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Effect of Fasting on Intestinal Motility and Transit in Albino Wistar Rats

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ABSTRACT

Fasting is the act of willingly abstaining from some or all probable kinds of food, drinks or both for a period of time. Knowledge of the effect of fasting on intestinal motility and transit is incomprehensible, this study, therefore, seeks to ascertain the effect of fasting on intestinal motility and intestinal transit. Twelve albino wistar rats of body weight ranging between 160-200 g were used. These rats were randomly assigned into 2 groups, control and test (fasted) with six rats each. Both groups were fed with normal rodent chow and water for 30 days but the test groups were deprived of food for 12 h during the time frame (6 am-6 pm) of the experiment. The results obtained showed that fasting caused a significant decrease in intestinal motility compared to the control group on administration of atropine, a significant decrease in motility on administration of acetylcholine at the range of 9.56±0.74 and 32.03±0.78 μg mL^{-1}, respectively for both control and the test groups. It was also determined that fasting did not cause any significant change in intestinal motility on administration of propranolol 387.50±24 and 387.50±141.97 μg mL^{-1}, respectively and -737.50±87.50 and -420.83±24.88 μg mL^{-1}, respectively, on administration of adrenaline. It was determined that fasting did not cause any significant change in intestinal transit (51.70±7.65 cm) and (40.74±7.14 cm), respectively in both groups. Conclusively, fasting reduces intestinal motility but has no significant effect on intestinal transit. Therefore, its use to enhance better well being and increased life's expectancy is encouraged as may be beneficial to patients with spastic colitis and some other intestinal motility disorders. However, it must be done under proper supervision to avoid other gastrointestinal complications such as ulcers.

Key words: Fasting, intestinal motility, intestinal transit, atropine, acetylcholine, propranolol, adrenaline

INTRODUCTION

Fasting generally means eating no food and drinking water for a period of time. It might also involve drinking adequate water but avoiding foods and caloric fluids for the duration of the fast (Mattson and Wan, 2005). Fasting is done for spiritual and religious purposes. Various research works have shown that fasting is beneficial to the well being of an individual. Other benefits of fasting include; reduce risks of cancer, cardiovascular diseases, diabetes, insulin resistance, immune disorders and more generally, slowing the aging process and potentially increasing maximum life span (Woods, 2003).

Although, some fasting methods require the use of juice or various amounts of food, the health effects of such methods is seriously questionable. According to Dr. Joel Fuhrman, a true fast consists of an intake solely of water and can last for extended periods of time. He further suggests that a fast should be preceded by healthy diet and should also be supervised by a knowledgeable physician to make sure that deficiencies of any nutrients do not occur (Fuhrman, 1995).

Fasting is also necessary for purification, rejuvenation, revitalization, clearer skin, weight loss, spiritual awareness and better resistance to disease. But bradycardia and hypotension may occur during prolonged fasting.

Fasting tends to have a lot of health benefits but many doubt its effect on the gastrointestinal system. Against this backdrop, it was therefore important to investigate keenly the effect of fasting on intestinal motility and transit.

MATERIALS AND METHODS

Experimental animals: This study was performed in the animal house in the department of physiology, college of medical sciences, University of Calabar. A total of twelve healthy albino wistar rats weighing between 160 and 220 g and of the same gender were used. The animals were divided into two groups of six rats each. The first group represented the control group, while the second group represented the test (fasted) group.

These animals were housed in metallic cages with netting root under optimal hygienic conditions and at standard temperature, with adequate natural lighting condition of 12 h light and dark cycle, respectively. Adequate bedding was provided to give warmth and comfort using saw dust. This also served as a medium of urine absorption, water and fecal matter. The animals were freely fed with growers starting mixture (vital feed) for a period of one week to enable them acclimatize after which the rats in the second group were deprived of food for 12 h (6 am-6 pm) daily for thirty days while being allowed access to drinking water. The control group had full access to food and water for 24 h daily throughout the duration of the experiment. All the animals were well taken care of under the international, national and institutional guidelines for care of laboratory animals as promulgated by the Fenwick *et al*. (2009).

Determination small intestinal motility: The determination of intestinal motility and transit was done using the method described by Obembe *et al*. (2008). Animals were deprived of food 18 h prior to the experiment. The animals were stunned and there after sacrificed. A cut was hurriedly made through the linea alba to expose the intestine. The proximal ileum was recognized and cut off, then placed in a container of tyrode solution and aerated. The ileum was then cut into small segments of 3 cm in length and mounted at one end to a fixed support in an organ bath. The other end of the ileum was fixed to a horizontal balance writing lever at a tangent to a kymograph drum. The tissue was allowed to equilibrate for 60 min. Within the 60 min, the bathing solution was replaced with tyrode solution at 15 min interval to avoid accumulation of metabolites. The tissue was then challenged with graded doses of acetylcholine (10^{-3}-10^{-9} mg) and later with atropine (0.1 mg), at an interval of 1 min/administration, adrenaline was then introduced into the organ bath and its effect was noted. Finally, propranolol was introduced into the organ bath and its corresponding effects on the tissue was noted and recorded accordingly.

Determination of small intestinal transit: Small intestinal transit was determined using the method of Uwagboe and Orimilique (1995), as used by Udo *et al. (*2013) and Obembe *et al.* (2008). The rats in the various experimental groups were starved for 24 h prior to the experiment but had

unhindered access to drinking water. Ten gram of activated charcoal was thoroughly mixed with 1 g gum Arabic in 100 mL of distilled water to serve as the indicator substance. Each animal was gavaged with 2 mL of the indicator substance, orally using a metallic (8 cm long) incubating syringe. The animals were timed for 60 min each, after which, they were sacrificed by cervical decapitation. The abdomen was instantly cut open through the linea alba to curtail bleeding. The duodenum was then identified, as the extension of the pyloric sphincter, while the ileocecal sphincter was also prominent at the cecal end. The duodenum was cut away from the pyloric sphincter and the ileum was also cut at the ileocecal sphincter. The small intestine was immediately straightened and the location of the indicator was identified along the small intestine. A thread was used to tie the intestine at the point where the indicator stopped. Using a measuring tape, the total length of the small intestine was measured and recorded. The length travelled by the indicator was also measured and recorded. The small intestinal transit was calculated as:

- Length travelled by marker substance×100%
- Total length of small intestine
- Values were recorded and statistically analyzed

Statistical analysis: The result obtained from the study were analyzed using the student t-test while data was presented as Mean±SEM and the result was regarded as significant at probability level, $p>0.05$.

RESULTS

Comparison of effect of graded concentrations of ACh on the Mobility of rat ileum in the control and test groups: The mean values between the control and test groups at ACh concentration (-9M) was (32.03±0.78) and (9.56±0.74), respectively. At (-5M), the mean values for the control and test groups were (96.09±0.78) and (91.91±0.74), respectively. The concentration level of Ach as shown in Fig. 1 showed a significant decrease ($p<0.001$) and ($p<0.01$) in the motility of the rat ileum in the test group compared with control.

Comparison of basal height of contraction of the rat ileum: The mean values of the basal height of the rats ileum for the control and test groups were (1.75±0.25) and (3.25±0.25) respectively. As shown in Fig. 2, the test group decreased significantly ($p<0.01$) when compared to control.

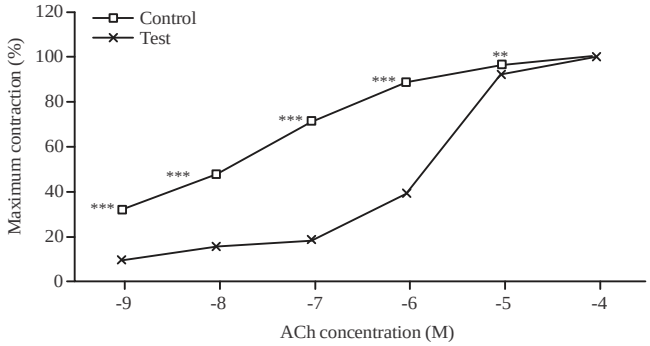

Fig. 1: Comparison of effect of graded concentration of ACh on the motility of rats ileum in control and test groups, values are Mean±SEM, n = 6

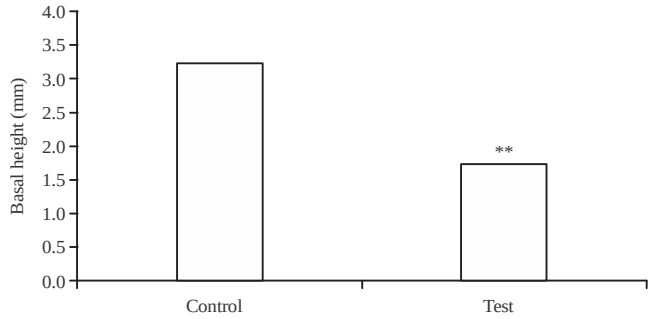

Fig. 2: Comparison basal height of contraction of the rats ileum, values are Mean±SEM, n = 6

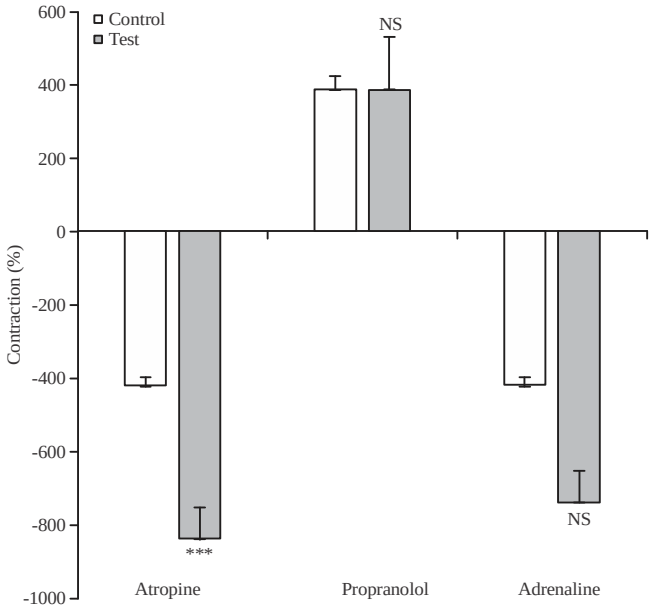

Fig. 3: Comparison of effect of atropine, propranolol and adrenaline and adrenaline on intestinal motility in rats ileum, values are Mean±SEM, n = 6

Comparison of effect of atropine on intestinal motility in the rat ileum: In Fig. 3, the percentage change in ileum contraction in the control and test groups were (-420.83±24.88) and (-837.50±87.50), respectively. The fasted group thus showed a significant decrease ($p<0.001$) compared to the control group.

Comparison of the effect of propranolol on the intestinal motility in rats ileum: The mean values of the percentage increase between the control and test groups were (387.50±141.97) and (387.50±37.50), respectively. The result showed that there was no significant difference between the two groups, as shown in Fig. 3.

Comparison of the effect of adrenaline on intestinal motility in rats ileum: As illustrated in Fig. 3, the mean values for both control and test groups were (-737.50±87.50) and (-420.83±24.88), respectively. There was no significant difference between the two groups.

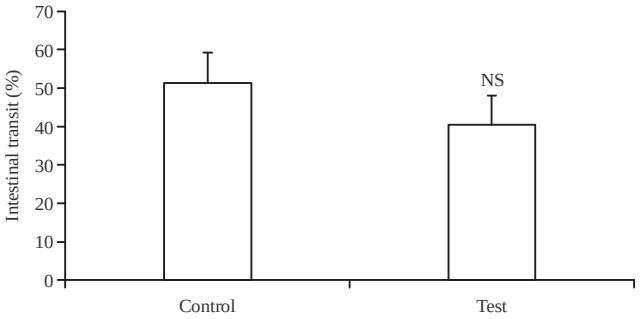

Fig. 4: Comparison of percentage intestinal transit between control and test groups, values are Mean±SEM, n = 6

Comparison of intestinal transit percent between the experimental groups: As shown in Fig. 4, the mean values of the percentage intestinal transit for both the control and test groups were 51.70±7.65 and 40.74±0.14 cm, respectively. No significant change in intestinal transit was observed among the groups.

DISCUSSION

Fasting is primarily an act of keen abstinence or cutback from certain or all food, drink, or both, for a period of time. Although it has been implicated with a lot of health benefit, there is paucity of information concerning its effect on intestinal motility and transit.

In this study, the result showed that the fasted group of rats showed a considerable decrease in basal height of contraction compared to control. This is in line with previous study by Kotal *et al*. (1996) where the authors reported that fasting decreased intestinal motility in rats, Chung and Diaman (1987) reported abolished gastric contractions and spiking activity, suggesting that the absence of food inhibited vagal stimulation and therefore reduced motility. This was supported by the result, where graded doses of acetylcholine were introduced. The fasted group, showed a significant decrease in intestinal motility with increased graded doses of acetylcholine which was further attenuated with the introduction of atropine to the intestinal ileum, this is also in line with reports by Chediack *et al*. (2012), where a decrease in small intestine motility was linked with reduction in small intestinal histology: perimeter, mucosal thickness, villus height and width and Funes *et al*. (2014), where authors suggested that fasting induces atrophy of the small intestine, which may likely lead to a decrease in intestinal motility.

These results suggest that in the treatment of disease conditions like peptic ulcer and diarrhea fasting maybe recommended since it decreases the rate of intestinal motility. For the effect of fasting on intestinal transit, the results showed no significant difference between the two groups. Though, Mittelstadt *et al*. (2005) has earlier reported a significant increase in gastrointestinal transit greater in fasted rats compared with fed rats.

CONCLUSION

In conclusion, fasting reduces intestinal motility but has no significant effect on intestinal transit. Therefore, its use to enhance better well being and increased life's expectancy is encouraged as may be beneficial to patients with spastic colitis and some other intestinal motility disorders; however, it must be done under proper supervision to avoid other gastrointestinal complications, such as, ulcers.

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