Garlic (Allium sativum) Extract Supplementation Alters the Glycogen Deposition in Liver and Protein Metabolism in Gonads of Female Albino Rats

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ABSTRACT
Garlic is an ayurvedic herb that has been extensively used as medication and as the taste enhancer of the food. The present investigation was undertaken to provide data on the efficacy of garlic (Allium sativum Linn.) extract on glycogen deposition and protein metabolism in female albino rats that may further explore medicinal potential of garlic. The rats were divided into four groups A, B, C and D, keeping group A as a healthy control. The garlic extract was tried in three different doses, 1ml, 2ml and 4ml/ kg body weight as low, medium and high dose respectively and given orally for the period of 7, 14, 21 and 28 days daily to the rats of group B, C and D as stated above. The significant (P<0.01 & P<0.05) increase in glycogen and protein level was observed when rats were fed with low and medium dose but when rats were fed with high dose of garlic extract there was significant (P<0.01) decrease in glycogen level and a not significant decrease in protein level was observed.

Keywords: Garlic Extract, Glycogen Deposition, Protein Metabolism, Albino Rats.

INTRODUCTION
Epidemiological studies, during the last decade, have revealed an inverse relationship between garlic, (Allium sativum Linn.) (Alliaceae), consumption and the incidence of certain forms of diseases, including stomach, colon and laryngeal cancers. [1] The importance of garlic has already been recognized in early Egyptian, Chinese and Indian civilizations, centuries ago as an herbal or traditional medicine. Today, in many parts of the world garlic is being used both as prophylaxis and for the cure of variety of diseases including acute and chronic infections like gastritis, dysentery, typhoid fever, cholera, tuberculosis, pneumonia, diabetes mellitus, heart disease and hypertension. [2] Previously it was reported that allyl-containing sulfides in garlic increase the uncoupling protein (UCP) content in brown adipose tissue, and noradrenaline and adrenaline secretion in rats. [3] It also reported that administration of diallyldisulfide, a major volatile sulfur-containing compound in garlic, enhanced triglyceride catabolism and growth of interscapular brown adipose tissue (IBAT) by increasing noradrenaline secretion in rats. [4,5] We speculated that garlic may affect whole-body protein metabolism by the stimulation of hormone secretion and that dietary supplementation of garlic may enhance hormone-regulated protein anabolism. Biochemical investigations of the effect of garlic in rats are limited to lipid metabolic studies only. The purpose of this study was to investigate the effect of dietary supplementation of garlic extract on the level of Glycogen in liver and Protein in gonads of female albino rats.

MATERIALS AND METHODS
The Extract
Six months old (after harvest) garlic bulbs were collected from the local market. Garlic bulbs were separated, peeled and washed with distilled water. After drying in shed, about 500 g of clean garlic bulbs were crushed with the help of electronic grinder. The extract was strained through muslin cloth after squeezing the crushed materials.

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The animals were divided into four groups. Group A animals, which served as healthy control, were given normal feed and tap water ad libitum throughout the experimental tenure. Rats of group B, C and D were fed with 1ml, 2ml and 4ml/kg body weight garlic extract daily for 7, 14, 21 and 28 days daily. In all the groups, the extract was forced fed by using ball - tipped needle every day between 11.00 AM to 12.00 PM. 

**Effect of extract on glycogen deposition**

There was a significant increase in the mean values of protein level in female albino rats. In group B and C, the level increased significantly ($P<0.01$) to the extent of 12.54% and 17.99% respectively, whereas a not significant increase of 2.81% in protein level was observed in group D (Table 1, Fig. 1).

**DISCUSSION**

Carbohydrates fulfill both structural and metabolic roles. Carbohydrates are major constituents of animal food and tissues. The glucose is the most important carbohydrate in the animal biochemistry because nearly all carbohydrates in food are converted to glucose for further metabolism. Glucose is a major fuel of the tissues of animals. It is converted into other carbohydrates having highly specific function, viz., glycogen for storage, in certain complex lipids and in combinations with proteins in glycoproteins. Glycogen is a storage polymer of glucose in animals. It is reported that garlic acts as a hypoglycemic agent. Therefore, it is assumed that administration of garlic increases response of insulin and also promotes the conversion of the inactive form of glycogen synthetase to the active form and enhances conversion of blood glucose into glycogen. These findings get support from Villar-Palasi and Lamer, Jain et al. Jain and Vyas and seemed to support the theory that garlic acted as a hypoglycemic agent. The hypoglycemic effect might be due to an increase in the insulin response during feeding, probably due to enhanced transport of blood glucose to the peripheral tissues. The abolition of this effect due to ingestion of garlic may inhibit some steps in the formation of glucose or in the deposition of this glucose as liver glycogen. On this basis, it is possible that the low levels of liver glycogen initially may also be related to inhibition of a part of the process of deposition. Reduction of hepatic glycogen may be explained as due to pathophysiological changes in liver (increased relative liver weight). The present study is in accordance to Nigam, Igbedioh and Akinanye who reported reduced hepatic glycogen with pathological changes in the liver of common house sparrow due to furadon $S_{50}$ exposure. The effects of garlic supplementation on protein metabolism have not been fully clarified. It is believed that garlic involved in hormonal secretion, may affect whole-body protein metabolism due to hormonal regulation by stimulating hormone secretion (noradrenaline and adrenaline), or it may affect protein metabolism by enhancing protein anabolism. These results get support from OI et al. who reported that supplementation of garlic powder at 0.8 g/100 g with a high fat diet and the administration of diallyldisulfide, a major volatile sulfur-containing compound in garlic, enhanced triglyceride catabolism and growth of interscapular brown adipose tissue (IBAT) by increasing noradrenaline secretion in rats. Further, they reported that allyl-containing sulfides in garlic increase the uncoupling protein (UCP) content in brown adipose tissue, and noradrenaline and adrenaline secretion in rats. We assume that allyl-containing polysulfides in garlic are responsible for the enhancement of noradrenaline and adrenaline secretion and increased in thermogenesis, indicated by the increased UCP content in IBAT. Thus, garlic administration may affect whole-body protein metabolism due to hormonal regulation by stimulating hormone.
Table 1: Percent change in glycogen and protein level after following the programmed feeding of *Allium sativum* (garlic) extract daily for 7, 14, 21 and 28 days respectively in female albino rats.

<table>
<thead>
<tr>
<th>REGIMENS</th>
<th>TREATMENTS</th>
<th>DAYS</th>
<th>07</th>
<th>14</th>
<th>21</th>
<th>28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glycogen</td>
<td>CONTROL (0)</td>
<td></td>
<td>541.094 ± 1.173</td>
<td>540.184 ± 1.022</td>
<td>539.092 ± 1.130</td>
<td>542.369 ± 1.451</td>
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<tr>
<td></td>
<td>(100%)</td>
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<tr>
<td></td>
<td>1ml/kg (bd.wt)</td>
<td></td>
<td>543.314 ± 1.274**</td>
<td>548.760 ± 1.362*</td>
<td>555.208 ± 1.830**</td>
<td>562.382 ± 1.551**</td>
</tr>
<tr>
<td></td>
<td>(0.41%) ↑</td>
<td></td>
<td>(1.59%) ↑</td>
<td>(2.99%) ↑</td>
<td>(3.69%) ↑</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2ml/kg (bd.wt)</td>
<td></td>
<td>549.301 ± 1.789*</td>
<td>553.279 ± 1.451**</td>
<td>566.725 ± 1.274**</td>
<td>572.901 ± 1.644**</td>
</tr>
<tr>
<td></td>
<td>(1.52%) ↑</td>
<td></td>
<td>(2.42%) ↑</td>
<td>(5.13%) ↑</td>
<td>(5.63%) ↑</td>
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</tr>
<tr>
<td></td>
<td>4ml/kg (bd.wt)</td>
<td></td>
<td>539.717 ± 1.187**</td>
<td>530.619 ± 1.834*</td>
<td>524.154 ± 1.201**</td>
<td>519.056 ± 1.644**</td>
</tr>
<tr>
<td></td>
<td>(0.25%) ↓</td>
<td></td>
<td>(1.77%) ↓</td>
<td>(2.77%) ↓</td>
<td>(4.30%) ↓</td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td>CONTROL (0)</td>
<td></td>
<td>84.911 ± 1.085</td>
<td>88.470 ± 2.310</td>
<td>93.645 ± 1.585</td>
<td>98.012 ± 1.126</td>
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<tr>
<td></td>
<td>(100%)</td>
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<tr>
<td></td>
<td>1ml/kg (bd.wt)</td>
<td></td>
<td>89.763 ± 1.879**</td>
<td>95.263 ± 1.097**</td>
<td>104.481 ± 1.183**</td>
<td>110.304 ± 1.103**</td>
</tr>
<tr>
<td></td>
<td>(5.71%) ↑</td>
<td></td>
<td>(7.68%) ↑</td>
<td>(11.57%) ↑</td>
<td>(12.54%) ↑</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2ml/kg (bd.wt)</td>
<td></td>
<td>94.292 ± 1.568**</td>
<td>100.276 ± 1.023**</td>
<td>108.687 ± 1.547**</td>
<td>115.641 ± 1.279**</td>
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<tr>
<td></td>
<td>(11.05%) ↑</td>
<td></td>
<td>(13.34%) ↑</td>
<td>(16.06%) ↑</td>
<td>(17.99%) ↑</td>
<td></td>
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<tr>
<td></td>
<td>4ml/kg (bd.wt)</td>
<td></td>
<td>86.044 ± 1.368**</td>
<td>90.410 ± 1.605**</td>
<td>95.424 ± 1.513**</td>
<td>100.762 ± 1.132**</td>
</tr>
<tr>
<td></td>
<td>(1.33%) ↑</td>
<td></td>
<td>(2.19%) ↑</td>
<td>(1.90%) ↑</td>
<td>(2.81%) ↑</td>
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</tbody>
</table>

- Values are expressed as Mean ± SE of five replicates, Values in parentheses are percent change with control taken as 100 percent.
- Data were analyzed through Two Way Analysis of Variance (ANOVA) followed by Student’s t-test.
- ‘NS’ not significant, ‘*’ significant (P<0.05) and ‘**’ significant (P<0.01), when treated groups were compared with controls.
- ↓ Decrease in % change and ↑ Increase in % change.

Fig. 1: Change in percent level of Glycogen and Protein in female albino rats after fed with different volumes of raw garlic extract for 7, 14, 21 and 28 days daily.

secretion. On the other hand decrease in protein level, observed in present investigation may be due to their degradation and possible utilization for metabolic purposes. Decreased protein content might also be attributed to the destruction or necrosis of cells and their consequent impairment in protein synthesis machinery. The quantity of protein depends on the rate of protein synthesis or on the rate of its degradation.

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REFERENCES