BIOLOGY EXTENDED ESSAY

INVESTIGATING THE DIGESTIVE ACTIVITY OF TWO YOGHURT BRANDS, BY MEASURING THE PRODUCED GLUCOSE MASS FROM MALTOSE, WHEN PROBIOTICS WORK ALONE OR COOPERATE WITH PREBIOTICS.

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WORD COUNT: 3874

ABSTRACT

"The human digestive system is a complex series of organs and glands that processes food. In order to use the food we eat, our body has to break the food down into smaller molecules that it can process; it also has to excrete waste."[1]

The objective of the study was to investigate whether the probiotics were enough for digestion (as in Activia) or should the prebiotics have cooperated with the probiotics in the yoghurts (as in Yovita).

Every food type is known to be digested by specific enzymes present in human body, or by the bacteria provided from other nutrients that live in digestive tract of human. These enzymes are produced by salivary glands in mouth, stomach, small intestine and pancreas.

The two mentioned different yoghurts; Activia and Yovita were placed into beakers and maltose monohydrate was added into them. The rate of glucose (monosaccharide) formation from the maltose disaccharide was measured by glucose measurer strips and the results were compared. By doing these processes, it was aimed to compare the effectiveness of these two brands in terms of their maltose digestion rates.

[1]: http://www.enchantedlearning.com/subjects/anatomy/digestive

"Maltose or malt sugar, crystalline disaccharide has the same empirical formula ($C_{12}H_{22}O_{11}$) as sucrose and lactose but differs from both in structure. Maltose is produced from starch by hydrolysis in the presence of diastase, an enzyme present in malt. Maltose is hydrolyzed to glucose by maltase, an enzyme present in yeast"[2].

Yoghurt is one of the most common nourishment that contains a high quality of digestive bacteria. In digestive yoghurts, probiotic bacteria are frequently encountered; however, some of them contain prebiotic fibers, as well. Between these different yoghurt brands, Yovita and Activia were selected for this practice.

Probiotic bacteria have a great and strong role in digestion. It provides regulation of the digestion system. However, on the other hand, it was found that as the prebiotics are present along with probiotics, the digestivity of the yoghurt and also the success of transferring alive bacteria into digestion system increases. As a result of that cooperation, the digestion amount of maltose in Yovita is expected to be more than in Activia. The hypothesis also supported the bacterial activity in Yovita.

As proposed, the average mass of the produced glucose from maltose sugar in Yovita appeared to be more than Activia so that the expectations met the experimental findings.

[2]: http://www.answers.com/topic/maltose (colombia encyclopedia)

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INTRODUCTION

The first time I was confronted with the topic of this extended essay was a conversation between me and one of my friends. My friend was complaining about her digestion problem. Firstly, it was thought that there was a problem present in her digestive system, however, the test results appeared to be normal. A solution for this was proposed as eating yogurt everyday to provide external support with the bacteria present in the yogurt. When the brand of the yogurt was changed, it was observed that the effect was clearer. The reason of this difference created a question on my mind. Being really enthusiastic I decided to search about the facts affecting digestion by taking this difference as a base.

To start with, "digestion involves mixing food with digestive juices, moving it through the digestive tract, and breaking down large molecules of food into smaller molecules. Digestion begins in the mouth, when you chew and swallow, and is completed in the small intestine."[3]

With the help of nourishment experts, I chose two yogurt trades to compare. I began to make a research about the carbonhydrate, lipid, protein, energy and calcium values and I took them as close as possible. As a result, I decided the trades "Activia" and "Yovita" to investigate the effect of bacteria on the digestive system because except the prebiotics and probiotics they include, the percentage of other ingredients was nearly same.

[3]: http://digestive.niddk.nih.gov/ddiseases/pubs/yrdd/

Activia, is a trademark under the brand of "Danone." It is completely probiotic yoghurt with probiotic bacteria. According to the adopted definition by Food and Agricultural Organization(FAO) and World Health organization(WHO) probiotics are: "Live microorganisms which when administered in adequate amounts confer a health benefit on the host." Also, "at the start of the 20th century, probiotics were thought to beneficially affect the host by improving its intestinal microbial balance, thus inhibiting pathogens and toxin producing bacteria."[4] In Activia, there are *Lactobacillus bulgaricus* and *Streptococcus thermophilis* and *Bifidobacterium lactis* which are completely probiotic bacteria.

On the other hand, Yovita is a trademark of Sütaş and contains *Bifidibacterium* in common with Activia. However, differently, there are *Acidophilus* bacteria and prebiotic fibers present in Yovita. "The prebiotic definition does not emphasize a specific bacterial group. Generally, however, it is assumed that a prebiotic should increase the number and activity of bifidobacteria and lactic acid bacteria. The importance of the bifidobacteria is that these groups of bacteria have several beneficial effects on the host, especially in terms of regulating digestion, including enhancing mineral absorption and the effectiveness and intrinsic strength of the immune system." [5] These prebiotic fibers serve a natural environment for probiotic bacteria to stay alive in the way to the digestive system, as well.

"Bifidobacterium Lactis is a very powerful transient probiotic bacteria. Scientific studies have proven that B. Lactis enhances immunity, improves digestion and can lower cholesterol"[6].

[4]: http://en.wikipedia.org/wiki/Probiotic

[5]: http://en.wikipedia.org/wiki/Prebiotic_(nutrition)

[6]: http://probiotics.org/bifidobacterium-lactis/

"Lactobacillus produce lactic acid and are used for many different things, including yogurt production and the maintenance of healthy intestinal microflora. Lactobacilli are commonly associated with the gastrointestinal tract of humans" [7].

"Acidophilus is a type of germ or bacterium commonly found in the normal digestive tract of mammals, mainly in the small intestine. It is also found in many dairy products, especially yogurt. Acidophilus and some related bacteria are considered to be "probiotic" because they may help the body maintain or restore its normal balance of helpful bacteria" [8].

The mentioned bacteria living in the yoghurt brands work on maltose by means of digestion and in the end they provide the maltose to turn into its monosaccharide; glucose by supporting small intestine enzymes helpful in maltose digestion.

While there have been several studies on the effect of bacteria on digestion, there was a few knowledge about how digestive system may be affected by probiotic or prebiotic nature of the nourishes. This difference could be observed and measured in yogurt more easily. This was one of the several reasons why I chose yogurt as the main substance of my experiment.

As a basic rule of the biology every enzyme needs a substrate to work on. In my experiment this substrate was maltose. I chose maltose as a substrate because it is a disaccharide which would be broken down into two glucose molecules so that it would be easier to collect data during the experiment by measuring increasing glucose levels.

[7]: http://microbewiki.kenyon.edu/index.php/Lactobacillus

[8]: http://www.cancer.org/Treatment/TreatmentsandSideEffects/ComplementaryandAlternativeMedicine

"Maltose or malt sugar, is a disaccharide formed from two units of glucose joined with an α(1→4)bond. The isomer "isomaltose" has two glucose molecules linked through an

α(1→6) bond. Maltose is the second member of an important biochemical series of glucose chains. Maltose is the disaccharide produced when amylase breaks down starch."[9]

This paper will focus on the research question: "How does the presence of prebiotic fibers in probiotic yoghurts in Activia and Yovita affect the digestion rate of maltose sugar therefore the production rate of glucose?" and will discuss how the experiment designed was planned and performed, as well as examining the results obtained by evaluating their validity and will also attempt to analyze their possible consequences. In other words, the effects of prebiotics and probiotics will be observed on the maltose to deduce the yoghurts' effects on the nutrition we eat.

[9]: http://en.wikipedia.org/wiki/Maltose

HYPOTHESIS

"A probiotic enters the intestinal tract and helps regulate the various bacteria that help with digestion and nutrient absorption. Whereas, prebiotics are the fertilizer for productive bacterial growth, feeding probiotic bacteria and assisting in its growth, helping healthy probiotic bacteria through digestive acids, keeping them whole and able to reach their final destination." [10]

Probiotics included in both yoghurt trades are "beneficially affecting the host by helping to reach digestional balance by means of intestinal microbial balance"[11]. Also, prebiotics are helpful in the digestive system by serving a natural environment to probiotic bacteria in order to assist them reach the digestive system as healthy as possible.

It can therefore be hypothesized that as the prebiotic fibers are included in the yoghurt, the rate of maltose digestion increases and the amount of maltose decreases by being digested and forming glucose. Accordingly, it can be said that yoghurt with prebiotic fibers in addition to probiotics is more effective in maltose digestion than one including only probiotics where the null hypothesis is; there will be no significant difference between the results of two yoghurt trades. It is also expected that the maltose in Yovita, including probiotic bacteria and prebiotic fibers, somehow be digested quickly when compared to the Activia including only probiotic bacteria. This was deduced by basing on the information about the function of prebiotics stated in the introduction.

[10]: http://www.ehow.com/how-does_4924224_how-prebiotics-probiotics-work.html

[11]: http://en.wikipedia.org/wiki/Probiotic

METHOD DEVELOPMENT AND PLANNING

Designing an appropriate method in order to support or reject the proposed hypothesis and answer the given research question brought various problems with it. One of them was how to take the ingredients of yoghurts as similar as possible. Because, without being able to determine this accurately, the whole quantitative data of turning maltose into glucose molecules would differ and cause unrealistic results. After a research, the problem could finally be solved by comparing every yoghurt brand with each other also consulting with nourishment experts.

Moreover, a further problem was determining the number of trials. This was a very significant step for being sure of the preciseness of the contrivance; otherwise, the experiment would be ruined without any conclusion. So that, it was decided to repeat the experiment 25 times including 5 trials for each different masses of each yoghurt brand; 10g, 20g, 30g, 40g and 50g. This would provide irrevocable data and prevent personal errors.

Including microorganisms like prebiotics and probiotics exposed an additional problem of observation and data collection. By using a food substance (yoghurt), the familiar ways of data collection became inconvenient because; no rulers, no electronic data collectors or any other experimental equipment could serve an appropriate chance for observation and simple data collection. As a result, including maltose as a substrate, which was a disaccharide consisted of two glucose molecules, it was planned to measure the digestion rate in yoghurts by using a glucometer. What's more, the data analysis would have made by using methods of t-tests between same masses of different yoghurts and ANOVAs in the same yoghurt among different masses.

Time was a major factor of the experiment, as well. The observation periods of trials were carrying a great importance also creating a big problem. Because of being the first of

these kinds of experiments in school, there was no source to arrange time in accordance. If the time was taken too short, the digestion couldn't have occurred, or if it would be too long then the enzymes would probably lose their ability and the data would fail in the end. So ten minutes were thought to be enough for each trial.

Now it became important to make sure that all variables were being controlled. Light intensity, temperature, pH, and humidity are the most apparent of these variables and were dealt with accordingly. It was decided to perform the practical in a room, as it is without a window and thus has a very stable temperature, as well as enabling the light to be thoroughly controlled. In addition, the pH values were stabilized in both Yovita and Activia yoghurts.

The reason behind selecting two different yoghurt brands was, initially, to compare the results and reach the experimental conclusion with valid statistics and secondly it was preferred to study with two rather than three or more yoghurts in order to control the variables easily also with minimum percent errors, because the laboratory was not professionally designed for this experiment and the experiment was held out without a partner.

Apart from that, there were independent and dependent variables having great roles in all experiments. Firstly, the independent variable was the mass of prebiotic fibers that Yovita contained different from Activia. Based on the independent variable, the rate of digestion and the amount (in mg) of formed glucose changed were categorized as dependent variable.

Early trials were carried out to monitor whether the contrivance worked without any problem in a coherent way. After the first trial the experiment reached a success, however, in the first one because of a technical problem in the scale, the maltose amount couldn't have estimated. As the problem was solved, before carrying out the second trial, the essential variables had to be controlled; light intensity, temperature, humidity and pH. In order to

achieve correct results it was also necessary to equalize the amount of yoghurt and maltose in both beakers.

Finally, for the accuracy of the results in all trials there were some vital points to pay attention. The crucial one was the arrangement of time during the reaction. Furthermore, the amount of glucose should have recorded from the initial moment to the last one to observe the changes perfectly in the specific time period.

METHOD

Materials and Aparatus

1. 750 g of first yoghurt trademark: Activia
2. 750 g of second yoghurt trademark: Yovita
3. maltose monohydrate sugar(750g)
4. glucose measurer strips
5. chronometer(±0.01s)
6. analytical balance(±0.1)
7. 25 petri dishes
8. 50 glass beaker of 250 cm3
9. thermometer(±0.1ºC)
10. humidity measurer(±1%)
11. pH-indicator strips(0-14)
12. 2 glass stirrer
13. 3 spoons
14. gloves
15. white paper(A4)
16. pen

The experiment is a process of digestion in which the effects of bacteria are investigated by using two different yoghurt trades. To explain the process, it is needed to emphasize the substances used, such as; yoghurts (Yovita & Activia), maltose as a substrate, and necessary lab materials. To begin with, the experiment process is an observation period of maltose in two different yoghurts. Moreover, the results will be taken into consideration and

the yoghurt which provides quicker digestion and the optimum digestion environment will be decided.

The system was designed with fifty glasses of beakers, the first twenty five were filled with the yoghurt Activia and the other twenty five beakers were filled with the yoghurt Yovita each including 10 grams which were measured in analytical balance. Moreover, after the preparation of yoghurts the maltose sugars were placed into the 25 petri dishes again on the analytical balance and they were adjusted to 5g each.

To 10g of yoghurts, 5 grams of maltose sugar were added one by one, the mixtures were stirred until all of the maltose dissolved in the yoghurt, the chronometer was immediately started and left for 10 minutes to provide the maltose sugar being digested in the highly digestive yoghurts. Meanwhile, the glucose amount in the beaker was measured by glucose measurer strips in each 2,5 minutes. This procedure was repeated for 20g, 30g, 40g and 50g of yoghurts including 50% maltose in 50 beakers one after another and each brand was labeled from 1 to 25, so there were 25 Yovita beakers and 25 Activia beakers obtained.

The contivance was not set with two variables as maltose and yoghurt masses and presence of prebiotics. The experiment was held out with different masses of yoghurts, however, in each of them the yoghurt mass to maltose mass ratio was constant (50%) so that it should not be counted as a variable. The aim of applying this change was to observe the same effect in each added mass of yoghurt and to be sure of the digestive activity in both low and high masses such as 20g and 50g.

The significant point was that; the beakers were placed in the same environment to avoid any possible errors. Also, the temperature, humidity and light intensity of the room

were stabilized by controlling all exists in the room (laboratory) such as; windows, door, air-conditioning and at the same time precisely measuring by devices.

After 10 minutes the maltose sugar in the beakers would totally be broken up by the enzymes in yoghurts and turned into their simple compounds; glucose and by using glycogen measurer strips, same as used in medicine for urinalysis, the glucose amounts(in mg)of each beaker were measured and noted. According to the data obtained, the digestivity of the two yoghurt trademarks would be decided on the basis of glucose amounts appeared in 10 minutes.

To reach a unique result some procedures had to be done to the recorded data. First of all, by applying two ANOVAs to the data group of Yovita and Activia separately, we reached the mean values of produced glucose mass in each yoghurt. Furthermore, five t-tests were exerted to the data groups of different yoghurts having same masses.

The experiment included 25 trials for each trademark so that the error and uncertainty was kept as minimum and the average result was recorded as the final finding of the experiment.

Picture 1: materials used during the experiment

Picture 2: used glucose measurer strips

Picture 3: 25 trials in beakers for Activia.

Picture 4: 25 trials in beakers for Yovita.

RESULTS:

Name of the yoghurt	Trials	Initial mass of the yoghurts (±0.1g)	Mass of the maltose (±0.1g)	Time measured for digestion occur (min±0.008)	Tempe-Rature of room (± 0.05°C)	Humidity of room (±1%)	Initial glucose amount in 100g of the yoghurt (±0.1mg)	Final glucose amount in the beaker (±0.1mg)	Glucose produced by the digestion of maltose (±0.1mg)
ACTIVIA	1	10.0	5.0	10.000	24.7**0**	35	100.0	1100.0	1000.0
	2	**10.0**	**5.0**	**10.000**	**24.70**	**35**	**100.0**	**1200.0**	**1100.0**
	3	10.0	5.0	10.000	24.7**0**	35	100.0	1200.0	1100.0
	4	**10.0**	**5.0**	**10.000**	**24.70**	**35**	**100.0**	**1050.0**	**950.0**
	5	10.0	5.0	10.000	24.7**0**	35	100.0	1100.0	1000.0
YOVITA	**1**	**10.0**	**5.0**	**10.000**	**24.70**	**35**	**90.0**	**1590.0**	**1500.0**
	2	10.0	5.0	10.000	24.7**0**	35	90.0	1590.0	1500.0
	3	**10.0**	**5.0**	**10.000**	**24.70**	**35**	**90.0**	**1690.0**	**1600.0**
	4	10.0	5.0	10.000	24.7**0**	35	90.0	1740.0	1650.0
	5	**10.0**	**5.0**	**10.000**	**24.70**	**35**	**90.0**	**1440.0**	**1350.0**
ACTIVIA	1	20.0	10.0	10.000	24.7**0**	35	100.0	1000.0	900.0
	2	**20.0**	**10.0**	**10.000**	**24.70**	**35**	**100.0**	**1100.0**	**1000.0**
	3	20.0	10.0	10.000	24.7**0**	35	100.0	1150.0	1050.0
	4	**20.0**	**10.0**	**10.000**	**24.70**	**35**	**100.0**	**1100.0**	**1000.0**
	5	20.0	10.0	10.000	24.7**0**	35	100.0	1050.0	950.0
YOVITA	**1**	**20.0**	**10.0**	**10.000**	**24.70**	**35**	**90.0**	**1490.0**	**1400.0**
	2	20.0	10.0	10.000	24.7**0**	35	90.0	1390.0	1300.0
	3	**20.0**	**10.0**	**10.000**	**24.70**	**35**	**90.0**	**1740.0**	**1650.0**
	4	20.0	10.0	10.000	24.7**0**	35	90.0	1290.0	1200.0
	5	**20.0**	**10.0**	**10.000**	**24.70**	**35**	**90.0**	**1490.0**	**1400.0**
ACTIVIA	1	30.0	15.0	10.000	24.7**0**	35	100.0	1050.0	950.0
	2	**30.0**	**15.0**	**10.000**	**24.70**	**35**	**100.0**	**1150.0**	**1050.0**
	3	30.0	15.0	10.000	24.7**0**	35	100.0	900.0	800.0
	4	**30.0**	**15.0**	**10.000**	**24.70**	**35**	**100.0**	**800.0**	**700.0**
	5	30.0	15.0	10.000	24.7**0**	35	100.0	850.0	750.0
YOVITA	**1**	**30.0**	**15.0**	**10.000**	**24.70**	**35**	**90.0**	**1690.0**	**1600.0**
	2	30.0	15.0	10.000	24.7**0**	35	90.0	1290.0	1200.0
	3	**30.0**	**15.0**	**10.000**	**24.70**	**35**	**90.0**	**1980.0**	**990.0**
	4	30.0	15.0	10.000	24.7**0**	35	90.0	1490.0	1400.0
	5	**30.0**	**15.0**	**10.000**	**24.70**	**35**	**90.0**	**1600.0**	**1510.0**
ACTIVIA	1	40.0	20.0	10.000	24.7**0**	35	100.0	1100.0	1000.0
	2	**40.0**	**20.0**	**10.000**	**24.70**	**35**	**100.0**	**1200.0**	**1100.0**
	3	40.0	20.0	10.000	24.7**0**	35	100.0	850.0	750.0
	4	**40.0**	**20.0**	**10.000**	**24.70**	**35**	**100.0**	**900.0**	**800.0**
	5	40.0	20.0	10.000	24.7**0**	35	100.0	800.0	700.0
YOVITA	**1**	**40.0**	**20.0**	**10.000**	**24.70**	**35**	**90.0**	**1490.0**	**1400.0**
	2	40.0	20.0	10.000	24.7**0**	35	90.0	1290.0	1200.0
	3	**40.0**	**20.0**	**10.000**	**24.70**	**35**	**90.0**	**1490.0**	**1400.0**
	4	40.0	20.0	10.000	24.7**0**	35	90.0	1390.0	1300.0
	5	**40.0**	**20.0**	**10.000**	**24.70**	**35**	**90.0**	**1610.0**	**1520.0**
ACTIVIA	1	50.0	25.0	10.000	24.7**0**	35	100.0	850.0	750.0
	2	**50.0**	**25.0**	**10.000**	**24.70**	**35**	**100.0**	**1150.0**	**1050.0**
	3	50.0	25.0	10.000	24.7**0**	35	100.0	900.0	800.0
	4	**50.0**	**25.0**	**10.000**	**24.70**	**35**	**100.0**	**950.0**	**850.0**
	5	50.0	25.0	10.000	24.7**0**	35	100.0	850.0	750.0
YOVITA	**1**	**50.0**	**25.0**	**10.000**	**24.70**	**35**	**90.0**	**1090.0**	**1000.0**
	2	50.0	25.0	10.000	24.7**0**	35	90.0	1540.0	1450.0
	3	**50.0**	**25.0**	**10.000**	**24.70**	**35**	**90.0**	**1740.0**	**1650.0**
	4	50.0	25.0	10.000	24. 7**0**	35	90.0	1560.0	1470.0
	5	**50.0**	**25.0**	**10.000**	**24.70**	**35**	**90.0**	**1790.0**	**1700.0**

Table 1: Table showing the names and initial mass of yoghurts, time measured for digestion, temperature & humidity of room, initial glucose amount in the 100g yoghurt, final glucose amount in the beaker and glucose produced by the digestion of maltose.

DATA ANALYSIS

Anova Between Different Masses of Activia:

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Mean*	*Variance*
10g	5	5150	1030	4500
20g	5	4900	980	3250
30g	5	4250	850	21250
40g	5	4350	870	29500
50g	5	4200	840	15500

ANOVA

Source of Variation	*SD*	*df*	*MS*	*F*	*P-value*	*F criterion*
Between groups	146600	4	36650	2,476351	0,04718	2,866081
Within groups	296000	20	14800			
Total	442600	24				

Anova Between Different masses of Yovita:

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Mean*	*Variance*
10g	5	7600	1520	13250
20g	5	6950	1390	28000
30g	5	6700	1340	60550
40g	5	6820	1364	14480
50g	5	7270	1454	76330

ANOVA

Source of Variation	*SD*	*df*	*MS*	*F*	*P-value*	*F criterion*
Between groups	106936	4	26734	0,693993	0,048561	2,866081
Within groups	770440	20	38522			
Total	877376	24				

T-test Between 10g Activia and Yovita:

t-Test: Paired Two Sample for Means

	Activia	*Yovita*
Mean	1030	1520
Variance	4500	13250
Observations	5	5
Pearson Correlation	-0,01619	
Hypothesized Mean Difference	0	
Df	4	
T Stat	-8,16667	
P(T<=t) one-tail	0,000612	
T Critical one-tail	2,131847	
P(T<=t) two-tail	0,001224	
T Critical two-tail	2,776445	

T-test Between 20g Activia and Yovita:

t-Test: Paired Two Sample for Means

	Activia	*Yovita*
Mean	980	1390
Variance	3250	28000
Observations	5	5
Pearson Correlation	0,301382	
Hypothesized Mean Difference	0	
Df	4	
T Stat	-5,74115	
P(T<=t) one-tail	0,002280	
T Critical one-tail	2,131847	
P(T<=t) two-tail	0,004561	
T Critical two-tail	2,776445	

T-test Between 30g Activia and Yovita:

t-Test: Paired Two Sample for Means

	Activia	*Yovita*
Mean	850	1340
Variance	21250	60550
Observations	5	5
Pearson Correlation	-0,07318	
Hypothesized Mean Difference	0	
Df	4	
T Stat	-3,71361	
P(T<=t) one-tail	0,010294	
T Critical one-tail	2,131847	
P(T<=t) two-tail	0,020589	
T Critical two-tail	2,776445	

T-test Between 40g Activia and Yovita:

t-Test: Paired Two Sample for Means

	Activia	*Yovita*
Mean	870	1364
Variance	29500	14480
Observations	5	5
Pearson Correlation	-0,71851	
Hypothesized Mean Difference	0	
Df	4	
T Stat	-4,06946	
P(T<=t) one-tail	0,007615	
T Critical one-tail	2,131847	
P(T<=t) two-tail	0,01523	
T Critical two-tail	2,776445	

T-test Between 50g Activia and Yovita:

t-Test: Paired Two Sample for Means

	Activia	*Yovita*
Mean	840	1454
Variance	15500	76330
Observations	5	5
Pearson Correlation	0,074136	
Hypothesized Mean Difference	0	
Df	4	
T Stat	-4,66196	
P(T<=t) one-tail	0,004788	
T Critical one-tail	2,131847	
P(T<=t) two-tail	0,009576	
T Critical two-tail	2,776445	

Mass of the yoghurt (±0.1g)	**P-value calculated in t-test**	**P<0.05**
10	0,000612	yes
20	0,002280	yes
30	0,010294	yes
40	0,007615	yes
50	0,004788	yes

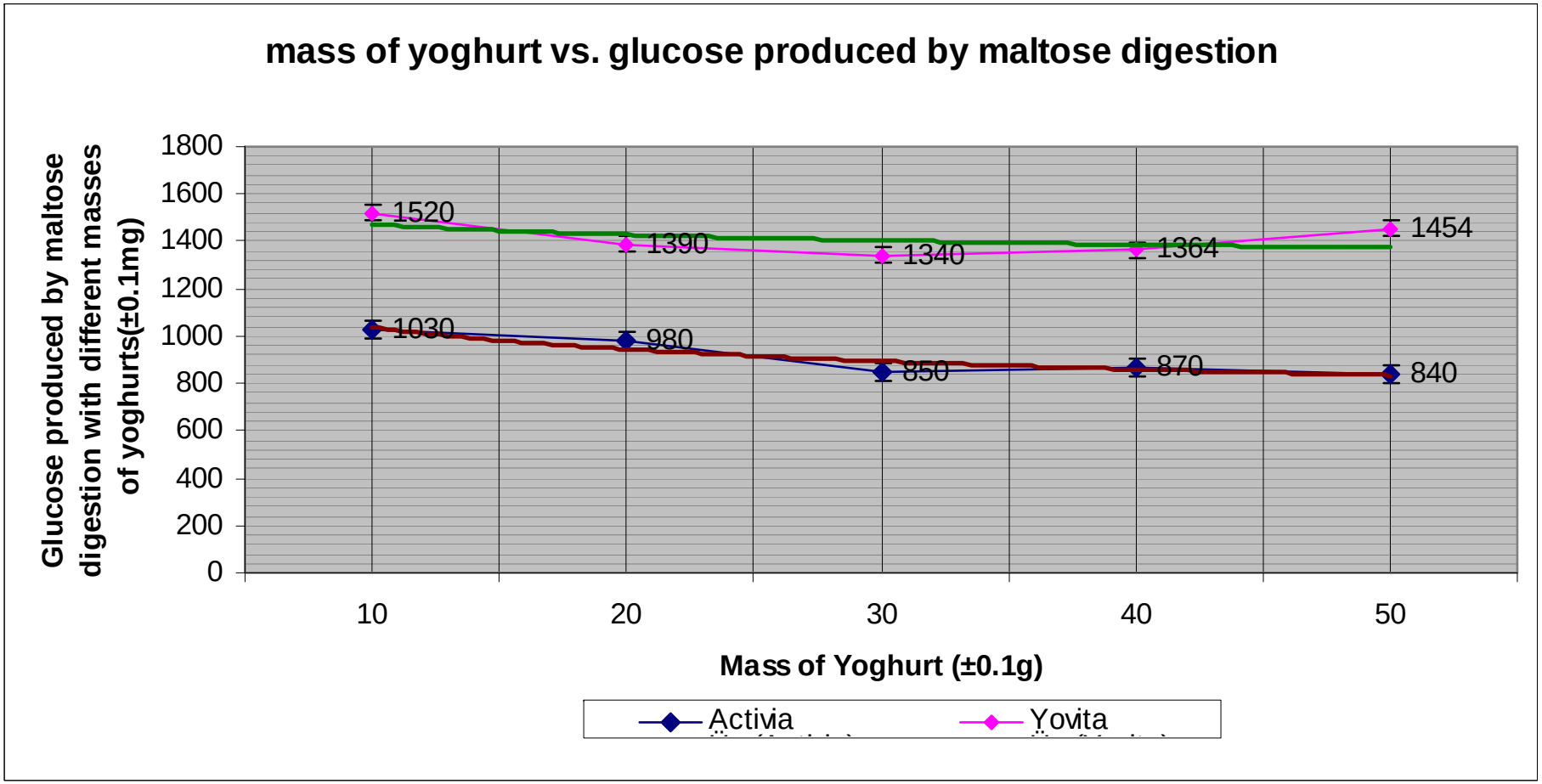
Table 2: Table showing the calculated p-values in t-tests applied between same masses of Activia and Yovita results.

Yoghurt Trade	**Mass of the yoghurt (±0.1g)**	**Mean value of glucose produced by maltose digestion (±0.1mg)**
Activia	10.0	1030.0
	20.0	980.0
	30.0	850.0
	40.0	870.0
	50.0	840.0
Yovita	10.0	1520.0
	20.0	1390.0
	30.0	1340.0
	40.0	1364.0
	50.0	1454.0

Table 3: Table showing the mean value for maltose turned into glucose at different masses of Activia and Yovita yoghurts.

Yoghurt Trade	**Mean value of totally produced glucose amount(±0.1mg)**
Activia	914.0
Yovita	1413.6

Table 4: Table showing the mean values of synthesized glucose at different masses for both Activia and Yovita yoghurts.



Graph 1: Graph showing the glucose produced (in milligrams) at different masses(10g, 20g, 30g, 40g, 50g) with constant maltose mass to yoghurt mass ratio of different yoghurt trades; Activia and Yovita.

EVALUATION

The aim of this experiment was to determine whether the pure probiotic yoghurt or probiotic yoghurt containing prebiotic fibers was more effective on the digestion where maltose disaccharide was used as a substance. It was hypothesized that the yoghurt supported with prebiotics; Yovita would have a more definite result on the substance to break it down to glucose monosaccharide in means of serving a better environment to the probiotics when compared to the result of pure probiotic yoghurt; Activia.

Yovita adduced a better digestive behavior leading a great mass of glucose synthesis, followed by Activia which was not bad but insufficient to reach the expected result. The mean values of glucose synthesis at each mass of Activia; 10g, 20g, 30g, 40g and 50g were ranged between 840 to 1030 mg with the total mean value of 914.0 mg, whereas the mean values of glucose synthesis at each mass of Yovita; 10g, 20g, 30g, 40g and 50g were ranged between 1340 to 1520 mg with the total mean value of 1413.6 mg which Activia had not reached even as a mean value at each mass.

To be clear the attention should be drawn to the the changing masses of yoghurts and maltose sugar. They were not the independent variables because the ratio between them was constant(50%), they were only control groups; a way of checking the experiment with higher masses to generalize the hypothesis.

The proposed null hypothesis was that; there would be no significant difference between the produced glucose amounts of Yovita and Activia. It seemed to me that there was a significant difference between the mean values of two trades but to be precise and accurate I had calculated the p-value for each mass of yoghurts to look at the statistical difference whether it was meaningful or not. As the p-values of comparisons of the groups calculated

with Analysis of Variance(ANOVA) were estimated smaller than 0.05, the null hypothesis is rejected that; there is a significant difference between the produced glucose amounts of Yovita and Activia (see Table 2).

The alternative hypothesis which was "as the prebiotic fibers are included in the yoghurt, the maltose decreases by being digested and forming glucose" in other words, if the prebiotic fibers are present in yoghurt, then the glucose synthesized would be more, as well. So the main hypothesis is accepted according to the results of the experiment which highly support our claim. (see Table 4)

One configuration of the results that was not expected was the time measured for bacteria (yoghurt), to complete the digestion of maltose in the beakers, are at close quarters for both yoghurts, which I personally taught that Activia would result in a relatively long period.

Both of the yoghurts have apparent differences in the masses of produced glucoses. The prebioticly supported yoghurt is obviously more efficient in digesting the maltose into glucose. On the other hand, the only probiotic containing yoghurt is digesting maltose nearly 36% less than the other one.

Standard deviation shows us how much dispersion from the mean value. Standard deviation of Activia is greater than the standard deviation value of Yovita given respectively as 146600 and 106936.

The graph shows us the mean values of glucose synthesis at each mass for Activia and Yovita on the same scale to enable us compare the findings more easily. Moreover, it also implies the errors with the error bars and the best fit line, also referred as trend line, is at the

same distance from all points so it shows us the proximity of results to the points on the line. (see Graph 1)

During the experiment; I had confronted with nothing unexpected that had an effect on the results of the study. However, when I was considering the method while writing the essay I had drawn my attention to some points that may create systematic errors which are listed below with some attached suggestions:

1. Although the ingredients of yoghurts were chosen as close as possible, by being products of different trademarks there stayed a small difference which may accelerate or decelerate the digestion of maltose into glucose. There should be yoghurts just differing in prebiotic fibers for more accurate results.
2. The initial glucose included in both yoghurts are calculated to be 500mg in 100g, however, there could have been some errors at its calculation and that may differ the change in glucose amount at the end. The experiment should be repeated by using a technological instrument with a low uncertainty.
3. As only one brand was used for each kind of yoghurt in the experiment, they may not reflect the whole characteristics of that classification. For example; Yovita, alone, does not represent the whole characteristics of the probiotic yoghurts including prebiotic fibers and also Activia is not capable of containing all properties of probiotic yoghurts.
4. Only single species of substance was used which was maltose but the effects might be different if the substances are varied and so dissimilar results may have been obtained from the newly used substance. In fact, this can not be counted as an error because the aim of the essay was limited with a single factor having an effect on the experiment. Repeating and analyzing the same experiment with different substance only lead us to a more accurate general fact that we may use in daily life.

5. The experiment is held in room conditions at 24.7ºC temperature and 35% humidity, however, these conditions may not be the optimum ones for bacteria to work in full performance as they do in the digestive track. So that, the experiment can be repeated in advanced laboratory provided more realistic environment.
6. The maltose used in the experiment may not completely show the properties of nutrition that we catalyze in our body, so the obtained results may have differed if the experiment was done with real nutrients in human body.
7. Despite including probiotics in common, the probiotic bacteria kind may differ from one yoghurt trand to another. For instance; Bifidibacterium is the only common one.
8. Doing the whole procedure on my own might have caused some errors, as well. It would be more accurate and precise if I had a partner.
9. The method included stirring after the addition of maltose to the yoghurt, but although they are stirred at equal time intervals the power and quickness of the stirring might have differed a bit which may cause an error at produced glucose masses.

CONCLUSION:

I have tried to clarify the answer of my research question: "Does the presence of prebiotic fibers in probiotic yoghurts affect the digestive activity of the yoghurt brand?" throughout my essay in the light of the results of my study.

The first reason I was moved to study on this subject in my extended essay was to obviate my curiosity and overcome the question in my mind constituted because of the unknown change in my friend's digestive property with the changing yoghurt brand. However, by being such a well rounded subject and me not being capable of dealing with such a large investigation, I had to limit my study to two yoghurt brands (Yovita and Activia) and a substrate (malt sugar) which I can put a good show. Although, there are studies with larger extends are held with similar topics, I have never confronted with any experiment done with Yovita and Activia together with maltose. This is the point my essay differs from other studies and researches on this topic; this has never been tried before.

There is a significant difference between the digestive activity of Yovita, in which probiotics and prebiotics cooperate, and Activia where only probiotic nature can be encountered. Yovita is more efficient yoghurt on the nutrient (maltose in this experiment) by means of digesting it to monomers as expected. At all masses; 10g, 20g, 30g, 40g and 50g of each yoghurt taken the alternative hypothesis is supported which was "as the prebiotic fibers are included in the yoghurt, the rate of maltose digestion increases and the amount of maltose decreases by being digested and forming glucose." Although the method can be modified for more accurate results, I personally consider this study as successful.

"Research at the University of California at Davis showed that eating live-culture yoghurt was associated with higher-than-average levels of gamma interferon, a key component of the body's immune system" [12] As discussed and proved in my study too, it is strongly advised to use products containing prebiotic fibers to transfer probiotics to the digestion system alive.

[12]: http://www.leaflady.org/yoghurt.htm

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