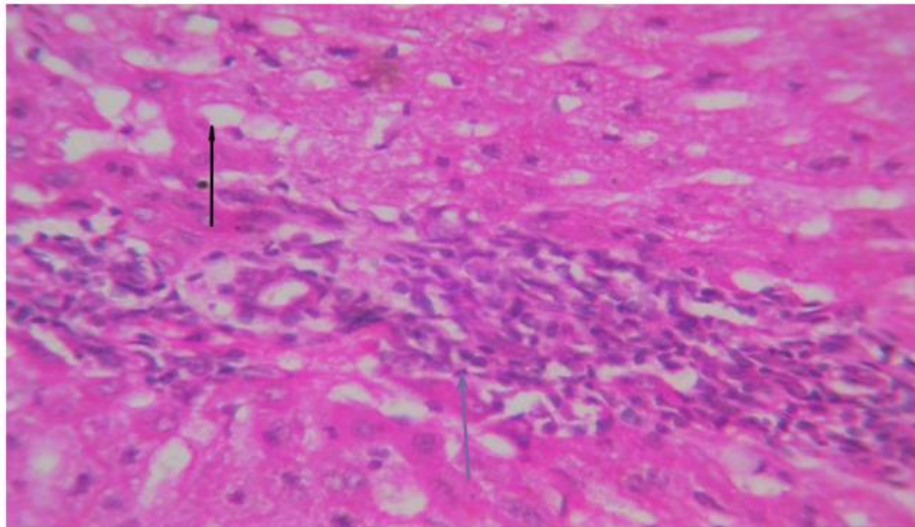
**Figure 9: Histopathology of liver of 8 week old rabbit of control group treated with normal diet. Black arrow: hepatocytes Blue arrow: sinusoids Red arrow: Lymphatic space**



**Figure 10: Histopathology of liver of 8 week old rabbit of experimental group 1 treated with Oil and feed. Orange arrow: Mitotic cells Black arrow: sinusoid Green arrow: Lymphatic space**



**Figure 11: Histopathology of liver of 8 week old rabbit of experimental group 2 Lobular boundary Blue arrow: Intact and normal association of sinusoids Green arrow: mitotic cells**



**Figure 12: Histopathology of liver of 8 week old rabbit of experimental group 4**  
**Purple arrow: kupffer cells Black arrow: Lymphatic space**

## DISCUSSION

*Lycium Barbarum* is a Chinese herbal drug belong to *Solanaceae* family with a present day range across Asia and South east Europe. *Lycium Barbarum* fruits are 1 to 2 cm long and are brilliant orange red in color. *Lycium Barbarum* polysaccharides is one the most active component of this plant and involve a lot of biological activities such as neuroprotection, ant fatigue, control of glucose, anti-tumor and anti-oxidant properties. LBP is a polysaccharide-protein aggregate with anticancer and immunological enhancing properties [11].

In the present study the Average values of initial weight final weight and weight gain in experimental and control groups are shown on the table 1 and graph 1. The control group compared to the experimental group not statistical significant according to the P value. The P value of 0.9952 Group 1 (the control group) and Group 2 (the experimental group) not significantly differ from one another because their mean difference is 0.0. Group 1 and group 4 have a mean difference of 0.04286. In a one-way analysis of variance, the p value for Figure 2 is 0.8116.

The -0.1903 mean difference between Group 1 and Group 2 and mean difference of 0.1046 between Groups 1 and 3. There is a mean difference of -0.1903 between Group 1 and Group 4. The graph in Figure 3 indicates that Groups 1, 2, 3, and 4 significant differences, 0.04816, 0.08329, and 0.03513, respectively. In the previous studies [12] observed that the effects of gojii berry supplementation on the hormonal profile, productive, and reproductive performance of rabbits. 105 nulliparous were used for this experiment and were divided into three groups based on dietary treatment: commercial diet (C), 1% (G1), or 3% (G3).



Results showed higher receptivity in G1 group, higher weight, size, and milk production. Goji berry likely influenced reproductive and productive performance by modulating hormonal patterns and milk production. Group 1 shows that statistically significant  $P < 0.001$ .

In the Current study, there is no significant difference in heart weight between control verses experimental groups of rabbits. As a result, the significance value is zero because the p value is bigger than 0.05. Similarly No significant difference is present in heart weight between control verses experimental groups of rabbits. As a result, p value is larger than 0.05. In the past studies [13] showed that *Lycium Barbarum* is effective in treating or reducing carbon tetrachloride-induced liver fibrosis, as well as the basic mechanism of this pathway. For the investigation, 50 male Albino rats were recruited, and they were subdivided into 5 groups: standard, CCl<sub>4</sub>, and CCl<sub>4</sub> with 400, 800, or 1600 mg/kg LBP.

Blood and tissue samples from each group were collected after the experiment. Some major symptoms of CCl<sub>4</sub> induced liver are aspartate transaminase activity, increased. The result indicated that *Lycium Barbarum* are suitable to treat CCl<sub>4</sub> induced liver hepatotoxicity and attenuating and turning some harmful parameters into positive way.

In the current study, No significant difference is present for total bilirubin rate, direct bilirubin & indirect bilirubin rate. The p value is larger than 0.05. In the previous study [14] increase serum bilirubin levels, direct & indirect are important, especially in individuals most at risk. Mild elevation of bilirubin levels can have important clinical benefits. In the present study consume excessive amounts of fat much lower antioxidant enzyme activity and higher MDA levels than people who consume a typical diet. Liver enzyme tests as the result show no significant difference is present for **ALT/SGPT** rate between control & experimental groups of rabbits.

Significant difference is present between the Alkaline Phosphate rates in all groups of rabbits. Significant difference is present between control verses treated group alkaline phosphate. No significant difference occurs for AST/SGOT, GGT and total protein (gm  $\pm$  SE) in different groups of rabbits. In the early study [15] investigates Goji berry, a traditional health food, and targets gut microbiota to prevent liver injury from alcohol abuse. Results show that Goji supplementation for 14 days alleviates acute liver injury by lowering serum ASPT/ ALT aspartate aminotransferase, alanine aminotransferase, pro-inflammatory cytokines, and lipopolysaccharide content.

In the previous studies, [16] observed that the mice treated *lycium barbarium* polysaccharides had significantly lower levels of lipid peroxide and lower levels of SOD, CAT, GSH-Px, and TAOC activity. The mice model had significantly lower and higher levels of serum, liver GSH, and no increased GSH oxidation, impaired GSH synthesis, and/or a lack of substrates for GSH formation could all lead to a drop in GSH. *Lycium barbarium* polysaccharides were found to significantly counteract a significant decline in GSH levels in high-fat mice.

In the present study, No significant difference is present for GGT, Total protein rate between the control and treatment groups. In Globulin significant difference occur in group 3 and group 4.

Significant difference  $a^{***}b^{**}$  is present for A/G ratio in group 3 and  $a^*$  for group 4. The protective benefits of *Lycium barbarum* polysaccharides in mice given a high-fat diet may be associated to the lipid metabolism through its antioxidant capacity acute medical applications of polysaccharides from *Lycium barbarum* in reducing chronic liver disease & hepatic injuries [17].

The effectiveness of LB extract in decreasing liver damage caused by PCT intoxication. Histopathological studies, biochemical analysis, and oxidative stress biomarkers have all proven this accuracy. In recent studies, LB extract has been intensively investigated. These researches reveal that LB extract has anti-oxidant, anti-aging, anti-tumor, and immune-stimulating actions. In hepatocytes, NAPQI interacts with cysteine when glutathione (GSH) reserves are low, causing oxidative damage and hepatic centrilobular necrosis.

The injured cells release AST and ALT into the bloodstream [18]. Histopathology of liver in 8 week old rabbits of control group hepatocytes sinusoids and Lymphatic space are present. In experimental group 1 treated with Oil and feed, Mitotic cells, sinusoids and Lymphatic spaces are present as shown in figure 10. Experimental group 2 Intact and normal association of sinusoids into Lobular boundary and mitotic cells present as shown in figure 11. In experimental group 3 kupffer cells and Lymphatic spaces were present as shown in figure 12.

## CONCLUSION

A plant species called *Lycium Barbarum* is a Chinese herbal drug belongs to the *Solanaceae* family has a number of traditional and medicinal uses. *Lycium Barbarum* juice help with a variety of conditions, including cardiovascular effects such as blood pressure and pulse rate, neurological and psychological impacts, musculoskeletal issues and beneficial to increase the life span and it also lowers the risk of arteriosclerosis and arterial hypertension.

Natural and easily accessible *Lycium barbarum* is the best and most affordable herb to treat a variety of conditions affecting both humans and animals, such as infertility, chronic and acute liver illnesses, ALDL, and NADNT disease. The parameters of total direct, and indirect bilirubin, no statistically significant differences were found.

Total protein, albumin, globulins, alkaline phosphate, and GGT rates were shown to differ significantly. In Histopathology, hepatocytes sinusoids, mitotic cells, kupffer cells and Lymphatic spaces are present in cells.

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