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Original Research Article

Effects of Cinnamon Extract on Body Weight and Blood Glucose Levels of Healthy Mice

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Abstract: Cinnamon is widely used as a flavor or a spice, and many research studies demonstrate its importance in regulating blood glucose and body weight. This research aims to investigate the role of cinnamon in weight and blood glucose reduction in healthy mice. Four groups of mice were selected to undergo the research. Twenty-four mice were divided into four groups: control, group 1 with light cinnamon concentration, and groups 2 and 3 with concentrated cinnamon solution. Groups 1 and 2 were used for random blood glucose analysis, and group 3 was used for fasting blood glucose analysis. The weight and blood glucose changes were recorded over ten days. Statistically, paired and unpaired t-tests were used to compare the results within and between groups. The weight or blood glucose level changes show insignificant differences. Regarding weight, the P-values were 0.057 for group 1, 0.076 for group 2, and 0.23 for group 3. The p-values for groups 1, 2, and 3 for blood glucose level were 0.3, 0.79, and 0.064, respectively. The results of this study indicate no significant effect of cinnamon on body weight or on reducing blood glucose levels.

Keywords: Cinnamon, weight, random blood glucose, fasting blood glucose, healthy mice.

INTRODUCTION

Cinnamon, a popular spice derived from the bark of trees belonging to the Cinnamomum genus, has been recognized for its potential health benefits, particularly concerning metabolic health. Research has suggested that cinnamon possesses bioactive compounds, such as cinnamaldehyde, which may play a vital role in glucose metabolism and weight management (Khan *et al*., 2003; Jarvill-Taylor *et al*., 2001). As the prevalence of metabolic disorders, including type 2 diabetes and obesity, continues to rise globally, exploring natural dietary interventions like cinnamon has become increasingly pertinent.

Several studies have established a link between cinnamon supplementation and improved glycemic control. For instance, a meta-analysis by Allen *et al*. (2013) demonstrated that cinnamon significantly reduced fasting blood glucose levels and improved insulin sensitivity in animal and human studies. In particular, the active components of cinnamon are believed to mimic insulin's activity and enhance glucose uptake by facilitating the translocation of glucose transporters to the cell membranes (Cao *et al*., 2007; Yoshikawa *et al*., 2005).

Studies conducted on mice in experimental settings have revealed that cinnamon can positively affect body weight and overall metabolic health (Kim *et al*.,2006). One of these studies suggested that administration of cinnamon extracts decreased body weight and fat mass in high-fat diet-induced obese mice, mainly attributed to improved insulin sensitivity and altered lipid metabolism (Sheng *et al*., 2008).

Heating cinnamon bark in water to create an aqueous solution is commonly used in such experiments (Khedkar & Ahmad Khan, 2023). This method allows for extracting beneficial phytochemicals while making the solution palatable for oral delivery.

Despite some promising findings, research evaluating the impact of heated cinnamon bark solutions on random and fasting blood glucose levels and body weight in healthy mice over a defined period remains limited. Through this investigation, we aim to establish further cinnamon's potential role as a natural therapeutic agent in managing blood glucose levels and body weight.

MATERIALS AND METHODS

Materials:

Cinnamon bark was procured from a local market, ensuring the selection of high-quality specimens. Three concentrations of cinnamon solutions were prepared: one from 5 grams and the other from 10 grams of cinnamon bark, each dissolved in 400 mL of distilled water. These solutions were subjected to heating to enhance the extraction of bioactive compounds. The final volume was adjusted to 400 mL to compensate for evaporation before administration to the mice. The prepared solutions were given to mice orally ad libitum instead of their water and in the same water bottles as their cages.

Preparation of Cinnamon Solutions:

The cinnamon bark was added to 400 mL of distilled water and heated until boiling for 15 minutes. After the initial boiling period, the solutions were allowed to cool and were reheated again after a 2-hour interval for an additional 15 minutes. This heating process aimed to maximize the extraction of the active components from the cinnamon bark into the solutions.

Animal Selection and Grouping:

Twenty-four healthy mice of the Swiss Albino type, aged 12-16 weeks, were selected for the study. The mice were acclimatized in a controlled environment with a 12-hour light/dark cycle and provided with rodent standard diet and water ad libitum. The number of mice is six for each group, with three males and three females for each group.

The mice were randomly divided into four groups:

1. Control group: This group received only water ad libitum and no cinnamon solution administration.
2. Cinnamon Solution Group (Group 1): This group was administered the cinnamon solution prepared from 5 grams of cinnamon bark for random blood glucose analysis.
3. Cinnamon Solution Group (Group 2): This group received the cinnamon solution prepared from 10 grams of cinnamon bark for random blood glucose analysis.
4. Cinnamon Solution Group (Group 3): This group received the cinnamon solution prepared from 10 grams of cinnamon bark for fasting blood glucose analysis.

Experimental Procedure:

At baseline, all groups underwent an initial assessment, during which random blood glucose levels were measured for the control group, group 1, and group 2, and fasting blood glucose levels were measured for group 3. The glucose analysis was done using a glucometer (Vivachek), and the blood samples were collected from the tail vein of the mice. The body weights of all mice were recorded using a digital weighing scale. Each group was monitored for any signs of distress or adverse reactions. Over ten days, body weight and random and fasting blood glucose levels were measured again following the same protocol as at baseline. Blood glucose was measured using the same glucometer (Vivachek) to ensure measurement consistency.

Statistical Analysis:

The data collected were subjected to statistical analysis, with statistical significance set at a p-value equal to or less than 0.05. The results were analyzed using an appropriate statistical test, paired student t-test to compare the effects of cinnamon on blood glucose levels and body weight in the same group before and after cinnamon administration, and unpaired t-test was used to compare the results between groups 1, 2, and the control.

Ethical Considerations:

The study was conducted under ethical guidelines established by the Institutional Animal Care and Use Committee (IACUC), and all efforts were made to minimize animal suffering. The university's ethical committee approved the research plan.

RESULTS AND DISCUSSION

Statistically, the changes were insignificant based on the results of the paired t-test performed on each group, which compared the analysis of glucose and weight measurements taken before and after administering the cinnamon solution. Groups 1 and 2 were tested without fasting, while group 3 underwent pre-test and post-test evaluations after fasting. The P-value for the change in random blood glucose between pre- and post-test for group 2, compared to the shift

between pre- and post-test of the control group, is significant (0.034). Nevertheless, the overall trend in group 2 does not indicate hypoglycemia, while the comparison between group 1 and the control shows insignificance (0.55). The effect of cinnamon extract on body weight, regardless of concentration, did not influence weight in healthy mice over the 10 days.

Table 1: The changes in the weights of mice over 10 days before and after cinnamon extract administration

	Control		**Group 1 (light concentration)**		**Group 2 (high concentration)**		**Group 3 (high concentration)**	
	Weight 1	**Weight 2**	**Weight 1**	**Weight 2**	**Weight 1**	**Weight 2**	**Weight 1**	**Weight 2**
1	27.8	27.7	29	28.8	27.5	27	34.7	34.4
2	30	31.1	36	38	34.5	36.2	32	29.75
3	24.8	23.5	29	30.3	20	21	22.6	21.4
4	28.5	31.2	26.2	31.1	25.3	25.6	28	29.35
5	28.5	28.3	29.8	30.8	31	32.8	24.8	23.45
6	29	30	27.5	28.8	24.8	25.3	25	24.5
Sum	168.6	171.8	177.5	187.8	163.1	167.9	167.1	162.85
Mean±SD	28.1±1.77	28.63±2.9	29.58±3.39	31.3±3.43	27.18±5.08	27.98±5.53	27.85±4.67	27.14±4.85
P-Value 1	0.38		0.057		0.076		0.23	
P-Value 2			Group 1 Versus Control 0.22		Group 2 Versus Control 0.7		Group 3 Versus Control 0.135	

Table 2: The changes in blood glucose levels of mice over 10 days before and after cinnamon extract administration

	Control		**Group 1 (light concentration)**		**Group 2 (high concentration)**		**Group 3 (high concentration)**	
	RBG 1	**RBG 2**	**RBG 1**	**RBG2**	**RBG1**	**RBG2**	**FBG1**	**FBG2**
1	129	130	193	157	160	134	135	110
2	155	129	198	160	153	154	149	97
3	212	167	164	158	129	144	75	77
4	143	138	160	136	108	113	143	117
5	156	131	83	117	152	165	107	99
6	142	119	163	158	132	134	100	95
Sum	937	814	961	886	834	844	709	595
Mean±SD	156.17±29.11	135.67±16.53	160.17±41.21	147.67±17.49	139±19.58	140.67±18.08	118.17±28.85	99.17±13.79
P-Value 1	0.028*		0.30		0.79		0.064	
P-Value 2			Group 1 Versus Control 0.55		Group 2 Versus Control 0.034*			

Key Findings (Weight):

- No significant weight changes within or between groups (all P-values>0.05).
- No significant differences were observed in body weight changes between any treatment group and the Control.

Key Findings (Blood Glucose):

- **Control Group**: Significant reduction in RBG (P=0.028) within the group.
- **Group 2 (RBG)**: Significant compared to Control (P=0.034) with no hypoglycemic trend.
- **Group 3 (FBG)**: Marginal reduction (P=0.064) but insignificant within the group.

Group Descriptions:

- **Group 1:** Mice before and after receiving a light cinnamon concentration (5g in 400 ml).
- **Group 2:** Mice before and after receiving a concentrated cinnamon solution (10g in 400 ml).
- **Group 3**: Mice before and after receiving a concentrated cinnamon solution (10g in 400 ml).
- **Weight 1:** Weight of mice before receiving cinnamon solution.
- **Weight 2:** Weight of mice after receiving cinnamon solution.
- **RBG1:** Random Blood Glucose before receiving the cinnamon solution.
- **RBG2:** Random Blood Glucose after receiving the cinnamon solution.
- **FBG1:** Fasting Blood Glucose before receiving the cinnamon solution.
- **FBG2:** Fasting Blood Glucose after receiving the cinnamon solution.
- **P Value 1:** For pre- and post-test change of the same group (paired t-test).
- **P Value 2:** For the change between pre- and post-test of groups 1,2, or 3 with the change of pre- and post-test of control (unpaired t-test).

The present study investigated the effects of cinnamon extract on body weight and blood glucose levels in healthy mice. Contrary to prior studies demonstrating cinnamon's metabolic benefits in disease models, our findings revealed no statistically significant changes in weight or blood glucose levels following 10 days of intervention in healthy mice. This

discrepancy may be attributed to several factors, including differences in experimental models, intervention duration, and extraction methods.

The absence of significant effects across groups aligns with the hypothesis that cinnamon's therapeutic potential may be more pronounced in metabolically compromised subjects. Regarding glycemic control, although the results of group 2 versus the control yielded a statistically significant P-value of 0.034 regarding change in random blood glucose, the overall trend across group 2 did not demonstrate a hypoglycemic effect. This finding is somewhat inconsistent with previous studies that have shown cinnamon's potential to significantly lower blood glucose levels in both human and animal models with hyperglycemia or insulin resistance (Khan *et al*., 2003; Mang *et al*., 2006).

Previous studies reporting improved glycemic control often utilized diabetic or obese animal models (Khan *et al*., 2003). In healthy mice, glucose homeostasis and weight regulation already function optimally, leaving little opportunity for further improvement. As a result, no significant changes in these mechanisms are expected. This is consistent with findings by Solomon and Blannin (2009), who observed minimal glucose-lowering effects of cinnamon in healthy humans.

The extraction methodology employed here, which is aqueous heating, may have influenced the bioavailability of bioactive compounds. Cinnamon's hypoglycemic properties are primarily attributed to cinnamaldehyde and polyphenols, which are more efficiently extracted using organic solvents (e.g., ethanol) rather than water (Lu *et al*., 2010). For instance, Qin *et al*. (2010) demonstrated that ethanol-extracted cinnamon exhibited more vigorous insulin-mimetic activity than aqueous extracts. Thus, the preparation method in this study might have limited the release or stability of key phytochemicals. However, we selected an aqueous extract because water is frequently used in tea preparation, and cinnamon is traditionally combined with tea extract as a flavor, reflecting the need for the investigation of the effect of aqueous solution of cinnamon on blood glucose levels for healthy subjects.

The short intervention period (10 days) may have been insufficient to elicit measurable metabolic changes. Long-term studies, such as a 12-week trial by Mang *et al*. (2006) in diabetic humans, reported gradual improvements in glycemic markers, suggesting that prolonged exposure is critical for observable effects. Similarly, prolonged administration may be required to observe minor metabolic changes in healthy mice.

The small sample size may further limit the reliability of the findings. A larger cohort could help reduce variability and enhance statistical power. Additionally, dosage calculations based on body weight, rather than fixed solution concentrations, might better align with pharmacological standards and improve clinical applicability (Subash Babu *et al*., 2007).

Despite these limitations, the study provides valuable insights into cinnamon's effects in healthy models, highlighting the importance of research designed for specific conditions. Future investigations should prioritize disease models (e.g., diabetic/high-fat diet-induced obesity), longer durations, and standardized extraction protocols to elucidate cinnamon's therapeutic mechanisms. Furthermore, exploring synergistic effects with other dietary compounds or medications could broaden its applicability in metabolic disorder management (Ranasinghe *et al*., 2013).

CONCLUSIONS

Cinnamon effects on healthy mice show no significant decrease in body weight or blood glucose levels, whether fasting or randomly. This negligible effect of cinnamon on healthy mice may be due to a healthy research model and short-term interval interventions, which recommends considering them in future studies.

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