RESEARCH ARTICLE

Does Natural Honey Affect Gastric Emptying in Rats?

Mohamad Yosof Rezk, Khaled Abdelfattah Abulfadle

Faculty of Human Medicine, Physiology Department, Zagazig University, Egypt

Correspondence to:
Mohamad Yosof Rezk
(myr777777777@yahoo.com)

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ABSTRACT

Background: Up to date no documented research tends to study influence of natural honey administration on gastric emptying in healthy male albino rats.

Aims & Objective: The present study was carried out to investigate the effects of natural honey administration on gastric emptying in healthy male albino rats.

Materials and Methods: A total number of 36 healthy, male, albino rats weighing 150- 200 grams were used in this study. The rats were subdivided into sex equal groups I (control group received distilled water), II (received a small dose of honey), III (received a large dose of honey), IV (received metoclopramide), V (received both small dose of honey and metoclopramide) and VI (received both large dose of honey and metoclopramide). Then, percentage of gastric emptying during one hour (experimental period) was calculated in all the groups.

Results: This study revealed that honey large dose and the combination of honey large dose with metoclopramide significantly ($P<0.05$) decreased the % of gastric emptying in male albino rats in their groups in comparison to the control group. These results suggested that honey decreases % of gastric emptying in male albino rats in a dose dependent manner.

Conclusion: Honey decreases % of gastric emptying in male albino rats and these effects are mostly mediated by its high concentrations of monosaccharides glucose and fructose. These results help in clarification of the role of honey in treating diarrhea and its utilization prior to surgeries and also, its role in increasing body weight in infants.

KEY WORDS: Honey; Gastric Emptying; Metoclopramide

INTRODUCTION

Honey is a natural product composed of at least 181 components and is basically a solution supersaturated in sugars; the fructose (38%) and glucose (31%) are the most important constituents.[1] An alternative medicine branch, called apitherapy, has developed in recent years, offering treatments based on honey and the other bee products against many diseases.[2] And according to the Muslim holy book "The Holy Hadith", dating back to the 8th century AD prophet Mohamed recommended honey against diarrhea.[3]

The application of honey for prevention and treatments of gastrointestinal disorders such as peptic ulcers, gastritis, and gastroenteritis has been reported.[4] Bogdanov et al.[5] stated that honey has anti-inflammatory, anti-oxidant and anti-microbial effects. In addition, Honey is a potent inhibitor of the causing agent of peptic ulcers and gastritis, Helicobacter pylori.[6] Also, Nasuti et al.[7] found that honey intake in rats prevented indomethacin induced gastric lesions by reducing the ulcer index, microvascular permeability, and myeloperoxidase activity of the stomach. Moreover, honey was found to maintain the level of non-protein sulfhydryl compounds (e.g. glutathione) in gastric tissue subjected to factors inducing ulceration.[7]

Also, the application of honey in infant nutrition used to be a common recommendation during the last centuries. Ramenghi et al.[8] reported that infants on a diet with honey had better blood formation and a higher weight gain than when a diet without honey was applied. Also, they stated that, honey was better tolerated by babies than sucrose and compared to a water based placebo significantly reduced the crying phases of infants. Moreover, Naguib et al.[9] reported that honey increased residual gastric volume if taken by patients 2 hours before surgery; however, the patients did not suffer any consequence especially rise in gastric pH, did not regurgitate or aspirate and thus they were not more prone to acid pneumonitis syndrome. Furthermore, Sanaa et al.[10] found that honey supplementation increased gastric emptying time in protein-energy malnutrition patients.

In adult rats, the rate of gastric emptying is modulated by properties of the diet, including its caloric content and osmotic properties.[11] Delayed gastric emptying has been documented in severe head injuries and in such cases metoclopramide has no significant prokinetic effect on gastric emptying.[11]

Dopamine antagonist metoclopramide, a safe and inexpensive prokinetic agent, has previously been shown to significantly accelerate gastric emptying.[12] Metoclopramide increases the rate of gastric emptying in human being through increasing the frequency and amplitude of gastric contractions.[13] Early postoperative intragastric enteral feeding in cardiac surgery patients is frequently complicated by delayed gastric emptying and subsequent intolerance of enteral formula. Alan et al.[14] found that a single dose of intravenous metoclopramide effectively improved gastric emptying in patients with early postoperative intragastric enteral nutrition with liquid isoosmolar enteral formula after uncomplicated open-heart surgery. They stated that metoclopramide significantly enhance peristaltic contractility of the esophagus, gastric antrum and duodenum. Both peripheral and central dopamine D2 receptors play an important role in the inhibitory effect of dopamine on gastric motility.[15]

Fructose is used widely in the diabetic diet and is known to empty from the stomach slightly faster than glucose but substantially slower than water.[16] Monosaccharides empty from the stomach more slowly than water or isotonic saline because of small intestinal feedback as their presence in small intestine causes relaxation of the proximal stomach, suppression of antral motility, and stimulation of phasic and tonic pyloric contractions. Fructose, when given as intragastric loads to monkeys, empties more rapidly than glucose.[16] The slightly more rapid rate of emptying of oral fructose compared with oral glucose has also been demonstrated in humans. On the other hand, acute hyperglycemia, induced by intravenous glucose, has major,

reversible effects on gastrointestinal motor function. Marked hyperglycemia slows gastric emptying in healthy subjects and patients with type 1 and type 2 diabetes when compared with euglycemia.[1] The mechanism(s) mediating the effects of hyperglycemia on gastric motility are poorly defined but appear to involve nitric oxide pathways.[17] Both glucose and fructose have the capacity to slow gastric emptying both as a result of their interaction with the small intestine and also the elevation of plasma monosaccharide concentrations.[16]

Although, the previous studies have reported effects of glucose and fructose administration on gastric emptying, yet, up to date no documented research tends to study influence of honey administration on gastric emptying in healthy male albino rats. Therefore, the present study was carried out to investigate the effects of honey administration on gastric emptying in healthy male albino rats.

MATERIALS AND METHODS

ANIMALS

The use of rats and all the experimental procedures were performed in accordance with the Institutional Guidelines for the Care and Use of Animals for Scientific Purposes and in accordance with the Recommendations from Helsinki Declaration. Thirty six male albino rats weighing 150- 200 grams were obtained from the Laboratory Animal Research Unit of Zagazig University, Egypt. The animals were acclimatized to the animal room condition for at least a week at 25 ± 2^0C with 12-hour light/12-hour dark cycles prior to the experiment. All animals were supplied with commercial pellet food and water *ad libitum*. The animals were fasted overnight prior to all experiments.[15]

The rats were subdivided into 6 equal groups:

(1) Control group (6 rats): received distilled water (5 ml/kg)[15]
(2) A group received a small dose of honey (6 rats): 0.312 g/Kg[18]
(3) A group received a large dose of honey (6 rats): 2.5 gm/kg[19]
(4) A group received metoclopramide (D_1 and D_2 receptor antagonist) group (6 rats): 1 mg/kg body weight[15]
(5) A group received both small dose of honey and metoclopramide (6 rats)
(6) A group received both large dose of honey and metoclopramide (6 rats)

PROCEDURES

Rats were administered honey by oral gavage[20] and injected intra-peritoneal with metoclopramide 30 minutes before the introduction of food. Measurement of percentage of gastric emptying was done by the method mentioned by Wang et al., 2001. Fasted rats were fed for one hour then, food and water were removed. After one hour, rats were killed by blow on the head, midline laparotomy was done, and the stomach was removed, clamped on its both ends and weighed. Then, the stomach was opened, its content was washed out with tap water, and the gastric wall was weighed. The amount of food contained in the stomach (in grams) was quantified as the difference between the weight of the stomach with and without its content. The amount of food ingested by the rats during one hour refeeding period was determined by the difference between the weight of the container before and after one hour food exposure. The amount of water was also measured before and after drinking and the amount of water taken by each rat was weighted and added to the amount of food intake. The percentage of gastric emptying during one hour (experimental period) was calculated according to the following equation: gastric emptying (%) = [1 – (wet weight of food recovered from the stomach/weight of food intake)] × 100.[20]

EQUIPMENTS

(1) Water distiller: Polna DEM 10
(2) Insulin syringes 1 ml, 5 ml, 10 ml from AMECO, Egypt
(3) Sterile surgical instruments
(4) Electronic balance: type AEG – 220, SHIMADZU Corporation, Japan

DRUGS AND CHEMICALS

Natural Honey: A natural honey was purchased from the College of Agriculture, zagazig University, Egypt.

Metoclopramide (primperan ampoules, 10 mg / 2 ml ampoule) from Memphis-delagrand Co.

STATISTICAL ANALYSIS

All data were presented as mean ± SD (standard deviation). Statistical significance was determined by using unpaired t test to detect significant differences between each group with the control and we also used one way ANOVA test for comparing all groups with the control group. P values less than 0.05 were considered to be significant. In statistical analysis, SPSS program version 12 for windows was used.

RESULTS

Table 1 and figure 1 demonstrate the effect of honey on % of gastric emptying in male albino rats. It was found that with honey small dose administration (Honey SD), there was an insignificant increase in the mean value (Mean ± SD) of (Honey SD) group (62.5 ± 8.31) (P>0.05), when compared to that of (control) group (52.3 ± 8.96).

It was also found that with honey large dose administration (Honey LD), there was a significant decrease in the mean value (Mean ± SD) of (Honey LD) group (34.3 ± 5.01) (P<0.05), when compared to that of (control) group (52.3 ± 8.96).

We also found that with metoclopramide administration (Metoclopramide group), produced an insignificant increase in the mean value (Mean ± SD) of (Metoclopramide) group (57.17 ± 9.11) (P>0.05), when compared to that of (control) group (52.3 ± 8.96).

It was also found that Honey SD with metoclopramide caused an insignificant increase in the mean value (Mean ± SD) of (Honey SD with metoclopramide) group (56.5 ± 8.14) (P>0.05), when compared to that of (control) group (52.3 ± 8.96).

It was found that combined honey large dose and metoclopramide administration produced a highly significant decrease in the mean value (Mean ± SD) of (Honey LD with metoclopramide) group (22 ± 5.22) (P<0.05), when compared to that of (control) group (52.3 ± 8.96).

Table-1: Demonstrate the Effect of Honey on % of Gastric Emptying in Male Albino Rats

	Control	Honey SD	Honey LD	Met	Honey SD + Met	Honey LD + Met
1	58	65	37	63	60	20
2	40	52	30	44	44	18
3	64	73	42	68	66	26
4	57	70	34	62	62	22
5	50	60	35	57	57	30
6	45	55	28	49	50	16
Mean	52.3	62.5	34.3	57.17	56.5	22
SEM	3.66	3.39	2.04	3.72	3.32	3.13
SD	8.96	8.31	5.01	9.11	8.14	5.22
P value		NS	0.002 (<0.05)**	NS (>0.05)	0.42 (>0.05)	0.000 (<0.05)**
One way ANOVA = 0.00						

Met: metoclopramide; SD: Small dose; LD: large dose; NS: insignificant t-test
* significant in comparison with the control; ** highly significant

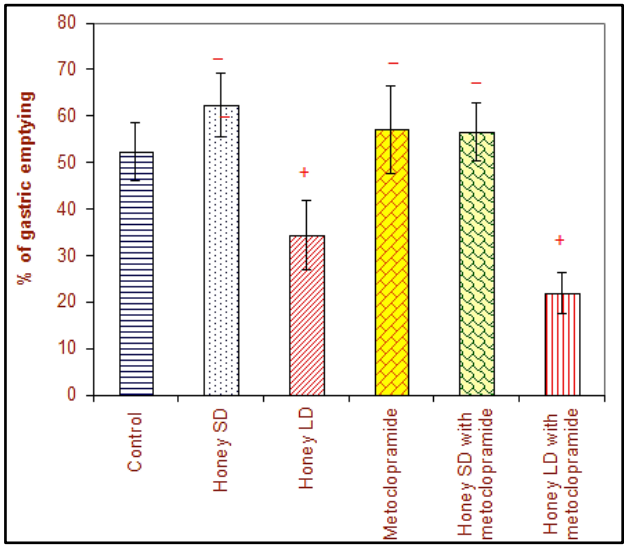

Figure-1: Effect of honey small dose, honey large dose, metoclopramide, honey small dose with metoclopramide and honey large dose with metoclopramide on % of gastric emptying in male albino rats (+: Significant in comparison with the control; – Insignificant in comparison with the control)

DISCUSSION

Although, some studies have reported effects of glucose and fructose administration on gastric emptying[1,16,17,22,23], yet, up to date no

documented research tends to study influence of honey administration on gastric emptying in healthy male albino rats. Therefore, the present study was carried out to investigate the effects of honey administration on gastric emptying in healthy male albino rats.

Our study revealed that honey small dose, metoclopramide and the combination of honey small dose with metoclopramide cause insignificant change of % of gastric emptying in male albino rats in their groups on comparison to the control group.

On the other hand, honey large dose and the combination of honey large dose with metoclopramide significantly decreased the % of gastric emptying in male albino rats in their groups in comparison to the control group.

These results suggested that honey decreases % of gastric emptying in male albino rats in a dose dependent manner which is supported by Naguib et al.[9] who reported that honey increased residual gastric volume if taken by patients two hours before surgery and they found that those patients did not suffer any consequence especially rise in gastric pH, did not regurgitate or aspirate and they suggested that those patients were less prone to acid pneumonitis syndrome.

Also, this study in agreement with Sanaa et al.[10] who found that honey supplementation increased gastric emptying time in protein-energy malnutrition patients.

The results of our study can be explained on the basis of effects of the main constituents of honey of glucose and fructose and this in agreement with Meier et al.[1] who found that natural honey is supersaturated in sugars of which the fructose (38%) and glucose (31%). Meier et al.[1] also found that marked hyperglycemia slows gastric emptying in healthy subjects and in patients with type 1 and type 2 diabetes when compared with euglycemia.

Our study is also supported by the findings of Julie et al.[16] who found that both glucose and fructose have the capacity to slow gastric emptying and they suggested that this occurs as a result of their interaction with the small intestine as their presence in small intestine causes relaxation of the proximal stomach, suppression of antral motility, and stimulation of phasic and tonic pyloric contractions.

Moreover, Kuo et al.[17] suggested that the mechanism of slowing of gastric emptying involves nitric oxide pathways. Furthermore, Marino et al.[11] stated that in adult rats, the rate of gastric emptying is modulated by properties of the diet, including its caloric content and osmotic properties.

Also, our results are supported by Pokorn and Vukmirovic[24] who found that the gastric emptying of saccharides after ingestion of honey was slower than that after ingestion of a mixture of glucose and fructose.

CONCLUSION

Our study pointed for the first time to the effects of natural honey administration on gastric emptying in healthy male albino rats. Our study revealed that honey decreases % of gastric emptying in male albino rats in a dose dependent manner and these effects are mostly mediated by its high concentrations of monosaccharides glucose and fructose. Our results help in clarification of the role of honey in treating diarrhea and its utilization prior to surgeries and also, its role in increasing body weight in infants. Further studies are needed to confirm effect of honey on other gastric functions.

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