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EFFECT OF REGULAR GARLIC INGESTION ON BODY WEIGHT AND BLOOD GLUCOSE: A CASE STUDY IN MICE

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ABSTRACT

Garlic a perennial erect plant is known to have sulphur-containing compounds that act on the hypothalamus increasing the sensitivity of the hypothalamus to leptin which alters the set point at which satiety is reached causing an organism to eat less. Nine mice (six of which were obese) were used in this study and grouped into three. Groups A and B were made of 3 obese mice each whereas group C consisted of 3 non-obese mice. For group A and group C mice, 20 ml aqueous garlic extract was added to their feed daily whereas no garlic was added to the feed of group B mice. The study was carried out over a period of 44 days. The weight and blood glucose was measured weekly and the average for each group was computed. Results indicated that Group A mice recorded a reduction in mean body weight by 46.5% ($p<0.05$). Group B mice had significant increase in mean body weight by 46.2% ($p<0.05$). The blood glucose level dropped significantly by 18.5% ($p<0.05$) in group A mice. Garlic had weight loss and hypoglycemic effect in obese mice. These effects were absent in non-obese mice.

INTRODUCTION: Garlic (*Allium sativum* Lin.) contains a variety of active compounds such as selenium and germanium that exhibit sulphur antioxidant property, as well as vitamin A, C and E which help scavenge harmful free radicals and also eliminate low density lipoprotein from blood thereby increasing high density lipoprotein in the blood [1]. Obesity is a condition in which there is excessive triglyceride storage in the body and long-term regulation of body weight is largely influenced by the degree of obesity [2]. There are serious health implications associated with obesity such as cardiovascular disease (mainly hypertension, heart disease and stroke), type 2 diabetes, musculoskeletal disorders like osteoarthritis, and some cancers such as endometrial, breast and colon [3]. Fat cells secrete a protein hormone called leptin in proportion to the amount of triglyceride they have stored [4]. Thus, in a long term, excess ingestion of calories resulting in increased fat deposition triggers an increase in leptin secretion.

Leptin impinges on its receptors in the hypothalamus to alter the set point at which satiety is reached, so that the individual eats less due to loss of appetite and, hence, assimilates fewer calories [4, 5]. Although leptin is a circulating signal that reduces appetite, obese people generally have an unusually high circulating concentration of leptin. Obese individuals are therefore resistant to the effect of leptin due to low sensitivity of the hypothalamus to leptin [6].

According to Sukander *et al.*, garlic has been proposed to have direct anti-atherogenic (preventive) and anti-atherosclerotic (causing regression) effects at the artery wall. The possible mechanisms of garlic as lipid lowering agent are its inhibitory effect on hepatic activities of lipogenic and cholesterogenic enzymes such as malic enzyme, fatty acid synthase, glucose-6 phosphate dehydrogenase and 3-hydroxy-3-methyl-glutaryl-CoA (HMG CoA) reductase [7].

It was also suggested that garlic lowers serum lipids by delaying lipid absorption from gastrointestinal tract and diminishing LDL cholesterol synthesis in the liver. Garlic also increases the body's metabolic rate by stimulating the adrenal gland to release adrenaline which increases the rate of fat metabolism in the body and in turn helps burn more calories to decrease weight [8]. Some researchers have proved that regular addition of garlic to diet can help reduce blood cholesterol and glucose levels [9, 10, 11].

This work is aimed at investigating the weight reducing effects of garlic in obese mice.

MATERIAL AND METHODS: The genetically modified obese mice and non-obese mice were obtained from Noguchi Memorial Institute, Accra. Nine mice (six of which were obese) were used in this study and grouped into three. Groups A and B were made of 3 obese mice each whereas group C consisted of 3 non-obese mice. For group A and group C mice, 20 ml aqueous garlic extract was added to their feed daily whereas no garlic was added to the feed of group B mice.

The aqueous garlic extract was prepared from locally available garlic bulbs in accordance to the method used by Mahesar *et al* [10]. Body weight was measured using a weighing balance while fasting blood glucose level was determined using the OneTouch Select glucometer. The blood sample was taken from the tail vein. The study was carried out over a period of 44 days during which the weight and blood glucose were measured weekly and the average for each was computed. Data analysis was done using SPSS-V15. The data were presented as Mean $\pm$ SD with statistical analysis carried out using student's t-test and ANOVA. Difference were considered to be statistically significant at error probability of less than 0.05 ($p<0.05$)

RESULTS:

TABLE 1: WEEKLY MEAN WEIGHT (g)

GROUP	MEAN WEIGHT		P- VALUE
	BEFORE	AFTER	
A	38.7 ± 2.89	20.7 ± 1.15	0.013*
B	30.3 ± 0.58	44.3 ± 2.08	0.005*
C	21.3 ± 1.15	22.0 ± 0.00	0.423

*p value < 0.05 was statistically significant

There was statistically significant decrease in mean weight in group A mice and significant increase in body weight in group B mice. Group C mice didn't show any significant variation in body weight.

TABLE 2: WEEKLY MEAN GLUCOSE LEVELS (mmol/l)

GROUP	MEAN GLUCOSE LEVEL		P- VALUE
	BEFORE	AFTER	
A	6.5 ± 0.44	5.3 ± 0.15	0.029*
B	6.9 ± 0.57	6.8 ± 0.68	0.667
C	5.3 ± 0.98	5.2 ± 0.93	0.130

* p-value <0.05 was considered statistically significant.

There was a statistically significant decrease in blood sugar levels in group A mice. The decrease in sugar levels in group B and C were not statistically significant.

DISCUSSION: Results obtained on weight in this study agree with research conducted by two researchers [7, 10] who suggested that garlic causes a reduction in BMI. This reduction in body weight is probably due to the action of allicin, a potent compound in crushed garlic that increases the body's metabolic rate by stimulating the adrenal gland to release adrenaline which increases the rate of fat metabolism in the body and in turn helps burn more calories and decrease weight [8].

The significant weight loss observed in group A may also be due to the fact that, sulphur-containing compounds in garlic acted on the hypothalamus of the obese mice, increasing the sensitivity of the hypothalamus to leptin, a hormone secreted by fat cells in the body, which functions by impinging its receptors in the hypothalamus altering the set point at which satiety is reached, so that the organism eats less [10]. We also observed that group A ate less compared to group B. Hence, the mean weight of the group A was significantly lower.

Comparing the mean weight of group C to that of group A, garlic had a significant weight loss effect on group A than group C. Group C did not significantly reduce in weight because they probably had reduced blood circulating leptin [9]. Hence, the weight loss effect of garlic was less compared group A. Garlic may have served other systemic and cardiovascular functions such as antithrombotic, antibiotic, antiglycative, anti-inflammatory, hypolipidemic, hypo-cholesteremic, anti-atherosclerotic, hypoglycemic and hypotensive

activities, rather than reducing weight significantly in the normal mice [9, 10, 11] .

Our results confirm the findings that garlic has a hypoglycemic effect on obese mice that fed on garlic [9, 10, 11]. The hypoglycemic effect may be due to the presence of flavonoids and sulphur-containing compounds in the garlic extract [10]. Garlic may potentiate insulin effect on plasma by increasing secretion of insulin from beta cells of the pancreas [7]. This elevated insulin level causes a decrease in blood glucose. Allicin, the principal bioactive compound in garlic extract also has a scavenging effect on excess glucose stored as fat. Some of the excess glucose is also converted to ATP [7].

On the other hand, the decrease in the mean glucose level of group B and group C was insignificant ($p > 0.05$).

CONCLUSION: The results from this study showed that regular administration of garlic to obese mice for 44 days significantly decreased blood glucose level by 18.5% and body weight by 46.5%. This observation may be useful in diet modification for obese human subjects by nutritionists and dieticians.

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