

Effects of Garlic (*Allium Sativum*) on the Weights of Liver in Albino Rats

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ABSTRACT

Background: The widespread use of the garlic as household remedy in the diabetic and hypertensive patients necessitates the estimation of its safer dose range and duration as it is completely metabolized in the liver.

Objective: To evaluate adverse effects of garlic (*allium sativum*) extracts on liver of adult albino rats.

Methods: In this experimental study a total of 45 wistar albino rats of both sexes weighing between 250-350 grams were selected randomly. They were divided in three groups. Two different doses of 500 and 1000 mg/kg of fresh garlic extract by orogastric tube for thirty days were given to the animals. After this period, histopathological analysis was then performed on the livers of the sacrificed rats. The gross parameters studied were the gross appearance and shape of liver and the quantitative gross parameters observed were body weight, liver weights and RTWI (relative tissue weight index).

Results: In the present study, the gross appearance and shape of liver showed significant changes like haemorrhages and nodular swelling on external surfaces of the liver of animals in experimental groups B and C. The body weight and liver weight of experimental groups B and C were increased as compared to control group A (P-value <0.001). When RTWI was compared among groups, the overall difference was significant (P-value <0.018).

Conclusion: It is concluded that there is a need to evaluate safer dose and duration of usage of garlic in general public due to its gross morphological effects on liver

Keywords: Garlic (*allium sativum*), Liver, Albino rats

INTRODUCTION

Garlic acquired a reputation in many cultures over centuries as a prophylactic and therapeutic medicinal agent.¹ Allicin (allyl 2-propenethiosulfinate or diallyl thiosulfinate) is thought to be the principal bioactive compound present in aqueous garlic extract or raw garlic homogenate. When garlic is chopped or crushed, allinase enzyme, present in garlic, is activated and acts on allicin (present in intact garlic) to produce allicin. Other important sulfur containing compounds present in garlic homogenate are allyl methyl thiosulfonate, 1-propenyl allylthiosulfonate and γ -L-glutamyl-S-alkyl-L-cysteine².

Modern use of garlic and garlic preparations is focused on the biological responses that have been largely attributed to reduction of risk factors for cardiovascular diseases³, prevention of cancer⁴, stimulation of immune function⁵, enhanced detoxification of foreign compound⁶, antioxidant effects⁷, cholesterol lowering effect⁸, hypoglycemic effects⁹ and neuroprotective effect which helps to reduce dementia¹⁰.

Different studies for garlic extract in mice and rats have reported LD50 values irrespective of the route used were greater than 32g/kg¹¹. The garlic extract in dose of 2g/kg damages the gastric and intestinal epithelial mucosal membrane, results in bleeding ulcers and sloughing of the villus structure of jejunum.^{12,13} In a study, hepatotoxic effects revealed atrophy of hepatocytes with pyknosis of their nuclei and vacuolar degeneration along with inflammatory cell infiltration in the hepatocytes.¹⁴ Aorta of the rats fed on dried garlic also showed vacuolation in the tunica media¹⁵. It also has potential to inhibit spermatogenesis as it decreases the functions of Leyding and Sertoli cell markers, which induces germ cell death¹⁶.

MATERIALS AND METHODS

This experimental study was conducted in Department of Anatomy, Shaikh Zayed Postgraduate Medical Institute, Lahore in collaboration with Department of Zoology Quaid-e-Azam Campus, University of the Punjab Lahore. Forty five Wister albino rats of both sexes weighing between 250-350 grams were selected for this study. After 14 days of acclimatization the animals were randomly divided into three groups. Each group comprised of 15

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animals. Group A was control, the animals of this group were not given garlic extracts but instead received distilled water 4 ml/kg body weight by orogastric tube for 30 days. The other two groups B & C were experimental. Garlic extract 500 mg/kg and 1000mg/kg was given respectively to the rats of experimental groups B & C through the orogastric tube for 30 days.

Garlic bulbs were purchased from the local market and then its extract was obtained from PCSIR, Laboratories Complex Lahore, which was prepared by soaking garlic paste in purified water. From 25 g of raw garlic, 1 ml of garlic extract was obtained which contained approximately 90mg of allicin. Two concentrations of extract were prepared 0.2 and 0.3 g/ml corresponding to doses of 500 and 1000 mg/kg body weight of animals respectively¹⁷. At the end of study the rats of all groups were weighed properly before dissection and recorded in proforma. On the day 7 all the rats were euthanized by giving morphine 0.3–0.5mg/kg intraperitoneally¹⁸, as an analgesic agent. The anaesthetic agent sodium pentobarbitol was administered intraperitoneally with dose of 45 mg/kg.¹⁹ After dissection the parameters recorded were gross appearance and weight of the liver. RTWI was recorded by the following formula

$$RTWI = \frac{\text{Mean weight of liver}}{\text{Mean body weight of Animal}} \times 100$$

Statistical analysis: The weight of animals, weight of liver and RTWI were analyzed statistically by analysis of variance (ANOVA) using SPSS 17 version. The P value less than 0.05 was considered significant for all analysis.

RESULTS

The gross appearance of livers of all the animals of experimental groups B and C showed haemorrhagic areas and irregular margins with nodular appearance on external surface randomly affecting all lobes as compared to smooth surface of control group A. These changes were mild in group B that received 500 mg/kg garlic extract and increased in group C which received dose of 1000 mg/kg of garlic extract (Fig. 1). The average body weight at the start of experiment recorded for control group A was 306.9±42.1 g, experimental group B 317.7±43.2 g and that for experimental group C was 321.8±43.2 g. The body weight at the end of study showed weight gain after consumption of garlic but difference was insignificant. The average liver weight of control group A was 14.68±1.31g. When comparison was

made for the liver weight among three groups it was observed that the average liver weight was increased in experimental group B with average value 17.37±1.87 g, and in experimental group C with value 16.88±2.07 g. The difference among groups was significant [P-value <0.001] (Tables 1-). Pair wise comparison showed that the difference of groups B and C from group A was statistically significant [P-values <0.001 and 0.004 respectively] (Table 3). The average relative tissue weight index for liver in three groups was compared to see the difference. It was observed that the average relative tissue weight index was 0.045±0.004, 0.050±0.005 and 0.048±0.006 in group A, B and C respectively. The difference among three groups was found significant [P-value 0.018] (Tables 4-5).The statistical significant difference in pair wise comparison was only among control group A and experimental group B (P-value 0.014). The difference between group A and C was insignificant.

Fig. 1: Photographs A and B showing gross features of the liver in control group, photographs C and D showing haemorrhagic areas and nodular swelling with distorted margins in experimental groups

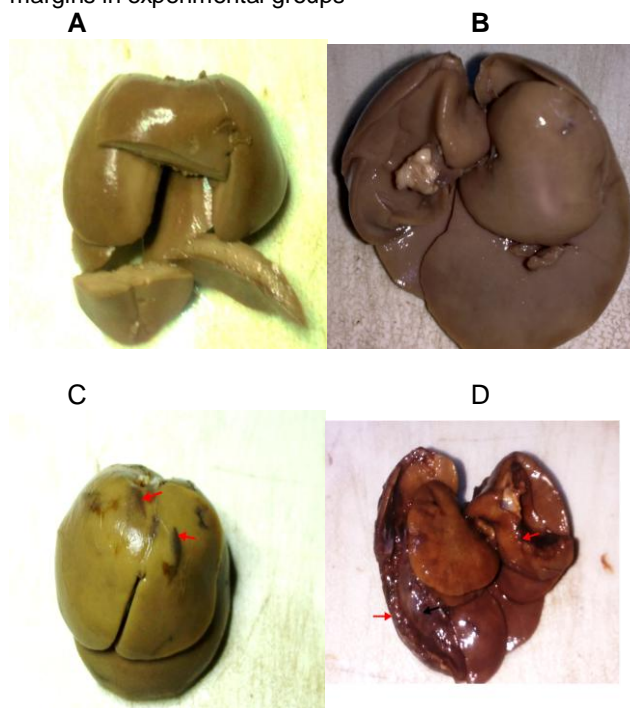


Table 1: Weight of liver of rats (g) in control and experimental groups after administration of garlic extract

| Group | Mean | SD | Minimum | Maximum |
|-------|-------|-------|---------|---------|
| A | 14.68 | ±1.31 | 12.82 | 16.85 |
| B | 17.37 | ±1.87 | 13.05 | 19.91 |
| C | 16.88 | ±2.07 | 13.60 | 20.07 |

Table 2: Comparison of weight of liver of rats in control and experimental groups after administration of garlic extract (based on ANOVA)

| | Sum of squares | df | Mean square | F | P value |
|----------------|----------------|----|-------------|------|----------|
| Between Groups | 61.6 | 2 | 30.8 | 9.72 | <0.001** |
| Within Groups | 133.0 | 42 | 3.2 | | |
| Total | 194.6 | 44 | | | |

DF = Degree of Freedom F = f-test (Ratio of variances)

**=Highly significant difference (P<0.01)

Table 3: Pair wise comparison of weight of liver in control and experimental groups after administration of garlic extract (based on TUKEY's test)

| (I) Groups | (J) Groups | Mean difference (I-J) | Std. Error | P value |
|------------|------------|-----------------------|------------|----------|
| Group A | Group B | -2.69 | 0.65 | <0.001** |
| | Group C | -2.20 | 0.65 | 0.004** |
| Group B | Group C | 0.49 | 0.65 | 0.734 |

**Highly significant difference (P<0.01)

++Non-significant difference (P>0.05)

Table 4: Relative tissue weight index for rats in control and experimental groups after administration of garlic extract

| Groups | Mean | SD | Minimum | Maximum |
|--------|-------|--------|---------|---------|
| A | 0.045 | ±0.004 | 0.040 | 0.053 |
| B | 0.050 | ±0.005 | 0.042 | 0.058 |
| C | 0.048 | ±0.006 | 0.036 | 0.055 |

Table 5: Comparison of relative tissue weight index of rats in control and experimental groups after administration of garlic extract (based on ANOVA test)

| | Sum of squares | df | Mean square | F | P value |
|----------------|----------------|----|-------------|------|---------|
| Between Groups | 0.00020 | 2 | 0.00010 | 4.41 | 0.018* |
| Within Groups | 0.00097 | 42 | 0.00002 | | |
| Total | 0.00117 | 44 | | | |

DF = Degree of Freedom F = f-test (Ratio of variances) * = Significant difference (P<0.05)

DISCUSSION

The present research work was designed to evaluate the effects of garlic on liver weights as it is the main metabolizing organ for garlic and its constituents. Allicin is the most bioactive sulphated component that has been proved lethal.²⁰ In this present study effects of garlic were observed in doses of 500 and 1000 mg/kg which was given for 30 days and the gross morphological effects on liver were observed. In the present study the average body weight of experimental groups B and C showed gradual weight gain after garlic consumption as compared to control

group A This may be due to the fact that garlic is appetite center stimulant as documented by Heydarpour in his study²¹. This is in accordance with the study by Saba Farnaz, who reported that allicin at low concentration has limited role in reducing cholesterol level by inhibition of metabolic pathways in cholesterol biosynthesis²². These two factors may be contributing in the increase in the body weight of animals.

The comparison of average liver weights was made among three groups. It was observed that the average liver weight was increased in experimental group B and C as compared to control group A. The experimental group C that received high dose showed increase in average liver weights but to lesser extent as compared to group B. These findings also correspond to body weight gain which was increased in experimental groups after administration of garlic and liver weights were also increased. This is indicating the relationship of body weight gain and increase in liver weights in experimental groups B & C. The overall body weight gain and increase in liver weight in experimental group B and C, was most probably due to inflammatory cells, nodular hyperplasia, congestion and haemorrhages in the liver and these findings were well marked on the gross appearance of the live in this study. So it was dose related findings as maximum dose used in this study was 1g/kg body weight of rats which is associated with weight gain and increased mean liver weights. In the previous studies by Maulik and Noori that showed the weight loss and reduction in the mean liver weights of Wister albino rats at higher doses 2 g/kg body weight of garlic extract was due to severe gastric injuries^{23,24}. The relative tissue weight index (RTWI) was calculated to see the changes in weights of liver compared to body weights of the animals. The difference among three groups was statistically significant. This clearly showed that the increase in animal body weight and liver weights resulted in increasing the RTWI values in experimental groups.

CONCLUSION

Garlic has dose related changes in the body weight and liver weights of the albino rats. It has been used worldwide as self-medication for the treatment of hypertension, diabetes mellitus and cardiovascular problems. But this use is without any knowledge of its dose requirement, duration of use and toxic level. There is a need of its safer dose evaluation so that it may be prescribed safely without any detrimental consequences.

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