Effect of Natural Honey on Intestinal Transit in Rats

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Article Information
Received 03 Dec 2016
Received in revised form 20 Dec 2016
Accepted 21 Dec 2016

Abstract
Honey is a natural sweet substance produced by honey bees. Honey has a very complex chemical composition that varies depending on the botanical source. It has been used both as food and medicine since ancient times. Honey has long been used for treatment of various diseases in folk medicine around the world. The present study was planned to explore the effect of Natural Honey (NH) on the intestinal transit of rats. The rats were fed chow, fresh palm oil diet (FPOD), Thermoxidized Palm Oil Diet (TPOD) and NH; and further the transit point was calculated as a percentage of the total length of the intestine. The NH treated rats significantly decreased the intestinal transit of rats compared to other groups. The findings exhibited that natural honey used for the treatment of diarrhoea.

1 Introduction
Diarrhoea is one of the main causes of high mortality rate in developing countries where over five million children under the age of five die annually from severe diarrhoeal diseases. According to the World Health Organization (WHO), 3-5 billion cases occur annually, and approximately 5 million deaths are attributable to diarrhoea. Diarrhoea is characterized by increased frequency of bowel movement, wet stool and abdominal pain. Diarrhoea is mostly common in crowd living conditions coupled with poor hygiene. It is a major contributor to malnutrition, and also causes rapid dehydration in infant and elderly people, which could lead to death if treatment is not given. To combat this problem, the World Health Organization (WHO) has initiated a diarrhea disease control program to study traditional medicine practices and prevention approaches.1-3

Honey is the natural sweet substance obtained from the secretions of the living parts or excretions of plants which the honey bees (Apis mellifera) collect and store. Though honey is used widely in traditional medicine, its use in modern medicine is limited. Honey is used for the treatment of many infections, and also used effectively as wound dressing including surgical wounds, burns and skin ulcers. Mainly because it speeds up the growth of new tissues and help to heal the wound, reduces pain and odor quickly.4-6

Intestinal transit is the time required for food to traverse a portion of the entire small intestine. In both the ancient and modern time, honey is accepted as food and medicine by all without exception. It is also used in apicultural practices and its economic importance is overwhelming. Fresh palm oil is natural food, shown to have nutritional values, usually consumed by man and animals with no noticeable adverse effect in the body, Manorama and Rukmini (1991).7 Thermoxidized food intake is also practiced worldwide. It has nutritional compositions and values except that some of its constituents may have been denatured during the process of thermoxidation. Its consumption may affect the body including gastrointestinal tract positively or negatively.

Barreino, et al (1968)8 reported that during quiescence in a fasted man, transit time through the jejunum was slow and absorption of xylose sugar was great and contractile events occurring within the intestine was unique with propulsive movement of the small intestine. Burnstock (1975)9 observed that some transmitters like adenosine triphosphate (ATP), 5hydroxytryptophane (5HT) and other peptides were involved in this movement. Reports on nutrients transport of substances along the small intestine are sketchy but there are indications that fresh palm oil diet, thermoxidized palm oil diet (TPOD) and natural honey (NH) intake may influence intestinal transit of food along the small intestine. Abaelu, et al (1991)10 observed that
diet rich in fresh palm oil does not adversely affect the transport of protein foods in the small intestine. Barreino, et al (1968) also reported that some food substances move faster while others move slowly along the gastrointestinal tract and absorption was better when food moved slowly. One of the functions of small intestine, apart from digestion and absorption, is to propel food materials along the gut by segmentation and peristaltic movements. These movements are modified by intrinsic and extrinsic nervous activities. Food substances when modified, may influence this function. Frankel (1980), Isong, et al (1997) and Boots, et al (2003) reported that thermally modified palm oil has richer free radicals than fresh palm oil and these radicals irritate the gastrointestinal tract causing increase intestinal motility.

Osim, et al (2009) observed inhibition of small intestine following NH intake. Osim, et al (1994), Igiri, et al (1997) and Alexander (1979) reported that free radicals in the TPOD alter intestinal morphology resulting in the damage and leakage of electrolytes in the intestine. Guyton and Hall (2006) suggested that opening of calcium-sodium channels enhances Ca$^{2+}$ entry into the cell which causes contraction of the smooth muscles of the intestine. They further suggested that the more the calcium-sodium channels are opened, the more Ca$^{2+}$ entry into the cells and the more the contraction leading to increase intestinal motility.

Though there is paucity of report on NH, fresh palm oil and TPOD intake on the intestinal transit time, this study therefore investigated fresh palm oil diet, TPOD and NH intake on the intestinal transit using Wister rats.

2 Materials and Method

2.1 Source of honey and palm oil

1 liter of natural honey, harvested from oil bean tree locally in Akatta, Oru East LGA, Imo State and 2 liters of fresh palm oil obtained from palm tree fruits were purchased from a local market (Afor Akatta) in Oru East LGA, Imo State, Nigeria. Both were taken to Physiology Department Laboratory, College of Medicine, Imo State University, Owerri, Nigeria, for the study. Fresh palm oil was used to formulate fresh palm oil diet, thermoxidized palm oil diets.

2.2 Thermoxidation of palm oil

The thermoxidation of palm oil was as reported by Isong, et al (1988). Owu, et al (1998) and Egbe, et al (2004). Fresh palm oil was heated in a stainless pot over a heating mantle at a temperature of 190 °C for five consecutive times. Each round of heating lasted for 20 minutes. It was allowed to cool for 5 minutes before the next round of heating.

2.3 Formulation of experimental diets

The experimental diets (FPO and TPO) were each formulated by adding 15 g of the fresh oil and thermoxidized oil respectively to 85 g of rat feed. The feed consisted of 21% (minimum) protein, 3.3% (minimum) fat, 6% (minimum) fiber, 0.8% calcium and 0.8% phosphorus. The rat feed was purchased from a local dealer on Pfizer Nigeria Ltd animal feed in Afor Akatta market.

2.4 Choice of experimental animals and maintenance

Wister strain rats were animals of choice for the study. This is because they are tough, easy to obtain, cheap to maintain and easier to get inbred colonies to avoid variations in outcome as a result of differences in species. The rats weighed between 180-200 g and were randomly selected for both sexes. They were all kept in plastic cages with wire net covers. The ethics of and for the use of experimental animals were strictly observed and adhered to. They were maintained in the animal house of Physiology Department, College of Medicine, Imo State University, Owerrri, Imo State, Nigeria, at a temperature of 28.0±2.0 °C with 12 hours of light and dark cycles. Each rat was kept in a separate cage. The cages were kept clean and water supplied through the calibrated feeding bottle with stainless nozzles.

20 Wister rats (180-200gm) were used in this study with Leishman’s stained food mixture. 8cm long plastic intubation cannula mounted in a 5 ml syringe was also used. Animal cages with wire-net covers and feeding bottles with stainless nozzles were also used. Natural honey harvested locally from oil bean tree in Akatta town, and fresh palm oil, bought from Afor Akatta market, both in Oru East Local Government Area (LGA), Imo State, Nigeria, were used in the study.

2.5 Experimental protocol

Method of Uwagboe and Orimilikwe (1995) was used. The animals were randomly grouped into 4 groups, the control Group (A), fresh palm oil diet Group (B), TPOD-fed Group (C) and natural honey-fed Group (D). Group A was fed with rat chow plus water. Groups B & C were fed with FPDO and TPOD, respectively and water while group D was fed with natural honey, water and rat chow (1 ml of honey was added to the first 10 ml of drinking water each day). The experiment lasted for 2 months. All the rats received 3 ml of Leishman’s stained food mixture using 8 ml long intubation cannula mounted in a 5 ml syringe. The experiment was timed for 90 minutes. At the end of 90 minutes, treacheostomy was performed under chloroform anesthesia. The abdomen was opened immediately and the location of the Leishman’s stained food mixture (black marker) in the intestine was located and measured using a tape rule in centimeter (cm). The total length of the intestine was measured also from the lower end of the pylorus to the ileocecal juncture for each rat. The intestinal transit (IT) was calculated using the formula

\[
\text{Intestinal transit (IT)} = \frac{\text{Length traveled by the black marker}}{\text{Total length of the small intestine}} \times 100
\]

UK J Pharm & Biosci, 2016: 4(6); 46
2.6 Statistical analysis

All experiments were repeated at least five times and the results expressed as mean ± S.E.M. The statistical analysis of data was done using one-way ANOVA (Analysis of Variance) with level of statistical significance taken as p < 0.05 with Duncan’s Multiple Range test. The statistical package used was Statistical Package for Social Science (SPSS 11).

3 Results

Table 1 showed mean intestinal transit of Group A, Group B, Group C and honey-fed Group D. Comparison of the groups showed that the intestinal transit in the honey-fed group was significantly reduced when compared with the control group, FPOD or the TPOD-fed groups (P<0.05). TPOD-fed group was significantly increased when compared with the control group, FPOD or honey fed groups (P<0.05). Groups A & B showed no significant difference between them (P>0.05).

Table 1: Effect of NH, FPOD and TPOD on gastrointestinal motility of animals

<table>
<thead>
<tr>
<th>Groups</th>
<th>Inhibition (%)</th>
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<tbody>
<tr>
<td>Group A (Control)</td>
<td>32.48±4.42%</td>
</tr>
<tr>
<td>Group B (FPOD)</td>
<td>35.96±1.18%</td>
</tr>
<tr>
<td>Group C (TPOD)</td>
<td>43.44±2.68%*</td>
</tr>
<tr>
<td>Group D (Honey-fed)</td>
<td>21.50±0.75%**</td>
</tr>
</tbody>
</table>

Values are expressed as mean ± SEM (n=5). **p<0.05 vs Control, FPOD and TPOD, *P<0.05 vs Control, FPOD and group D

4 Discussions

Intestinal transit is a function of gastrointestinal tract. It determines how food and other food substances move within the small intestine. Digestion and absorption of food in the small intestine is better when food moves slowly along the small intestine than when it moves faster, Barreino, et al (1968). Diarrhea is usually associated with increase motility of the small intestine and this increase usually leads to decrease absorption of food nutrients with water and electrolyte losses. Schild,(1980)23 observed that most anti-diarrhea drugs act by decreasing intestinal movements through their actions on enteric and extrinsic nervous activity, thus decreasing peristaltic movements. The result obtained in this study showed that natural honey intake caused significant decrease (P<0.05) in intestinal transit while TPOD intake caused significant increase in intestinal transit (P<0.05).

One of the functions of small intestine, apart from digestion and absorption of food nutrients, water and electrolytes, is to propel food substances along the intestinal tract by segmentation and peristaltic movements. These movements are associated with enteric and extrinsic nervous activity. Decreasing intestinal transit makes for efficient digestion and absorption as peristaltic movement is decreased while increasing it will increase the movements. This will adversely affect digestion and absorption of food and other food nutrients.

Mechanism whereby honey decreased intestinal transit is not fully understood but Osim, et al (2009)14 reported that natural honey caused inhibition of smooth muscles of the small intestine. This action may have caused the decrease movement of black marker along the small intestine as observed in this study. Alagwu, et al (2013)16 suggested that the action of honey on the small intestine may not only be beneficial in the treatment of diarrhea disease since its intake caused relaxation of intestinal smooth muscles but may even prevent diarrhea state as diarrhea is associated with increase in intestinal motility. TPOD increased intestinal transit as was observed in this study. This action may also be due to thermal oxidation as free radicals are released during the process as was observed by Frankel (1980)11, Isong, et al (1997)12 and Boots, et al (2003)13. Free radicals are reported to irritate the gastrointestinal tract with increase intestinal motility. Osim et al (1994)15, and Igiri, et al (1994)16 reported that these irritants alter intestinal morphology resulting in the damage and leakage of electrolytes in the small intestine. Guyton and Hall (2006) suggested that calcium-sodium channels are opened as a result of these radicals and this encourages more Ca2+ entry into the cells causing increase contractions of the smooth muscles of the intestine leading to increase intestinal motility.

Since TPOD intake significantly caused increase in intestinal transit, thermally oxidized foods may not only worsen diarrhea state but may cause it since its intake may cause release of free radicals and these radicals may irritate the gastrointestinal tract which may lead to intestinal hurry. It is therefore concluded that honey intake decreased intestinal transit and its consumption may relieve or even prevent intestinal hurry while TPOD intake increased intestinal transit, and its intake may worsen or even cause intestinal hurry. FPOD intake has no adverse effect on the IT as observed in this study as reported by Manorama and Rukmini (1991)7. It is therefore suggested that people taking thermoxidized oil food should equally add anti-oxidant or honey as honey contains anti-oxidant in their food as this may help minimize the effect of free radicals on the gastrointestinal tract.

5 Conclusion

The findings of study demonstrated that natural honey significant decreased the intestinal transit of rats. Hence, it can be used for the treatment of diarrhoea. Further studies are required to confirm the underlying mechanism of the observed activity of the natural honey.

6 Competing Interests

Authors have declared that no competing interests exist.
7 Author’s contributions
EAA and GCU carried out literature review, experimental work and discussion. DNA and EEN were responsible for statistical work and calculations in addition to manuscript proofing.

8 References