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Original Article

The effect of a single dose of *Lactobacillus paracasei* strain *Shirota* on whole gut transit time among healthy young adults

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Introduction

Yakult contains *Lactobacillus casei* strain *Shirota (LcS)*. It has several protective effects on our digestive system which include preventing diarrhoea and improving constipation. The objective of our study was to determine the effect of a single dose of Yakult on whole gut transit time (WGTT) among young adults.

Methods

A cross-sectional study of 73 students who did not have any gastrointestinal disorder was performed. Subjects were given 4 carbon pills as a visual indicator to measure their WGTT in the normal setting of their usual activities. They then repeated measurement while consuming one dose of commercially available Yakult and 4 carbon pills (visual indicator). In the 2 settings, subjects were instructed to consume carbon pills and carbon pills with Yakult within 1 hour after bowel motion.

Results

The WGTT decreased in 48 of the 73 subjects (65.8%) after consuming Yakult. The mean WGTT was reduced by 4.4 ±14.6 hours. There was no significant effect of Yakult on the form of stools.

Conclusion

Yakult which contains *Lactobacillus casei* strain *Shirota (LcS)* is well known for helping in digestion and preventing constipation. A single dose of Yakult produces a reduction in the WGTT.

Keywords: *Lactobacillus casei* strain *Shirota (LcS), whole gut transit time (WGTT), bowel habit, constipation, factors affecting bowel habit*

INTRODUCTION

Yakult is a fermented skimmed milk drink containing a unique strain of bacteria, *'Lactobacillus casei Shirota' (LcS)* which reaches the gut alive.[1] In healthy individuals, gut microbiota maintains a symbiotic relationship with the gut mucosa. Beneficial bacteria in the digestive tract such as LcS serves to protect against toxic by-products of digestion. Studies have also shown that a normal gut microbiota has substantial metabolic, immunological and gut protective functions.[2] It is estimated that the gut microflora comprises of over 35,000 bacterial species.

The efficacy of probiotics has been clearly demonstrated in treating viral gastroenteritis and diarrhoea caused by antibiotics.[3] Both infection and antibiotics disrupt the natural balance of bacteria in the human digestive system, which probiotics can help restore. The other spectrum of digestive disorder, constipation, is however more common than diarrhoea. It affects about 14% of adults and accounts for about 3.2 million medical visits in the United States each year.[3] On average, Americans spend three-quarters of a billion dollars each year trying to ease their bowel opening. A study of 1,652 Malaysian students from Universiti Putra Malaysia showed that the prevalence of functional constipation among the students was 16.2%.[4] In a cross-sectional study of fruit consumption among Malaysian adults aged 20-39 by Universiti Kebangsaan Malaysia,

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it was found that the intake was 1.6±1.0 servings/day, which was lower than the Malaysian Dietary Guideline 2010 of >2 servings/day.[5] This may be the factor contributing to functional constipation.

Probiotics have been reported to relieve functional constipation, when it is measured by various outcomes such as symptoms, stool nature and frequency and gut transit time in a systematic review of randomized controlled trials.[6] Two out of 14 studies in a search of randomized controlled trials, one investigating the strain of *Bifidobacterium lactis* and another on *Lactobacillus casei Shirota*, showed a reduced whole gut transit time (WGTT) by 12.4 hours (95% CI 2.5 – 22.3).[6] The beneficial effects of probiotics may be explained by a few theories. One of it being that with increasing short fatty-acid chain production with ingestion of probiotics, the pH in the intestine will be reduced thus triggering peristalsis and consequently the WGTT.[7]

Normal WGTT or oro-fecal transit time, is considered to be between 10-73 hours. It consists of gastric emptying followed by transit through the small and large bowels. Studies show gastric emptying (GET) ranges from 2-5 hours, small bowel transit (SBTT) 2-6 hours and large bowel transit (CTT) 10-59 hours. GET, SBTT and CTT can be measured by a wireless motility capsule,[8] scintigraphy with radio-labelled markers or radiology with radio-opaque markers separately[9-10], but WGTT alone can easily be measured with ingestion of coloured or radiopaque markers[10-11] or dye[12] more easily.

LcS is a probiotic that has been found to improve functional constipation, including WGTT in several studies[7,13-15]. All these studies investigate long term use of LcS of at least 4 weeks. However, it is postulated that LcS may potentially benefit individuals even with administration of a single dose. This is because production of short chain fatty acids from fermentation of carbohydrates by these bacteria may happen immediately.[7,16]

Therefore, it is of interest to determine if ingestion of a single dose of Yakult culture drink (65ml) containing 6.5x 109CFU of LcS may affect WGTT and stool consistency in healthy young adults.

METHODOLOGY

Study design and setting

A cross-sectional study was carried out from August 2019 to December 2020 among undergraduate students enrolled in the medical programme in the International Medical University (IMU). The target population consisted of young adults without any gastrointestinal disease. Based on previous data whereby WGTT was measured using activated carbon as a marker, there was no significant change over several weeks, therefore the current study focuses on having the intervention group solely, without any controls.[17]

Ethical aspect

As this research required participants to consume Yakult and four activated charcoal tablets, verbal and written consent was obtained. Ethical approval was obtained from the International Medical University Committee on Ethics (CSc/Sem6(05)2020).

Inclusion and exclusion criteria

All students in the clinical campus without any gastrointestinal disease were invited to participate. Those who had been diagnosed with a colorectal, anal disease or on prebiotics or probiotic supplements, laxative and diarrhoea medication were excluded.

Individuals with comorbidities such as diabetes and hypertension were excluded. All participants were given clear information on the objectives, methods, possible risks and complications of this study. They were all required to sign consent forms before participating in this study.

Sample size and sampling

A sample size of 173 participants was required to detect a mean difference of 5% in the change expected in WGTT (i.e. 1.25 hrs, based on mean WGTT of 25 hrs) with 80% certainty (selectstatistic.co.uk).

Questionnaire and intervention

A structured questionnaire and data collection sheet was used as a survey instrument and sent to the participants via Google Form. Individuals were followed up to ensure that the participants understood the questionnaire to avoid misunderstanding and confusion. The questionnaire included the general information (name, age, gender, race, working status and medical condition particularly gastrointestinal disease), whole gut transit time (bowel habit, consistency of bowel movement, medication taken to help in passing motion), lifestyle (amount of water consumed in a day, amount of time spent in exercising in a week, stress level, meal time routine), beliefs (role of diet, amount of water and exercise in affecting the frequency of passing motion).

Participants were instructed on one occasion to consume only activated charcoal tablets within one hour of their bowel motion and record the time bowel motion occurred with the colour change subsequently. On the second occasion, they consumed both Yakult and activated charcoal tablets. They were asked to record the date and time of the first bowel motion, form of stools, time four tablets were taken, meal consumed on that day and the date where dark coloured stool was noted.

Statistical analysis

The data collected was entered into Microsoft Excel and exported into Statistical Package for Social Science (SPSS) version 26 for statistical analysis.

The duration of WGTT was non-parametric hence the Wilcoxon Signed Rank test was employed. Statistical analysis was done by using chi-square test for other categorial data. The statistically significant value was set as $p<0.05$.

Disclaimer

The funding for this research was provided by the IMU. Products (Yakult, charcoal tablets) used in this study were not sponsored.

RESULTS

In view of the restrictions we faced because of the Covid-19 pandemic, we were only able to enrol 73 subjects in the study which included 50 females and 23 males. The target subject of this study was young adults and the age of the subject recruited ranged from 19 to 27 years old. Most of the subjects are healthy students with no underlying comorbidities.

Forty eight out of 73 subjects (65.8%) had decreased WGTT after taking Yakult. On the other hand, 22 (30.1%) subjects had an increase in WGTT and 3 (4.1%) had no changes in WGTT after consuming Yakult.

The usual whole gut transit time of the subjects was considered short with 80.8% having <40 hours WGTT. The number increased in those with short WGTT with Yakult intervention (87.7%). However, the difference was not significant (p=0.249) (Table I).

Table I: Number & percentage of subjects having short (<40 hours) and long (≥40 hours) WGTT with carbon only vs carbon with Yakult.

Treatment	<40 hours WGTT	≥40 hours WGTT	P value
Carbon	59(80.8%)	14(19.2%)	
Carbon + Yakult	64(87.7%)	9 (12.3%)	0.249

There was a significant difference between WGTT with and without Yakult (p=0.012) as shown in Table II and Figure I.

Table II: Mean WGTT and difference in WGTT according to carbon only vs carbon with Yakult.

Measurements	Carbon only	Carbon + Yakult	P value
Mean (SD) WGTT (hours)	27.6 (14.3)	23.1 (11.7)	0.012
Difference in WGTT (hours)	-4.4 (14.6)		0.012

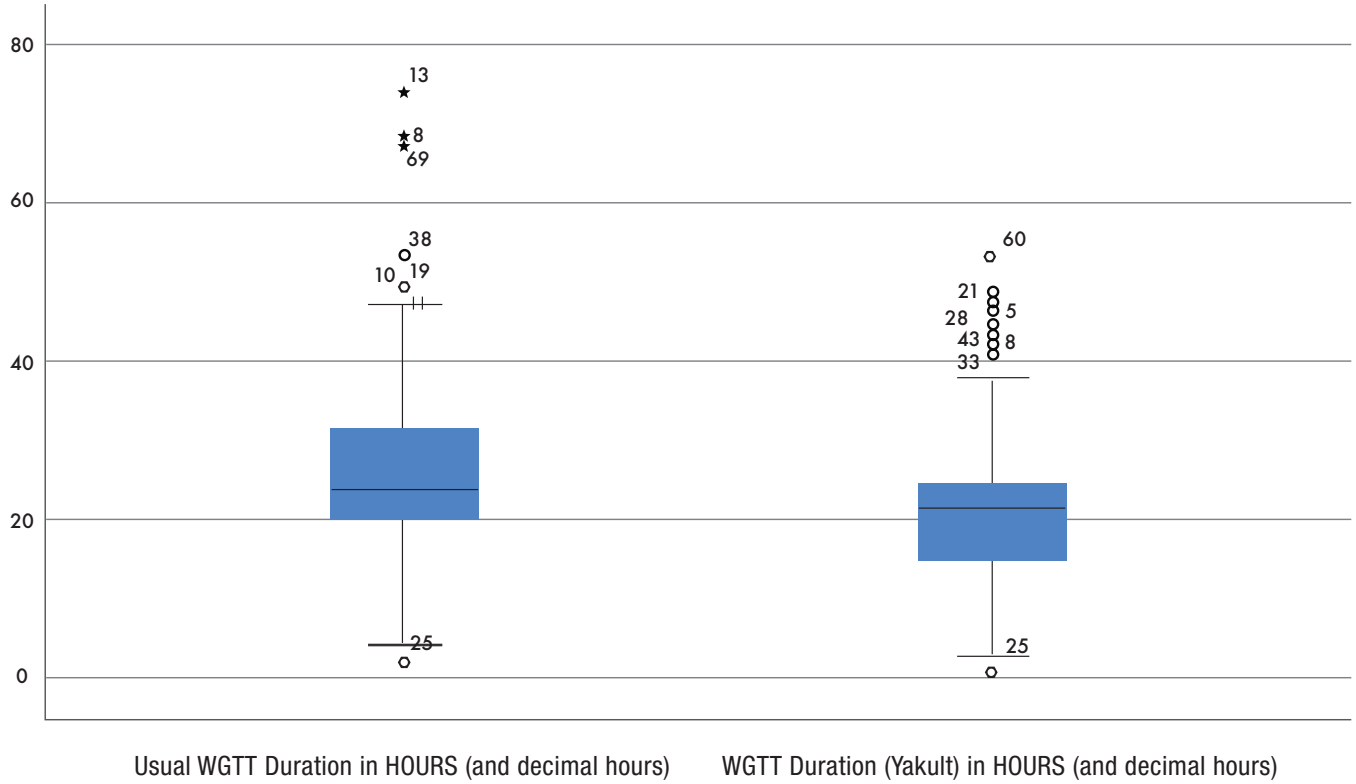

Figure I: Changes in WGTT with and without Yakult.

Treatment	Stool Type						
	1 (Pellets)	2	3	4	5	6	7 (Watery)
Carbon	1 (1.4%)	9 (12.3%)	21 (29%)	29 (40%)	8 (11%)	5 (6.8%)	0
Carbon + Yakult	1 (1.4%)	5 (6.8%)	17 (23%)	35 (48%)	6 (8.2%)	8 (11%)	1 (1.4%)

Table III: Bristol Stool Type before and after Yakult

There was a shift towards softer stool after taking Yakult *(LcS)* (Table III). The number of subjects with normal stool consistency (Types 3 & 4) increased from 69% -71% ($p<0.001$).

DISCUSSION

Based on the results, a single dose of Yakult shortens WGTT with a shift towards softer stool consistencies. Stool consistency is found to correlate with WGTT, with shorter WGTT producing softer stools.[18] Other studies on laxatives usually examine the effect of Yakult and other probiotics over a period of time and assess the effects using a questionnaire of bowel habits.[8] Medical opinion about the benefits of a single dose of probiotics as a laxative is ambiguous as probiotics are recommended on the basis of giving the bowel time to be colonized by the probiotic.

LIMITATIONS

Dietary differences may affect WGTT. We did not standardize the diet of the subjects prior to both WGTT measurements, but assumed that variations of diet among different individuals in a group will have no net difference in WGTT. Ideally, all participants should have been put on a standardized diet but having the subjects retain their habitual diet and lifestyle during the intervention phase, allows us to see the effect of single dose Yakult *(LcS)* in the real world.

Using activated carbon as an indicator poses the possibility it may affect WGTT itself. However, if it might, it is more likely to prolong WGTT.[19] Our measure of WGTT depended on the subjects reporting when they see a colour change and depended on the cooperation of the subjects. We cannot be sure that they identified the colour accurately and there are also occasions when stools drop into the water become unobservable, thus difficult to see.

The sample we obtained was smaller than we intended in view of the ongoing COVID-19 pandemic, thus it was difficult for us to recruit a larger sample size, and also investigate different age groups, which may yield more accurate results. Sample sizes are inversely proportional to margins of error – by having a smaller sample size, the margin of error is increased, and the confidence level of the study is also reduced. However, because the effect we obtained was larger than we expected, we saw a significant difference.

STRENGTHS

Our sample is largely homogenous. The population of students we sampled share many similar and common features in their environment, which controls for factors that may influence WGTT measurements, such as activities, lifestyle, and weather, which may influence hydration.

CONCLUSION

A single dose of *LcS* shortens whole gut transit time by 4.4 ±14.6 hours.

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