Change of Gastric Emptying With Chewing Gum: Evaluation Using a Continuous Real-Time $^{13}$C Breath Test (BreathID System)


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Background/Aims
There are few reports on the correlation between chewing gum and the gastrointestinal functions. But previous report showed use of chewing gum to be an effective method for controlling gastrointestinal symptoms. The aim of this study was to determine the correlation between chewing gum and gastric emptying using the continuous real time $^{13}$C breath test (BreathID system).

Methods
Ten healthy male volunteers participated in this randomized, 2-way crossover study. The subjects fasted overnight and were randomly assigned to chewing gum (Xylish, 2-3/1 tablet) for an hour following intake of a test meal (200 kcal/200 mL) or intake of the test meal alone. Gastric emptying was monitored for 4 hours after administration of the test meal by the $^{13}$C-acetic acid breath test performed continually using the BreathID system.

Results
No significant differences in the calculated parameters, namely, $T_{1/2}$ (median, 111.82 vs 109.26 minutes; $P = 0.575$), $T_{lag}$ (median, 53.28 vs 56.53 minutes; $P = 0.333$), gastric emptying coefficient (median, 3.58 vs 3.65; $P = 0.285$), regression-estimated constant $\beta$ (median, 1.85 vs 1.80; $P = 0.575$) and regression-estimated constant $\kappa$ (median, 0.61 vs 0.62; $P = 0.959$) were observed between the test meal alone group and the test meal and chewing gum group.

Conclusions
This study showed that chewing gum had no effect on the rate of gastric emptying. Therefore, since chewing gum did not enhance the speed of gastric emptying, it may ameliorate gastrointestinal symptoms through other mechanisms, such as saliva and autonomic nervous system.

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Key Words
Breath test; Chewing gum; Gastric emptying
Introduction

In Japan, use of chewing gum has prevailed ever since World War II. There are few reports on the correlation between chewing gum and the gastrointestinal functions.

But, the previous study showed that consistently chewing gum increased the esophageal and pharyngeal pH. According to another study, chewing gum increased the salivary flow rate and controlled acid reflux and the related symptoms. Gastric emptying may cause retention of solid foods, gastric distention, resultant increase of gastric acid secretion and transient lower esophageal sphincter relaxation. We hypothesized that chewing gum may increase chewing activity, saliva production, gastric motility and thereby accelerate the rate of gastric emptying.

In this study, we investigated the physiologic effect of chewing gum on the rate of gastric emptying using a continuousreal-time $^{13}$C breath test (BreathID system, Exalenz Bioscience Ltd, Modiin, Israel).

Materials and Methods

Subjects

The subjects were 10 asymptomatic male volunteers, none of whom were habitual drinkers. None had a history of gastrointestinal disease or abdominal surgery, and all were non-smokers. None of the subjects were on any routine medication at the time of the study. The study was conducted in accordance with the declaration of Helsinki. The study protocol using the BreathID system was approved by the Ethics Committee of Yokohama City University School of Medicine.

$^{13}$C-Acetic Acid Breath Test

Ten subjects participated in this randomized, 2-way crossover study. They were randomly assigned to receive a test meal and a chewing gum (Xylish, Meiji Seika, Tokyo, Japan; 1 pack [17 g/12 tablets] include: carbon 13.5 g, xylitol 6.7 g, 36 kcal, protein 0 g, lipid 0.1 g, Na 0 mg and sugar 0 g), or only a test meal. The 2 tests were conducted as follows; (1) experiment A: the subjects chewed gum for an hour just minutes after intake of test meal and (2) experiment B: the subjects only took a test meal without chewing gum. Breath samples were continuously collected via a nasal tube using the BreathID system (Exalenz Bioscience Ltd) at baseline before the test meal and following completion of the test meal ingestion (time 0) for up to 4 hours.

Data analysis of the $^{13}$C-acetic acid breath test

The data from the $^{13}$C breath test were analyzed using Oridion Research Software ($\beta$ version, Oridion Medical Ltd, Jerusalem, Israel). The time versus $^{13}$CO$_2$ excretion rate curve was fitted to the conventional formula of $z(t) = m(1-e^{-kt})$, and the regression-estimated constants ($\beta$ and $\kappa$) were determined. After mathematical analysis, the time required for the emptying of 50% of the labeled meals (T$_{1/2}$), the analog to the scintigraphy lag time for 10% emptying of the labeled meal (T$_{lag}$), the gastric emptying coefficient (GEC), and $\beta$ and $\kappa$ were calculated. A larger (smaller) $\beta$ indicates slower (faster) emptying in the early phase, and a larger (smaller) $\kappa$ indicates faster (slower) emptying in the later phase.

Statistical Methods

Statistical evaluation was carried out using Oridion Research Software (\(\beta\) version, Oridion Medical Ltd, Jerusalem, Israel). The time versus $^{13}$CO$_2$ excretion rate curve was fitted to the conventional formula of $z(t) = m(1-e^{-kt})$, and the regression-estimated constants ($\beta$ and $\kappa$) were determined. After mathematical analysis, the time required for the emptying of 50% of the labeled meals (T$_{1/2}$), the analog to the scintigraphy lag time for 10% emptying of the labeled meal (T$_{lag}$), the gastric emptying coefficient (GEC), and $\beta$ and $\kappa$ were calculated. A larger (smaller) $\beta$ indicates slower (faster) emptying in the early phase, and a larger (smaller) $\kappa$ indicates faster (slower) emptying in the later phase.

Results

$^{13}$C-Acetic Acid Breath Test

Ten male subjects (mean age, 22; median age, 22; range, 20-28 years) completed this study. No adverse events occurred during the study. The subjects’ mean height was 171.1 with median height of 170 cm (range, 165-178 cm), mean weight of 63.9