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Full Length Research Paper

Effect of chronic intake of *Zingiber officinale* (ginger) enriched diet on the gastrointestinal sections of albino rats

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The effect of chronic intake of *Zingiber officinale* (ginger) on the small and large intestines of albino rats was studied. The ginger sample was mixed with the normal rat ration in three different proportions to represent low, medium, and high concentrations, respectively. The fourth group representing the control received no ginger. All the rats were fed twice daily *ad libitum* for two months. Analysis was done every two weeks throughout the period of the study. The following indices were determined, glucose, cholesterol, and triglycerol. Also acid lipase, acid phosphatase and amylase activities were determined. The result showed that the level of glucose increased within the first one month in the small intestine, but decreased in subsequent weeks as compared to the control. In the large intestine there was a general decrease except for the first two weeks. Cholesterol and triglycerol levels generally decreased as compared to the control throughout the period of the study. The variance was not significant ($P < 0.05$). The activities of acid lipase and acid phosphatase generally decreased as compared to the control throughout the period of the study and within the small, and large intestines. Amylase activities on the other hand increased in the small intestine, but decreased in the large intestine over the control. The sample studied may have stimulated increased absorption of glucose, cholesterol and triglycerol, while the activities of acid phosphatase and acid lipase were inhibited.

Key words: Spice, gastrointestinal tract, digestive enzymes, glucose, lipids.

INTRODUCTION

Zingiber officinale (Ginger) of the family zingiberceae is a perennial herb with thick tuberous rhizomes producing an erect annual stem up to 1.5 m. Younger ginger roots are juicy and fleshy with a mild taste, while the older ones are fibrous and nearly dry (Chen and Hashimoto, 2002). Phytochemical analysis shows that ginger contains volatile oils (1 to 3%), pungent compounds; (gingerols and shogaols) among others (Alyahya et al., 1989). The oils contain zingerberine and bisoroline as major constituents with other terpenes. Shogaols have been found to be twice as pungent as gingerols (Huang and Yamhara, 1990).

Apart from its use as spicing agent, ginger has been found useful medicinally in the treatment of certain diseases like nausea caused by motion sickness, atherosclerosis, rheumatoid arthritis, and digestive disorders (Huang and Yamhara, 1990). This has been attributed to the antioxidant and anti-inflammatory properties of the active agents in the ginger. It is also used in the industries to improve taste of some products like beer, beverages, cakes, biscuits, breads etc. Spices particularly those ones with pungent compounds have long been recognized for their digestive stimulant action. Animal studies have shown that many spices induce greater secretion of bile acid which plays a vital role in the digestion and absorption of fat (Ptatel and Srinivasan, 2004). Spices also produce significant stimulation of the activities of digestive enzymes like pancreatic lipase, amylase, and protease (Platel and Srinivasan, 2004). In this study, the effect of prolonged intake of ginger on the

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Table 1. Ginger roots were bought from Eke Okigwe Central Market, Imo State.

Groups	Normal rat feed (g)	Concentration of ginger (g)	Total compositions (g)
A = Control.	100.00	-	100.00
B = low conc.	97.50	2.50	100.00
C = Med. Conc.	95.00	5.00	100.00
D = High conc.	92.50	7.50	100.00

gastrointestinal tracts (small and large intestines) using rats as models was determined.

MATERIALS AND METHODS

Ginger roots were bought from Eke Okigwe Central Market, Imo State, and sun dried before grinding into powdered form using electronic milling machine. This was sieved with 1mm sieve and used to formulate the animal ration as shown in Table 1.

Animals and treatment

A total of thirty-two rats mean body weight. 183.32 ± 16.01 g were bought from the Faculty of Veterinary Medicine, University of Nigeria Nsukka. They were separated into four groups of eight rats each to represents control, low, medium, and high concentrations of the ginger extracts respectively as shown in Table 1. The control group received normal rat feed and water *ad libitum*, without any ginger spice throughout the experiment. Analysis was done every two weeks for a period of two months.

Extraction of git sections (small and large intestines)

At the end of every two weeks, 8 h after the last feeding, a total of eight rats were sacrificed under light chloroform anaesthesia in a dissector. The rats were dissected using sterilized surgical blade and the intestines carefully removed. A portion of each small and large intestine (l.Og) was crushed in a mortar with antibumping granules in 15.0 ml distilled water for 5 min. The resulting paste was centrifuged at 4000 x g for 30 min, and the supernatant used for all the analysis.

Determination of glucose, cholesterol and triglycerol

Glucose was determined using the Trinder and Ann method, (1969). Cholesterol was determined by the method of Allain and Roeschlau (1974) and triglycerol by the method of Fossati and Prencipe (1982).

Enzyme assay

Acid phosphatase, alkaline and acid lipases activities were determined by the method of Francis (1996), and according to the method of Tietz et al. (1995), respectively, while amylase activity was determined by the method of Smith and Roe (1949).

Statistical analysis

Data were expressed as a mean ± SD 3 determinations. Analysis of variance (ANOVA) was used to compare values with control and $P \leq 0.05$ was regarded as significant (Woodson, 1987).

RESULTS AND DISCUSSION

In Table 2, the result of glucose level determined from both the small and large intestines was presented. It showed that in the small intestine, the glucose levels increased within the first month of the experiment, whereas it decreased within the last one month. However in the large intestine, the hyperglycemic effect occurred only within the first two weeks, while throughout the rest of the period of the experiment (next 6 weeks), there was hypoglycemic effect. A number of spices have been shown to stimulate bile secretion or activity of digestive enzymes leading to an accelerated digestion and hence a reduction in the food transit time in the gastrointestinal tract (Kalpana and Srinivasan 2004). This probably accounts for the hypoglycemic effect observed in this study. *Z. officinale* active ingredient could have stimulated effective transport of glucose to the blood stream. The desired hypoglycemic effect can only be achieved by prolonged intake of the spice as suggested by the study.

The result of cholesterol level as determined from the small and large intestines (Table 3) shows that *Z. officinale* has strong hypocholesterolemic effect. However within the first two weeks, there was an increase in the level of cholesterol over the control as determined from the small intestine. Similarly, the result showed decreased levels of triglycerol in the small intestine as compared to the control throughout the period of the experiment (Table 4). However, in the large intestine, the levels of triglycerol rather showed an increase over the control with the low concentration throughout the period of the experiment. The other concentrations rather showed a decrease over the control throughout the experiment (Table 4) due to their amphipathic nature, the bile acids are the most important factor affecting micelle formation and therefore cholesterol absorption (Murray et al., 1990). The ability of the sample studied to stimulate secretion of bile will invariably lead to increased absorption of cholesterol and hence the hypocholesterolemic effect observed. The lowering effect on cholesterol and triglycerol is best achieved by using higher concentrations and for a prolonged period as indicated by this study.

In Tables 5 and 6, the activities of acid lipase and acid

Table 2. Small and large intestines glucose content (mg/ml).

Small intestine	2nd	4th	6th	8th
Control	97.60 ±16.11	111.40 ± 22.60	113.60 ± 15.16	165.00 ± 21.12
Low Conc.	354.50 ±18.12	172.00 ± 28.15	95.30 ± 25.12	82.10 ± 23.15
Medium Conc.	363.60 ± 51.05	121.40 ± 31.12	99.50 ± 37.81	84.30 ± 31.16
High Conc.	334.80 ± 42.11	164.30 ± 34.12	88.60 ± 42.11	73.80 ± 34.32
Large intestine				
Control	110.50 ± 3.72	167.70 ±15.34	120.00 ± 0.56	88.48 ± 11.06
Low Conc.	339.60 ± 57.03	156.50 ± 4.00	96.75 ± 27.88	81.28 ± 29.07
Medium Conc.	380.40 ± 72.17	145.20 ± 8.23	86.25 ± 27.88	67.90 ± 34.00
High Conc.	332.60 ± 59.76	140.30 ± 4.31	76.25 ± 25.66	63.97 ± 29.82

Doses time (weeks).

Table 3. Small and large intestines cholesterol levels (mg/ml).

Small intestine	2nd	4th	6th	8th
Control	16.36 ± 0.35	24.30 ± 4.13	27.10 ± 3.12	28.50 ± 2.06
Low Conc.	38.32 ± 5.14	30.37 ± 3.12	20.10 ± 3.12	9.81 ± 0.03
Medium Conc.	29.33 ±1.92	26.64 ± 1.13	18.22 ± 1.12	9.35 ± 0.15
High Conc.	28.03 ± 1.61	24.30 ± 1.08	16.82 ± 0.18	8.41 ± 0.05
Large intestine				
Control	86.89 ± 16.50	41.19 ± 1.27	12.75 ± 8.21	8.73 ± 9.55
Low Conc.	43.72 ± 8.94	11.22 ± 1.82	7.03 ± 3.29	5.41 ± 3.83
Medium Conc.	33.88 ± 4.99	15.22 ± 1.23	14.95 ± 1.32	11.6 ± 42.43
High Conc.	28.96 ± 5.45	5.95 ± 2.22	9.23 ± 1.22	6.24 ± 2.12

Doses time (weeks).

Table 4. Small and large intestines tryglycerol levels (mg/ml).

Small intestine	2nd	4th	6th	8th
Control	210.40 ± 37.81	226.90 ± 41.25	269.40 ± 31.32	283.60 ± 26.05
Low Conc.	156.70 ± 36.12	83.60 ± 0.38	60.40 ± 0.58	39.60 ± 3.32
Medium Conc.	165.70 ± 41.32	136.6 ± 21.86	68.70 ± 3.21	30.60 ± 0.35
High Conc.	61.20 ± 0.58	50.00 ± 0.42	35.00 ± 0.31	26.90 ± 0.41
Large intestine				
Control	76.94 ± 3.18	71.27 ± 4.92	113.90 ± 9.29	82.51 ± 1.18
Low Conc.	133.86 ± 7.08	119.27 ± 2.21	101.02 ± 3.87	96.37 ± 5.40
Medium Conc.	49.40 ± 60.77	101.80 ± 73.84	71.86 ± 8.05	95.38 ± 54.56
High Conc.	54.98 ± 4.15	45.09 ± 7.45	100.34 ± 10.97	69.31 ± 0.63

Doses time (weeks). All values are mean **±**SEM of three determinations.

phosphatase from the small and large intestines generally decreased as compared to the control throughout the period of the study. Ginger and other spice principles (curcumin, capsaicin, and piperine) are known to enhance the activity of intestinal lipase, sucrase, and maltase (Platel and Srinivasan, 2004). It was also shown that while dietary ginger has a positive influence on this enzyme (lipase), other spices or spice mixes showed no such beneficial influence (Pathak and Pai, 1991). However in this study, there was no positive stimulation

Table 5. Small and large intestines activities of acid lipase (I.U/L).

Small intestine	2nd	4th	6th	8th
Control	6.30 ± 0.29	6.60 ± 0.12	7.00 ± 0.12	7.30 ± 0.29
Low Conc.	5.60 ± 0.25	5.80 ± 0.13	6.20 ± 0.10	6.50 ± 0.27
Medium Conc.	6.00 ± 0.30	6.30 ± 0.13	6.80 ± 0.16	7.00 ± 0.27
High Conc.	5.10 ± 0.13	5.30 ± 0.01	5.40 ± 0.04	5.50 ± 0.10
Large intestine				
Control	6.00 ± 0.20	6.20 ± 0.09	6.40 ± 0.03	6.80 ± 0.26
Low Conc.	5.40 ± 0.20	5.60 ± 0.09	5.80 ± 0.03	6.20 ± 0.26
Medium Conc.	5.90 ± 0.29	6.20 ± 0.12	6.60 ± 0.12	6.90 ± 0.29
High Conc.	4.40 ± 0.31	4.90 ± 0.02	5.10 ± 0.10	5.30 ± 0.21

Doses time (weeks).

Table 6. Small and large intestines activities of acid phosphatases (I.U/L).

Small intestine	2nd	4th	6th	8th
Control	33.43 ± 10.22	44.64 ± 4.25	57.37 ± 3.10	72.72 ± 11.96
Low Conc.	41.41 ± 9.62	48.68 ± 5.42	65.04 ± 4.02	77.16 ± 11.02
Medium Conc.	43.23 ± 13.08	53.33 ± 7.53	78.98 ± 7.17	89.49 ± 13.34
High Conc.	46.26 ± 13.03	54.74 ± 8.13	83.02 ± 8.19	91.30 ± 12.97
Large intestine				
Control	51.51 ± 8.96	82.21 ± 8.77	47.67 ± 11.17	94.94 ± 16.12
Low Conc.	76.15 ± 1.38	77.77 ± 2.32	52.22 ± 12.44	88.88 ± 8.73
Medium Conc.	47.17 ± 5.84	45.25 ± 6.95	87.16 ± 17.25	52.52 ± 2.75
High Conc.	36.06 ± 2.49	45.65 ± 3.05	29.49 ± 6.28	50.36 ± 5.73

Doses time (weeks).

Table 7. Small and large intestines activities of amylase (I.U/L).

Small intestine	2nd	4th	6th	8th
Control	52.70 ± 18.12	101.20 ± 15.14	188.10 ± 26.13	238.00 ± 23.78
Low Conc.	105.90 ± 5.01	155.30 ± 19.11	209.40 ± 19.12	263.50 ± 21.12
Medium Conc.	129.40 ± 8.32	148.20 ± 23.15	175.30 ± 8.35	247.10 ± 24.05
High Conc.	78.80 ± 21.03	117.6 ± 6.04	149.40 ± 9.41	222.30 ± 24.11
Large intestine				
Control	219.05 ± 17.62	234.29 ± 12.45	309.52 ± 12.54	324.76 ± 17.62
Low Conc.	133.33 ± 35.08	231.43 ± 2.38	268.57 ± 10.00	330.95 ± 27.46
Medium Conc.	120.00 ± 33.41	220.95 ± 0.24	243.81 ± 7.86	296.19 ± 25.32
High Conc.	156.19 ± 19.69	192.38 ± 7.62	227.60 ± 4.12	284.76 ± 23.17

Doses time (weeks**).** All values are mean ±SEM of three determinations.

of either lipase or acid phosphatase enzymes probably due to the slight alkaline nature of the intestine which may not favour the activities of the enzymes. Alkaline lipase activity is enhanced by bile salts under alkaline conditions by and calcium ions (Brokerhoff and Jensen, 1974). Intestinal lipase which is distinct from pancreatic lipase probably assumes a greater role in digestion of fat only when pancreatic lipases are limited.

The activities of amylase determined from the small intestine (Table 7) showed that there was a general

increase as compared with the control throughout the period of the experiment, while the activities generally decreased in the large intestine (Table 7). Pancreatic amylase activity was elevated by dietary ginger which has the maximum affect (184%), followed by the spice principles curmin (96%) piperine, (87%) and capsaicin (72%) (Kalpana and Srinivasan, 2004). The enzyme activity was however, decreased by dietary fenugreek, and while mustard has no influence (Kalpana and Srinivasan, 2004). Single dose administration of capsaicin, peperine, and fennel enhanced the activity of pancreatic amylase, while whole spice ginger amin, coriander and ajowan inhibited the activity (Huang and Yamahara, 1990). It is possible that within the large intestine *Z. Officinale* exhibited inhibitory effect on the enzyme.

Conclusion

The digestive stimulatory effect of *Z. Officinale* has been demonstrated in this study. This is believed to occur through stimulating the liver to secrete bile juice rich in bile acid components vital to fat digestion and absorption hence, reduction in cholesterol, glucose and triglycerol levels. Stimulation of enzyme activities that is responsible for digestion. In this study only amylase activity from the small intestine was stimulated.

REFERENCES

Allain P, Roeschlau A (1974). Cholesterol Determination, J. Clin. Chem., pp. 195-207.
Alyahya OP, Wu P, Glatzel P (1989). Traditional Chinese Herbal Medicine, J. Med., 289: 817-824.
Brokerhoff H, Jensen R (1974). Lipolytic Enzymes. Acad. Press. New York.
Chen AC, Hashimoto AM (2002). Antiemetic effect of Herbs, J. Clin. Pathol., 35: 771-779.
Francis F (1996). A Mannal of Laboratory and Diagnostic Tests. (5th Ed). Lippincolt. U.S.A.
Fossati P, Prencipe I (1982). Triglyceride Determination, J. Clin. Chem., 28: 2077-2080.
Huang A, Yamahara P (1990). Constituents of Ginger In: Traditional Chinese Herbs (Alyahya P. Ed), Suekwa press. China.
Kalpana P. Srinivasan K. (2004). Digestive Stimulant Action of Spices. India J. Med. Res. 119: 121-132
Pathak K, Pai C (1991). Influence of Spices on Salivary and Gastric Secretion, Indian J. Med. Res., 110: 167-189.
Ptatel K, Srinivasan K (2004). Effect of Spices on Pancreatic Lipase Activity Indian J. Med. Res., 119: 167-172.
Smith BW, Roe JH (1949). Amylase Determination, J. Biol. Chem., 179: 53.
Tietz NW, Burtis ER, Silverman LM, Christen RH (1995). Textbook of Clinical Chemistry. (3rd Ed), W.B. Saunders. U.S.A.
Trinder P, Ann A (1969). Glucose Determination, Clin. Biochem., 6: 24.
Woodson RF (1987). Statistical methods for analysis of biomedical data, probability, and mathematical statistics. Wiley Chichester, London.