THE EFFECTIVENESS OF *Pachyrhizus erosus* IN LESSENING INTESTINAL COLIFORMS

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ABSTRACT

This study was conducted to determine if Pachyrhizus erosus is effective in lessening intestinal coliforms. Specifically, it sought to: 1) to determine the perceived effectiveness of Pachyrhizus erosus as compared to prebiotic (positive control) and water (negative control) in terms of color, consistency, and growth of colonies 2) to determine the changes in children's stool characteristics after taking Pachyrhizus erosus in terms of color, consistency, and growth of colonies 3) to determine the significant difference in the stool analysis before and after taking Pachyrhizus erosus. The study employed an experimental type of research design. There were 32 respondents that were chosen through convenience sampling. A pre and post stool culture test was administered to 30 respondents. Aside from this, a separate study of a positive control and negative control was done to standardize the measure of success of the study. The mean of the percentage of color, consistency, and growth of the colonies was computed. The t-test was also used to assess the result of the pre and post test of stool culture. The results shows that Pachyrhizus erosus (singkamas) is not only a vegetable you eat everyday, but it is also a good substitute for probiotic drinks. Further, studies should be done regarding Pachyrhizus erosus.

Keywords: *prebiotic, probiotic, intestinal coliforms, Pachyrhizus erosus*

INTRODUCTION

According to Sharpe (2017), coliform bacteria is a large group of different types of bacteria that can be isolated throughout the environment. They reside in soil and surface water and can be found on human skin. There is a great number of coliform bacteria that can be seen from the body waste of both humans and animals. Most of them are harmless, but some can cause mild illnesses, and a few can lead to serious human diseases. Washington State Department of Health (2016) suggested to use coliform bacteria as a medium to test the presence of pathogens because it is easy to culture and inexpensive. It can also be performed in aerobic and anaerobic conditions.

There are various groups of coliform bacteria-- total coliform bacteria, fecal coliform bacteria, and *E.coli.* The total coliform bacteria can be seen mostly in our environment-- in soil or vegetation, while fecal coliform bacteria are present in feces of humans and animals. On the other hand, *E.coli* commonly exist in the intestines. Each group is a subgroup of the other. Fecal coliform bacteria are the subgroup of total coliform bacteria, and *E.coli* is also a subgroup of fecal coliform bacteria (Water Research Center, 2014).

Jicama or Singkamas (*Pachyrhizus erosus*) is a large bulbous vegetable that is rich in soluble fibers such as oligofructose and inulin that serve as prebiotics or food for the good bacteria (Jackson, 2016). Aside from this, it also contains carbohydrates and fibers that can boost bone strength (Jackson, 2016). Many related studies also showed that it has a very low glycemic index which is good for diabetics and is low in calories that is beneficial for those interested in weight reduction (Balzer & Steinbeck, 2016; Hubbard, 2016).

Despite a lot of beneficial nutrient content of Jicama or Singkamas (*Pachyrhizus erosus*), the researchers did not find any study published regarding its effect to coliform bacteria. The

researchers assessed the components of Jicama or Singkamas (*Pachyrhizus erosus*) and its viability as a medical breakthrough in reducing pathogens in the human body. To be more specific, the research study wants to determine if Jicama or Singkamas (*Pachyrhizus erosus*) is effective in lessening intestinal coliform.

METHODOLOGY

The study employed an experimental type of research design to technically determine the effectiveness of *Pachyrhizus* erosus in lessening the intestinal coliforms. The causal relationship of the two variables, (1) *Pachyrhizus erosus* and (2) intestinal coliforms, was tested through stool culture. A random number of respondents was asked to participate in the experiment.

Research Design

The researchers used experimental research design for the study. A pre and post stool culture test were administered to 30 respondents. Aside from this, a separate study of a positive control and negative control was done to standardize the measure of success of the study. The independent variable was the amount of *Pachyrhizus erosus* consumption while the colony of coliforms was the dependent variable.

Research Locale

The study was conducted in various places of Calamba and Cabuyao, Laguna but the experimentation was conducted at a laboratory in LPU-Laguna.

Respondents of the Study

The respondents of the study were chosen through convenience sampling. They are 19-25 year old students and relatives of the

researchers. Due to cost and time constraints, the researchers have chosen convenience sampling for the study.

Data Collection

Materials used in microscopic examination and stool culture of feces

The researcher used the following instruments and materials: petri dish, autoclave, incubator, refrigerator, inoculating loop, MacConkey agar, Erlenmeyer flask, stirring rod, stool container, weighing scale, and alcohol lamp.

Data Gathering Procedure

Before the start of the actual data gathering, the researchers asked for the authentication of singkamas from the National Museum. Afterwards, they randomly selected 32 respondents who were willing to participate in the experiment. They conducted a pre-test and post test of the 32 respondents' stool culture. The respondents were given 5 days to consume 100 grams of singkamas (*Pachyrhizus erosus*) after lunch.

Table 1. Number of respondents

No. of Respondents	Kind of Intake for the Five Days	Kind of Experiment
30	*Pachyrhizus erosus*	Actual Testing
1	Probiotic drink	Positive Control
1	Water Intake	Negative Control

Specimen collection

The researchers collected stool sample in a clean, dry, wide-mouth bottle with a light-fitting lid to retain moisture and to prevent

spillage. The amount of stool needed was about the size of a thumb. About 5-6 tablespoons, if it is watery or mucoidal. Stool must be free from urine, toilet water, and soil. The researchers examined the color and consistency of the stool using the Bristol stool chart then wrote their observation in the laboratory reports.

The culture was done on an agar plate that was incubated at the right temperature for the bacterial growth. After the bacterial colonies grew on the medium, the bacteria were observed by the growth of colonies (light growth, moderate growth, and heavy growth). The stool culture lasted for 48 to 72 hours.

MacConkey Agar Preparation

The materials used were: sterilized Erlenmeyer flask, stirring rod, petri dish, MacConkey agar powder, and distilled water. The researchers weighted 15 grams of MacConkey agar powder then mixed it with 250mL of distilled water in the Erlenmeyer flask until the MacConkey agar powder was dissolved. It was sterilized by autoclaving and was cooled at room temperature. Before pouring into sterile petri plates, it was mixed well.

Stool culture procedure

The researchers sterilized the inoculating loop using an alcohol lamp by placing the loop to the flame until it is red hot, then allowed it to cool down. Using the inoculating loop, the experimenters obtained a loopful of the sample and streaked it over approximately half of the agar plate using parallel streaks. The inoculating loop was sterilized again and was cooled down. The researchers went back to the edge of the first area that was just recently streaked, then extended the streaks at about ¼ of the agar plate. After, the inoculating loop was strerilzied again and was cooled down. Going back to the second area that was just streaked, the streaks were extended at about ¼ of the plate. Lastly, the researchers labeled the petri dish after streaking.

Ethical Considerations

The participants were given an informed consent and were asked to sign a waiver that they were voluntarily participating in the research study regarding the effectiveness of *Pachyrhizus erosus* in lessening intestinal coliforms. It was also stated in the waiver that the participants are free to withdraw their participation at any time.

Data Analysis

This study determined the perceived effectiveness of *Pachyrhizus erosus* in lessening intestinal coliforms. A compared t-test of the pre and post test result of the stool culture was utilized to prove its prebiotic effect against bacteria.

RESULTS AND DISCUSSION

This chapter elaborated on the results and discussion that were gathered from the five-day experimental study of the researchers. The researchers have applied a Paired T-test to determine and evaluate the effectiveness of Pachyrhizus Erosus.

Table 2. Changes in Stool Color, Consistency and Growth of Colonies applying *Pachyrhizus erosus* and Controls

Stool Characteristics	(+) Control		(-) Control		*Pachyrhizus erosus* ($\bar{x}$)	
	Before	After	Before	After	Before	After
Color	Dark Brown	Dark Brown	Light Brown	Light Brown	Light Brown	Brown
Consistency	Type 3	Type 3	Type 4	Type 4	Type 3	Type 3
Growth of Colonies	Heavy Growth	Moderate Growth	Heavy Growth	Heavy Growth	Heavy Growth	Moderate Growth

Table 2 shows that the pre and post test of intake of prebiotic *and Pachyrhizus erosus* had the same effect in terms of color, consistency, and growth of colonies while there is no significant changes before and after the intake of water.

Monasterolo, et al. (2013), said that ability to prevent digestion and to be in the large intestine is the efficacy of prebiotic fibres such as inulin-type fructans, where they are completely fermented by the gut microbiota and that leads to a selective increase of good bacteria (e.g. bifidobacteria and lactobacillus). The saccharolytic fermentation of prebiotics by the colonic microbiota is led by an increase in the bacterial cell mass, an increase moisture component of digestion, and a softer stool consistency. The increase in bowel content mechanically stimulates peristalsis by which excretion is facilitated. Moreover, fermentation leads to the generation of fermentation end products such as short chain fatty acids (SCFA) which can directly influence intestinal motility by stimulating peristaltic reflexes similar to that induced by mechanical stimulation.

On the contrary, Spritzler (2017) stated that the gut microbiota is the group of bacteria and other microbes that reside in the gut. This gut microbiota is highly complex and composed of both good and bad bacteria. Having the right balance of bacteria is important for maintaining the gut healthy to protect the body against diseases. Inulin can help promote this balance. In fact, studies have proven that inulin can help promote the growth of good bacteria. Increasing the amounts of these bacteria can help improve the digestion, immunity, and overall health.

Table 3. Frequency and Percentages of the Changes in Stool Color after taking *Pachyrhizus erosus*

Stool Color	Before		After	
	Frequency	Percentages	Frequency	Percentages
Light Brown	14	46.7	14	46.7
Dark Brown	16	66.7	16	66.7
Total	30	100	30	100

Table 3 shows that no changes in color was observed in administering the three (3) paired t-test. Hence, the measures taken have no significant effect in the changes of the stool color.

Roth (2017) stated that iron-rich food can cause stools to become dark, from green to black. People with iron-deficiency anemia undergoing treatment and pregnant women taking prenatal vitamins are most likely experiencing darkened stools. Food rich in iron that could change the color of your stool when eaten in large quantities include prunes, beef, oysters, tofu, molasses, kidney beans, and raisins.

Wedro (2017) mentioned that the normal stool ranges from light to dark brown. Even though changes in stool color or texture can be normal, most changes should be evaluated. There are a lot of symptoms associated with stool color changes, such as food and drinks intake or illnesses.

Table 4. Frequency and Percentages of the Changes in Stool Consistency after taking *Pachyrhizus erosus*

Stool Consistency	Before		After	
	Frequency	Percentages	Frequency	Percentages
Type 3	9	30.0	11	36.7
Type 4	20	67	19	63.3
Type 6	1	3.3	0	0
Total	30	100	30	100

Type 3 = Sausage like Stool with cracks on the surface ; Type 4 =Sausage/snake like stool but soft and smooth ; Type 6= Flufffy with ragged edges

The table 4 shows that both intake of prebiotic drink and *Pachyrhizus erosus* have a better effect, exhibiting a Type 3 (sausage like stool with cracks) stool consistency than that of simply taking water which exhibits Type 4 (sausage/snake like stool). This is because *Pachyrhizus erosus* is rich in soluble fiber such as oligofructose and inulin that serve as prebiotics or food for the good bacteria called probiotics, present in the digestive system (Axe, 2017). Moreover, prebiotic drinks that contain “good” bacteria helps keep digestive system healthy by limiting the growth of harmful bacteria (Smith, 2017).

Roger (2017) mentioned that one of the most effective ways to treat sticky stool is to make healthy food choices. Eating a variety of fresh fruits and vegetables is a good suggestion for better digestive health. They contain soluble fiber which is important for proper bowel function. They also contain a range of nutrients for optimal overall health. Some of the best food to help keep your stool healthy are asparagus, broccoli, carrots, baked potato, sweet potato, green beans, mango, apricots, banana, oranges, oatmeal, and garbanzo beans.

According to Nugo (2018), one of the most common benefits of fiber is normalizing the bowel movements by increasing the weight and size of the stool and softening it, allowing it to pass more easily through the digestive system.

Table 5. Frequency and Percentages of the Changes in Stool Growth of Colonies after taking *Pachyrhizus erosus*

Stool Growth of Colonies	Before		After	
	Frequency	Percentages	Frequency	Percentages
Light	3	10	7	23.3
Moderate	7	23.3	23	76.7
Heavy	20	66.7	0	0
Total	30	100	30	100

Table 5 shows that the effect of taking *Pachyrhizus erosus* and drinking prebiotic drinks exhibited nearly the same results. Both exhibited a positive change. The growth of the colonies before taking the two measures was heavy growth while moderate growth was evident after the test was conducted. Thereby proving that *Pachyrhizus erosus* is effective in lessening intestinal coliforms and a good substitute for prebiotic drinks. This is also healthy since it is a natural food. No positive change was noted upon administering water to the respondents. Therefore, *Pachyrhizus erosus* and prebiotic drinks could aid in keeping the digestive system healthy.

Yap, et al. (2008) mentioned that they are fermented by colonic microbiota to short chain fatty acids (SCFA) and gas. β-(2-1)-fructans inulin and oligofructose or fructo-oligosaccharides (FOS) are found in many foods, specifically natural carbohydrates, such as leek, garlic, onion, artichoke, chicory, banana, asparagus, and wheat. Selective fermentation of these fructans by bifidobacteria could result to the

improvement of the composition of gut microflora. In vitro studies showed that oligofructose and inulin selectively promote the growth of bifidobacteria.

Slavin (2013) stated that dietary fibers, fructans, such as inulin, stimulate gastro-intestinal function by acting as prebiotics. They are refusal to digestion, fermentability, and selectivity that promote the growth of beneficial bacteria. Resistance to the digestion of the small intestine is due to the deficiency of enzymes that hydrolyze the polymer bonds in humans which allows the prebiotic to reach the colon intact and undergo fermentation by a limited number of bacteria species. Antioxidant capability followed by cooking and simulated digestion processes is preserved by the inulin.

Table 6. Compared Sample T-Test Results in the Perceived Effectivity of *Pachyrhizus erosus* in Improving Stool Characteristics and Decreasing Intestinal Coliform

Stool Characteristics	T	Df	Sig (2-tailed)	Interpretation
Color	.000	29	1.000	No Significant Difference
Consistency	1.140	29	.264	No Significant Difference
Growth of Colonies	7.954	29	.001	Significant Difference

Table 6 shows that the stool color and consistency had no significant changes after the intake of *Pachyrhizus erosus* while the growth of colonies had a significant change which was the target result of the study. Therefore, it is considered effective.

Slavin (2016), stated that polysaccharides were originally involved in dietary fiber. Oligosaccharides is also known as “prebiotics”. Based on the study, they have proven that inulin and oligofructose (OF), lactulose, and resistant starch (RS) lessen the bad bacteria, in example Bifidobacterium is a beneficial bacterial genus. They also isolated

galactooligosaccharides (GOS), transgalactooligosaccharides (TOS), polydextrose, wheat dextrin, acacia gum, psyllium, banana, whole grain wheat, and whole grain corn that are carbohydrates and carbohydrate-containing foods that has prebiotic effects.

Axe (2018), stated that oligosaccharide, a simple sugar, are that linked together to form fuctans such as inulin is a type of carbohydrate which is also a content of *Pachyrhizus erosus*. This makes the inulin pass through that does not absorbed by small and large intestines. The intestinal microflora such as bacterial organisms, including bifidobacterium that is in the gut ferments and feeds by the inulin. Oligofructose acts like a prebiotic that gives effect in the lining of the gut and colon. The reason why inulin-type fructans had proven to lessen the possibility of having colon carcinogenesis and inflammatory bowel diseases is that fermentation of inulin-type fructans in the large bowel allows the bacteria to grow that causes significant positive changes in the structure of the gut microflora and significantly decreases the number of harmful yeast, parasites and bacterial species living in the body that trigger inflammation.

CONCLUSIONS

In conclusion, the following significant results were identified by the researchers. There is a significant difference between the pre and post stool culture of *Pachyrhizus erosus* in decreasing intestinal coliforms. The pre and post test of stool culture shows that *Pachyrhizus erosus* has a favorable effect against intestinal coliforms.

The researchers also proved that there is no significance that the consumption of *Pachyrhizus erosus* has no effect on the stool color and consistency before and after the experiments.

There is a significant difference in the stool analysis before and after the consumption of the *Pachyrhizus erosus.* Therefore, the researchers were able to prove that the *Pachyrhizus erosus* has a potential action in lessening intestinal coliforms.

RECOMMENDATION

The following recommendations were identified by the researchers to improve the study: A random sampling method with a large number of respondents must be employed to ensure the greater validity of the results. For further studies, use other medium and agar plate in identifying the intestinal coliforms through biochemical testing. Increase the number of days of consumption of singkamas and implement monitoring food intake plan to limit the external factors that may affect the result of the study.

REFERENCES:

Acharya, T. (2013). Culture Media Used in Microbiology, Laboratory Diagnosis of Bacterial Disease, Microbiology. Retrieved from https://www.scribd.com/ document/323675471/Principles-of-MacConkey-Agar-Mannitol-Salt-Agar-Blood-Agar-Plate-and Chocolate-Agar-Plate

Axe, J. (2017). 7 Reasons to Get Prebiotics in Your Diet — Plus Best Sources. Retrieved from https://draxe.com/prebiotics on November, 2017

Axe, J. (2017). Jicama: Full of Prebiotic Fiber, It Helps Weight Loss. Retrieved from https://draxe.com/jicama/ on November, 2017

(2017). The difference between prebiotics & probiotics. Retrieved from https://www.thehealthychef.com/2017/05/whats-the-difference-between-pre-probiotics/ on November, 2017

Godofredo (2017). Philippine Medicinal Plant by the Philippine Alternative Medicine. Retrieved from http://www.stuartxchange.org/Sinkamas

Kanjan (2017). Plant Resources of South-East Asia. Retrieved from http://uses.plant project.org/en/Pachyrhizus_erosus_ (PROSEA)

Lixandru (2014). Properties and Benefits of Turnips. Retrieved from https://www. natureword. com/tag/turnip-and-vitamin-c/ on November, 2017

Mann, E. (2013). Dysregulated Circulating Dendritic Cell Function in Ulcerative Colitis Is Partially Restored by Probiotic Strain Lactobacillus casei Shirota*. Mediators of Inflammation*, *2013,*

Article ID 573576, 12. Retrieved from https://www.hindawi.com/journals/mi/2013/573576/

R. et al., (2013). The use of inulin-type fructans improves stool consistency in constipated children. Retrieved from http://www.tandfonline.com/doi/full/10. 1080/09637486.2016.1263605

Niness (2013). How the Plant Fiber Inulin Boosts Beneficial Bacteria in the Colon. Retrieved from https://bodyecology.com/articles/plant_fiber_inulin_boosts_ beneficial_bacteria_in_colon.php on November, 2017

, M. (2016). Stool color: When to worry. https://www.mayoclinic. org/stool-color/expert-answers/faq 20058080 on November, 2017

, G.(2017). Causes and Treatments for Sticky Poop. Retrieved from https://www. healthline.com/health/sticky-poop on November, 2017

What Foods Can Turn Your Bowel Movements Dark? Retrieved from https://www.livestrong.com/article/529564-what-foods-can-turn-your-bowel-movements-dark/ on November, 2017

, W. (2017). Health Effects of Coliform Bacteria. Retrieved from https:// extension.psu.edu/coliform-bacteria on November, 2017

J. (2013, April 22). Fiber and Prebiotics: Mechanisms and Health Benefits. *Nutrients*, *2013*. Retrieved from https://www.ncbi.nlm.nih.gov/ pubmed/23609775