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Baltaci, Aysegul ***Awareness, Availability, and Usage of Probiotic Foods by Local Food Pantry Participants***

Abstract

Food pantries, nonprofit organizations, have a crucial role in decreasing food insecurity for low-income and unemployed households. The types and brands of foods available at the pantries vary on a daily basis because of the variability of food products at their sources. Thus, the healthfulness of available food can vary significantly, including such staples as yogurt and cheese products. It is known that some brands of yogurt and cheese products contain probiotic bacteria, which are live microorganisms that provide health benefits to the consumer. The purpose of this research is two-fold: first, we have surveyed food pantry participants to assess their knowledge and selection of probiotic-containing foods; and second, we have evaluated and compared the availability and viability of probiotic cultures in the cheese and yogurts available at a local food pantry, in a retail market, and in fresh, homemade food products. The results show; 82.9% of questionnaire participants reported that they heard the word probiotics, but only 44% of those are knowledgeable on probiotics. Importantly, knowledge of probiotics correlates to increased consumption of yogurt but not pickles and cheese. *Lactobacillus* viability did not vary significantly between expensive and cheap yogurt brands but was absent in processed yogurt and cheese.

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Chapter I: Introduction

According to the Household Food Security in the United States 2016 report, published by Economic Research Center of United States Department of Agriculture, a total of 41.3 million people live in food insecurity in the United States, including 28.3 million adults and 12.9 million children (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2017). In the United States, food pantries play a significant role in decreasing food insecurity by providing food to low-income families (Rochester, Nanney, & Story, 2011).

A food pantry is defined as "a public or private nonprofit organization that distributes food to low-income and unemployed households, including food from sources other than the Department of Agriculture, in order to relieve situations of emergency and distress." (USLegal, 2016, n.p.). Food pantries offer various food types including dairy, fresh produce, meats, baked goods, and some personal items. Food pantries obtain foods and other items from food banks; local grocery stores such as Walmart, Aldi, and Co-op stores; and through individual donations.

The food selection at pantries varies daily due to the availability of foods from their sources. For instance, food pantries sometimes have very high quality, natural cheeses, and yogurts; while at other times have only highly processed cheeses or yogurts or none at all. High quality, natural cheese and yogurt are likely to have a stronger probiotic culture than highly processed foods. Because of the potential health benefits of probiotic-rich foods, assessing the probiotic strength of various cheeses and yogurts brands is an important question that may ultimately steer the availability of specific brands or food types at pantries.

The reputation of cultured foods with probiotic bacteria as functional foods is rapidly increasing due to its shown health benefits on the gastrointestinal tract (by alleviating symptoms of enteritis and irritable bowel syndrome) and the immune system in addition to their nutritional

value (Aljewicz, Siemianowska, Cichosz, & Tonska, 2014; Al Khalaileh & Ajo, 2013; Phillips, Kailasapathy, & Tran, 2006). The additional benefits of probiotics to human health include an enhanced immune response, reduction of serum cholesterol, vitamin synthesis, anti-carcinogenic activity, and antibacterial activity (Boylston, Vinderola, Ghoddusi, & Reinheimer, 2004).

Probiotic cultures are live microorganisms within a food product which provide a health benefit when consumed in adequate amounts, according to the World Health Organization (Fan, Breidt, Price, & Perez-Diaz, 2017). Probiotic cultures must survive in food products above a threshold level of 10^6 colony forming unit/gram (cfu/g) in the fermented milk products to offer health benefits (Al Khalaileh & Ajo, 2013; Talwalkar & Kailasapathy, 2004). The probiotics used primarily in the food products are *Lactobacillus, Bifidobacterium* and *Streptococcus thermophilus*, and more recently *Bacillus* (California Dairy Research Foundation, 2011). Probiotic strain composition, bacterial count and the applied carrier are the determinants of the effectiveness and type of the resulting health benefits (Aljewicz, Siemianowska, Cichosz, & Tonska, 2014). Dairy products are the most popular food vehicle of probiotics and some studies have shown that efficacy of probiotic delivery may be enhanced by dairy food matrix (Fan, Breidt, Price, & Perez-Diaz, 2017). Cheeses may be a better carrier for probiotic cultures due to their higher pH, lipid content, oxygen level, and storage conditions compared to fermented milk and yogurts. Fermented milk and yogurt products are not considered optimal for the maintenance of high concentrations of some probiotic strains due to poor viability in commercial yogurts (Boylston, Vinderola, Ghoddusi, & Reinheimer, 2004; Sharp, McMahon, & Broadbent, 2008). Nevertheless, yogurt is likely the most recognized vehicle for probiotics among the dairy products (Ng, Yeung, & Tong, 2010).

Statement of the Problem

As mentioned earlier, pH level, oxygen content, lipid content, and storage conditions likely impact the viability and availability of probiotic strains in food during processing and digestion. One of the most suitable and commonly used food vehicles to deliver probiotics to consumers is fermented dairy products (Casteele et al., 2006; Ng, Yeung, & Tong, 2010). The viability of probiotic bacteria in the fermented dairy products may change during processing, maturation and storage period until consumption (Mortazavian, Mohammadi, & Sohrabvandi, 2012; Tripathi & Giri, 2014). Moreover, the availability and viability of probiotic bacteria depend on the brand and the type of dairy products. In food pantries, the amount, healthfulness, and type of food products, especially dairy products, vary based on the donations as well as the characteristics of the person placing food bank orders (Cureton et al., 2017). Therefore, the selection at food pantries at times may be limited for probiotic foods and/or foods which contain an adequate number of probiotic bacteria.

Also, according to Hunger in America, 2014 study conducted by Feeding America, food banks, and meal service programs are utilized by one in seven Americans to feed themselves and their families (Weinfield et al., 2014). One in seven Americans is equivalent to 46 million people in the US, including 12 million children and 7 million seniors (Weinfield et al., 2014). The study also showed that 79% of food bank participants report purchasing inexpensive, unhealthy food just to have adequate food to feed their families (Weinfield et al., 2014). While there may be sufficient food items available at food pantries, the healthfulness is varied. People choose their food based on their food habits, knowledge, and health beliefs. Thus, it is very important to educate food pantry participants about healthy food choices to improve their overall health. For this purpose, conducting research on individuals' knowledge on food, food choices, and

availability in food pantries is a critical first step in understanding how food pantries may be used to promote healthy diets and improve the health of low-income people.

Purpose of the Study

The purpose of this research is two-fold: first, we surveyed food pantry participants to assess their knowledge and selection of probiotic-containing foods, and second, we evaluated the availability and viability of probiotic cultures in the cheese and yogurts provided by a local food pantry as well as high-quality store-bought products and homemade yogurt.

Research Questions

This research project had the following research questions;

1. Have the food pantry participants ever heard of probiotics and know what they are?
2. Do food pantry participants who are knowledgeable about probiotics consume probiotic foods in their diet differently than those who are unknowledgeable?
3. Are live probiotic bacteria presenting in the cheese and yogurts provided by food pantries?
4. How does the quantity and viability of probiotic bacteria in the cheese and yogurts provided by food pantry compare to high-quality live culture products available in grocery stores?

Definition of Terms

The purpose of this section is to define several terms to assist the reader in comprehension, and for clarity of the study.

Colony counter. Laboratory equipment used to count colonies of bacteria, or other microorganisms, growing on agar, usually in a Petri dish (Your dictionary, n.d.)

Food bank. A non-profit organization that is an important link between food manufacturers, suppliers, food service companies, farmers and hunger-relief charities (Feed My People, 2018; Feeding America, 2018b).

Food insecurity. "Limited or uncertain availability of nutritionally adequate or safe foods or a limited/ uncertain ability to acquire food in socially acceptable ways" (Olson & Holben, 2002, p.1841).

Food pantry. "A public or private nonprofit organization that distributes food to low-income and unemployed households, including food from sources other than the Department of Agriculture, in order to relieve situations of emergency and distress" (USLegal, 2016, n.p.).

Incubator. An apparatus which maintains a constant temperature for growth of microorganisms and cell cultures (Dictionary.com, n.d.)

Probiotic. Live microorganisms within a food product which provide a health benefit when administered in adequate amounts according to the World Health Organization (Fan, Breidt, Price, & Perez-Diaz, 2017).

Stomacher. A mixing device which is suitable for preparing bacterial suspension from foods, fabrics, swabs, and other soft materials (Sharpe & Jackson, 1972). A sterile plastic bag contains the sample and diluent are placed inside the machine and vigorously pounded on its outer surface by paddles of the stomacher (Sharpe & Jackson, 1972).

Viability. Ability to live, especially under certain conditions (Dictionary.com, n.d.).

Assumptions of the Study

One of the assumptions of this research study was that the questionnaire given to the food pantry participants was appropriate for the education level and easy to understand. Also, it was assumed that food pantry participants completed the questionnaire honestly, accurately, and as

completely as possible and answered the questionnaire based on their current nutritional knowledge, food behavior, and food preferences.

Limitations of the Study

One of the limitations of this research study was that *Lactobacillus* was the only probiotic bacteria selected for in the culturing methods to quantify the probiotic content in cheese and yogurt samples.

Another limitation of this research study was the sample size and regional focus, as the participants were from only five different food pantries located in West Central Wisconsin. Also, the majority of the participants were white so that the result may be extrapolated to communities with similar demographics but not to the general population.

Chapter II: Literature Review

This chapter includes a detailed discussion of the food banks and food pantries in the United States, followed by a comprehensive description of probiotics. Also, the viability of probiotic bacteria in the food products are presented. Finally, general characteristics of food pantry participants was examined.

Food Banks

There is adequate food to feed every man, women, and child in the United States. However, unfortunately, 72 billion pounds of safe, edible food goes to waste each year (Feeding America, 2018a). On the other hand, the most recent data from United States Department of Agriculture have shown that 12.3% of households (or 15.6 million people) were food insecure at some time during 2016 in the United States (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2017). At this point, food banks have a crucial role to decrease food waste as well as increase food security.

Food banks are non-profit organizations that are important links between food manufacturers, suppliers, food service companies, farmers and hunger-relief charities (Feed My People, 2018; Feeding America, 2018b). A food bank works as a warehouse for millions of pounds of food and other products, safely storing, and distributing the products to the smaller line agencies, including soup kitchens and food pantries, instead of providing food directly to people struggling with hunger (Feeding America, 2018b; Feeding Wisconsin, 2015; Simmet, Depa, Tinnemann, & Stroebele-Benschop, 2017). Some food banks distribute food directly to the people in need through the mobile food pantries in rural areas because rural areas may not have traditional emergency food pantries (Feeding Wisconsin, 2018). Food banks carry out their day-to-day operations by donors and volunteers (Feeding America, 2018b). Food banks act as an

umbrella organization for food pantries, community meal sites, shelters, after-school programs and senior programs to decrease food insecurity (Feed My People, 2018; Foodbank of the Southern Tier, 2018a). As a conclusion, food pantries rely on food banks for the majority of food items that they offer to the participants.

Demographics of the food bank participants. According to the Hunger in America 2014 National Report prepared for Feeding America, the race/ethnicity of food bank participants in the United States are 43.4% White, 26.1% Black, 19.7% Hispanic, 2.2% Native American, 1.4% Asian, 0.5% Pacific Islander, and 2.1% others (Weinfield et al., 2014). Wisconsin food bank and food pantry participant demographics differ slightly and consist of 56.5% White, 23.0% Black, 9.1% Hispanic, and 11.4% other, based on the Hunger in America 2014-State Report for Wisconsin (Mills et al., 2014). The education level of adult food bank in the United States is 26.1% with some high school education, 36.4% high school diploma, 14.8% with some college coursework, 5.7% with a bachelor's degree, and 17.1% with some other education such as General equivalency diploma (GED), license, or degree beyond high school diploma (Weinfield et al., 2014). In Wisconsin, the education level of food bank participants is 18.0% with some high school education, 42.3% high school diploma, 13.5% with some college course work, 5.4% with a bachelor's degree, and 20.9% with some other education (Mills et al., 2014).

According to the Hunger in America 2014, the majority of food bank clients are food pantry participants. Total of food bank clients is 46.5 million annually. Of those, 43.9 million clients are food pantry participants, with the exception of mobile pantries, which directly come from food banks (Weinfield et al., 2014).

Food Pantries

A food pantry is a public or private non-profit organization which functions as the arms that reach out to the community directly within a specified area by distributing food and other products such as personal care items to the people who suffer from hunger and food insecurity (Feeding America, 2018b; Foodbank of the Southern Tier, 2018b; Simmet, Depa, Tinnemann, & Stroebele-Benschop, 2017; USLegal, 2016). The food pantry is the general name, but the term food shelf is used in some regions of the United States. Food pantries accept items from food banks as well as from food drives, local grocery stores, farmers, and individual donations.

Operation of every food pantry is unique. The pantries may vary in the days open as well as the availability of food and other items. Unlike grocery stores, pantries may be only being open weekly, biweekly or monthly (Simmet, Depa, Tinnemann, & Stroebele-Benschop, 2017). Moreover, the products available may vary significantly, even on a daily basis. (Stepping Stones of Dunn County, 2018). Typically**,** food pantries provide canned and packaged non-perishable items to the participants. Some fresh or frozen food such as bread, dairy, produce and meat may be available (Stepping Stones of Dunn County, 2018). Personal care items such as diapers, wipes, shampoo, and toilet papers may also be available (Stepping Stones of Dunn County, 2018).

As mentioned earlier, food banks and food pantries help to decrease food waste and increase food security for the people in the United States. The Hunger in America 2014 report shows that one in seven people rely on the food banks for food each year in the USA (Weinfield et al., 2014). However, nutritional quality is not the major concern influencing acceptance of donations (Campbell, Hudson, Webb, & Crawford, 2011) and food pantries mostly rely on non-perishable items, so their fresh produce and dairy products sections are quite limited. Most of the

probiotic foods are fermented dairy products, which will affect the availability of these foods in food pantries.

General characteristic of food pantry participants. Low-income people are assumed to have limited access to healthy foods, social support, and cooking skills compared to those with higher income (Dave, Thompson, Svendsen-Sanchez, McNeill, & Jibaja-Weiss, 2017; Simmet, Depa, Tinnemann, & Stroebele-Benschop, 2017;). Although all food pantry participants are not necessarily low-income individuals, because many food pantries welcome anyone in need without asking their income level, the majority of the food pantry participants are low-income level with many also receiving food assistance (Simmet, Depa, Tinnemann, & Stroebele-Benschop, 2017). Some generalized characteristics of food pantry participants are having low food security, poor diet, limited access to other affordable, nutritious foods as well as having lack of knowledge, skills, and resources needed for menu planning, shopping, and food preparation (Dave, Thompson, Svendsen-Sanchez, & Cullen, 2017). In addition, Hunger in America 2014 National Report states that 79% of food bank participants report purchasing inexpensive, unhealthy food just to have adequate food to feed their families (Weinfield et al., 2014). Moreover, Simmet et al. suggest that food pantry participants have inadequate dietary intake, particularly for fruit and vegetables, milk products, and calcium (Simmet, Depa, Tinnemann, & Stroebele-Benschop, 2017).

Low-income individuals have higher obesity rate and tend to have poor dietary behaviors and have more diet-related health conditions (Simmet, Depa, Tinnemann, & Stroebele-Benschop, 2017). Based on the Hunger in America 2014 report, high blood pressure and diabetes are common diet-related diseases among food bank participants (Weinfield et al., 2014). Those diseases are

more prevalent among low-income and socioeconomically deprived individuals (Simmet, Depa, Tinnemann, & Stroebele-Benschop, 2017).

Probiotics

Probiotics in the form of fermented milk products are one of the oldest sources of nutrition and, unknowingly, have been used for health and well-being (Levin, 2018). According to the World Health Organization, probiotic cultures are live microorganisms within a food product which provide a health benefit when consumed in adequate amounts (Fan, Breidt, Price, & Perez-Diaz, 2017; Williams, 2010). Elie Metchnikoff, who was the Nobel Prize-winning Russian physiologist and known as the "father of probiotics", was the first to introduce the concept behind probiotics by proposing that gut flora could be altered with beneficial bacteria replacing harmful microbes in 1907 (Hibberd, Duffy, & Shurtleff, 2016; Sarao & Arora, 2017; Williams, 2010). The term probiotic is a Greek word meaning "for life" and initially used in the 1960s (Williams, 2010).

Numerous commercial probiotic products are available, which contain different probiotic strains that confer varying health benefits (Sarao & Arora, 2017). Probiotics include yeast or bacteria (Williams, 2010). Probiotic products may include only one microorganism or a blend of several species (Williams, 2010). Today, lactic acid bacteria (LAB), specifically *Lactobacillus* and *Bifidobacterium* species, are extensively used in commercial probiotic products (Boylston, Vinderola, Ghoddusi, & Reinheimer, 2004; Sarao & Arora, 2017; Williams, 2010). Besides, some commercial products contain strains from other species such as *Propionibacterium*, *Enterococcus*, and *Escherichia* (Sarao & Arora, 2017). The yeast *Saccharomyces bulardii* also have shown some health benefits to humans (Parvez, Malik, Kang, & Kim, 2006; Sip & Grajek,

2010; Williams, 2010). Common microorganisms used in probiotic preparations are listed in Figure 1.

Lactobacillus *sp.*	*Bifidobacterium* *sp.*	*Enterococcus* *sp.*	*Streptococcus* *sp.*
L. acidophilus	*B. bifidum*	*Ent.faecalis*	*S. cremoris*
L. casei	*B. adolescentis*	*Ent.faecium*	*S. salivarius*
L. delbrueckii ssp.	*B. animalis*		*S. diacetylactis*
(bulgaricus)	*B. infantis*		*S. intermedius*
L. cellobiosus	*B. thermophilum*		
L. curvatus	*B. longum*		
L. fermentum			
L. lactis			
L. plantarum			
L. reuteri			
L. brevis			

Figure 1. The most common lactic acid bacteria used in probiotic preparations.

Since 2014, research on probiotics has increased tremendously with a focus on the relationship between probiotic consumption and its effects on human health (Fan, Breidt, Price, & Perez-Diaz, 2017). Although some of the health benefits have been validated, some of them are still supported by limited evidence (Williams, 2010). The beneficial effects of probiotics on the gastrointestinal tract and the immune system have been shown in numerous clinical tests (Aljewicz, Siemianowska, Cichosz, & Tonska, 2014; Kneifel & Salminen, 2011). The major beneficial health effect of probiotics has been shown to restore the microbial balance and

improving mucosal defenses against pathogenic bacteria in the gastrointestinal tract (Al Khalaileh, & Ajo, 2013; Williams, 2010). There is strong evidence for using probiotics in the treatment of certain diarrheal diseases, particularly rotaviral diarrhea in children. In contrast, there is inconsistent evidence regarding the impact of probiotic treatment on antibiotic-associated diarrhea (AAD) and travelers' diarrhea (Williams, 2010). Probiotics may also have promising health benefits on Crohn's disease, ulcerative colitis (UC), irritable bowel syndrome (IBS), and *Helicobacter pylori* infections although there are conflicting clinical trial results (Williams, 2010). Researchers have studied the potential health benefits of probiotics on a wide range of health issues including upper respiratory infections (e.g., acute otitis media), colon and bladder cancer risks, allergic disorders including atopy, immune response, dental caries, serum cholesterol, digestion of lactose, anticarcinogenic activity, vitamin synthesis, and colic in infants (Al Khalaileh, & Ajo, 2013; William, 2010).

Currently, various probiotic products are available in the market. Probiotics are available in the form of capsules, tablets, packets, or powders and are included in many different fermented foods, particularly yogurt and dairy drinks (Williams, 2010). The most common and ideal vehicle for delivering probiotic bacteria are dairy products (Fan, Breidt, Price, & Perez-Diaz, 2017; Nagpal et al., 2012; Soccol et al., 2010). The most common dairy products which contain probiotic bacteria are yogurt, kefir, cheese, ice cream, frozen dessert, and cultured drinks such as cultured buttermilk, yogurt drinks, and dairy drinks (Granato, Branco, Nazzaro, Cruz, & Faria, 2010; Soccol et al., 2010). In the market, there are also some non-dairy food products containing probiotics available such as nutrition bars, breakfast cereal, infant formula, pickles, soy-based drinks, and fruit-based foods (Fan, Breidt, Price, & Perez-Diaz, 2017; Granato et al., 2010; Soccol et al., 2010).

Although a variety of food products contain probiotic bacteria and are available in grocery markets, the effectiveness and type of the health benefits of probiotics directly depend on the probiotic strain composition, bacterial counts, and the applied vehicle (Aljewicz, Siemianowska, Cichosz, & Tonska, 2014). Probiotic bacteria must survive in food products above a threshold level of 10^6 colony forming unit/gram (cfu/g) in the fermented milk products and survive harsh conditions of the gastrointestinal tract to offer health benefits (Al Khalaileh & Ajo, 2013; Nagpal et al., 2012; Talwalkar & Kailasapathy, 2004).

Viability of Probiotic Bacteria in the Food Products

There are some factors that affect the viability of probiotic bacteria in food products. Processing conditions, product environment, and storage conditions may adversely affect the survival and viability of probiotic cultures (Castro, Tornadijo, Fresno, & Sandoval, 2015). The viability of probiotics is affected by the gastrointestinal tract as well (Mortazavian, Mohammadi, & Sohrabvandi, 2012). Main factors affecting the viability of probiotic food products are acidity, temperature, food ingredients, molecular oxygen, microencapsulation, the probiotic bacterial strains, freezing and thawing operations, drying processes, packaging materials, and other conditions during production and storage periods. During consumption and digestion, saliva (amylase), gastric acidity, bile acids and enzymes in the intestine, low level of oxygen, and competitive exclusion of pathogens in gastrointestinal tract impact probiotic viability (Mortazavian, Mohammadi, & Sohrabvandi, 2012).

Overall, standardized protocols and quality control procedures should be done to preserve the probiotic culture during the process of producing and manufacturing probiotic functional foods (Mortazavian, Mohammadi, & Sohrabvandi, 2012).

Chapter III: Methodology

This study included two parts. The first part examined the awareness and usage of probiotic foods by participants of local food pantries in Wisconsin. The second part analyzed the viability of probiotic bacteria in various kinds of yogurt and cheese available in a local food pantry as well as store-bought, high-quality cheese and yogurt, and homemade yogurt.
First, this chapter will provide a general view of the food culture of the Midwest region of the United States and then will describe sample selection, instrumentation, data collection, data analysis, and methodological limitations for each part of this research.

Food Culture of the Midwest Region of the United States

The food in the Midwest region of the United States was influenced by Germans, British, Italian, Hungarians, and Scandinavians. The common ingredients of Midwest cooking are dairy products such as milk, cheese, and eggs. Also, smoking, pickling, and canning are common methods to preserve foods (Food in Every Country, 2018).

Pickles and cheese are two traditional foods of the Midwest. According to the USDA Economic Research Center-Vegetable and Melon Outlook report, Midwest residents consume more pickling cucumbers (4.3 pounds per person in a year) than any other regions of the United States (Lucier & Jerardo, 2007). Wisconsin is in the Midwest and is known as “America’s Dairyland.” Wisconsin is the number one producer of American and cheddar cheese, and leads total cheese production in the United States (Bussler, Hubbell, Joyner, & Woodstock, 2017). Cheese is one of the food staples of the Midwestern (Food in Every Country, 2018).

Conversely, yogurt is not a traditional Midwest food, and the origin of yogurt is the Middle East (Fisberg & Machado, 2015). Yogurt consumption of Americans is quite low, and only 6% of Americans consume yogurt in their diet (Fisberg & Machado, 2015).

Part 1: Assessing Awareness and Usage of Probiotics by Food Pantry Participants

This section will explain the details of the questionnaire procedure such as sample selection, instrumentation, data collection, data analysis, the criteria to split participants into two groups based on knowledge on probiotics, and methodological limitations.

Sample Selection and Description

Before starting the data collection, approval from the UW-Stout Institutional Review Board (IRB) was obtained (Appendix A). The subjects of this study were participants at local food pantries in West Central Wisconsin in the Fall of 2017. People younger than 18 years of age were excluded from the study.

Instrumentation

The instrument used in data collection was a questionnaire titled "Assessment of the Knowledge and Beliefs of Participants of Food Pantries in Wisconsin Regarding Probiotic Use" (Appendix B) with a written informed consent (Appendix C). The questionnaire was obtained from past research conducted by Al-Nabulsi et al. (2014). Permission from Al-Nabulsi et al. (2014) can be found in Appendix D. The questionnaire was designed to assess the knowledge and consumption of probiotic foods by food pantry participants.

The questionnaire included demographic questions such as age, gender, marital status, race, education level, and occupation as well as participants' health issues, type of supplement/herbal usage, knowledge of probiotics, usage of probiotics, and the reasons for consuming probiotics. The survey included six questions to examine knowledge of probiotics, four questions to assess the usage of probiotics, and a single question to evaluate the reasons for consuming probiotics.

Data Collection

Data were collected for this study from September through November 2017. A total of 205 food pantry participants from five local food pantries participated in the study.

Prior to data collection, the researcher obtained permission to conduct the questionnaire from Assistant Directors and/or Food Pantry Coordinators of multiple local food pantries. One of the Community Connections Program Coordinators requested to see the questionnaire to ensure that the language of the questionnaire was appropriate for food pantry participants. Thus, the researcher emailed the copy of the questionnaire to the Coordinators and received some feedback on the questionnaire. The researcher then updated the questionnaire based on their feedback.

After permission was obtained and the questionnaire was ready, the researcher set up appointments with multiple local food pantries. Upon arrival to the pantries, the pantry participants were asked to participate in the UW-Stout thesis project with an explanation of the project details and a description of the raffle. The survey was anonymous. Thus, participants did not give any identifiable personal information on the questionnaire. Hard copies of the questionnaire were used. Research details were explained verbally, and verbal consent was obtained from the participants. After the participants agreed to participate in the questionnaire, the instrument was administered by handing it to the subject and asking him/her to read and complete it. After the subjects completed the questionnaire, they were offered to enter their names for a raffle to win either $5, $10, or $15 Kwik Trip gift cards. Of those who agreed to be in the raffle were asked to enter their names and phone numbers to a separate box which was provided by the researcher. The completed instruments were placed into a file. The total data collection took about 10-15 minutes to complete per person. After the data collection was done, three names were taken from the raffle box to distribute the prizes. The first name drawn was

awarded $15 Kwik Trip card; the second name won $10 Kwik Trip card, and the third name won $5 Kwik Trip card. The winners were called to get their addresses, and they received their gift cards via mail.

Data Analysis

Data were entered into Excel (Microsoft Corp, Seattle, WA) then imported into the Statistical Program for Social Sciences (SPSS, version 24.0, 2016, SPSS Inc., Chicago, IL) for data analysis. Descriptive statistics (means, standard deviations, frequencies, and percentages) were calculated for all variables. Data were split into two groups based on the participant's answers to probiotic questions. Participants with correct answers were in the knowledgeable group; those with incorrect answers were placed in the unknowledgeable group. Descriptive statistics were run for all variables for both groups. Three T-tests were run to find the correlation between consumption of cheese, yogurt, and/or pickles and the two groups (knowledgeable and not knowledgeable). Also, Pearson Chi-Squared analyses were also run to find whether there is a correlation between knowledge and some of the demographic features of the groups such as gender, marital status, and race/ethnicity. Results with a p-value ≤ 0.05 were assumed to be statistically significant.

The Criteria to Split Participants into Two Groups Based on Knowledge on Probiotics

The participants were split into two groups based on their knowledge of probiotics. The first group is designated as the *knowledgeable group* and the second one is designated as the *unknowledgeable group*. Participants were placed in the knowledgeable group when they correctly selected the definition of probiotics, answered the health benefit of probiotics question correctly and identified one or more of the probiotic-containing foods. The correct definition of the probiotics was "live microbial cultures consumed or applied for health benefit." The correct

health benefit of probiotic answer on the survey was “increased immune function.” Also, the food sources of probiotics on the survey were cheese, yogurt, and pickle.

Limitations

One of the limitations is that subjects may inaccurately estimate the amount of probiotic, cheese, yogurt, and pickle intake. Another limitation may be that some of the subjects did not understand or respond thoughtfully to the questions. For example, current college students may select bachelor’s degree option because they will eventually get bachelor’s degrees or some of them may select some college instead of high school graduate.

Part 2: Qualifying Probiotic Bacteria in the Cheese and Yogurt

This section will explain the details of the laboratory procedure which analyzed probiotic bacteria in the cheese and yogurt products.

Product Selection and Description

In total, five kinds of yogurts and two types of cheeses were evaluated for probiotic content in this study. The items were chosen based on availability in the food pantry, quality, and price. During December 2016-January 2017, the researcher was a volunteer (3 hours/week) in the local food pantry which she monitored and documented the food items. The types and brands of yogurt and cheese available at the local food pantry were monitored and documented (via photographic record) for four days in a two-month period before the brands to be tested were selected. Dannon Light & Fit Greek vanilla low-fat yogurt, Great Value Original vanilla low-fat yogurt, Siggi’s vanilla (strained non-fat) yogurt, Bongards Pasteurized Process American cheese, Yoplait Gogurt, and Ellsworth cheddar cheese curds were selected for analysis of probiotic bacteria viability. These cheese and yogurt items are available time to time but as a quite limited

amount. Bongards Pasteurized Processed American cheese is part of a senior commodity box. Thus it is always available for seniors but not necessarily other pantry participants.

In addition to store brands, homemade yogurt was included. This yogurt was made using a basic yogurt recipe with homemade yogurt starter. The yogurt was made by heating 1 gallon of 2% fat milk up to 83° C (150° F) and subsequently cooled to 43° C (110° F). 3 oz. of whole fat homemade yogurt starter was stirred into the warm milk mixture, poured into a stainless-steel pot, and covered with a lid. The mixture was covered with a blanket and allowed to sit for 9 hours before being moved to a refrigerator. The yogurt was incubated in the refrigerator for 5 hours before it was used.

MRS agar was chosen to isolate LAB (Lactic Acid Bacteria). MRS medium was designed by de Man, Rogosa, and Sharpe in order to optimize the production of probiotic bacteria. It is used commonly for the cultivation of *Lactobacillus spp*. of the LAB (Sathyanarayanan, Kunthala, & Gurumurthy, 2011).

Instrumentation

The instruments used were an Isotemp incubator (Fisher Scientific), a stomacher (model 400, Seward, London, UK), and a colony counter (Reichert Quebec Darkfield).

Data Collection Procedure

The cheese and yogurt samples (11.0 g) were individually mixed with 99.0 mL of 2.0% sodium citrate (Sigma-Aldrich Inc.), warmed to 45° C (overnight) in plastic stomacher bags, and placed in a stomacher for 120 s at 230 rpm (Sharp, McMahon, & Broadbent, 2008). The contents of the stomacher bags were serially diluted (10x) using 0.1% BBL polypeptone peptone and plated on MRS agar using 500 □l of the dilution. The plates were incubated for 3-5 days at the

room temperature, and the cultures were subsequently counted to obtain the CFU/g for each sample. The probiotic viability of each cheese and yogurt sample was completed in triplicate.

Data Analysis

As an initial test of the method, control food samples were subjected to the stomacher and plating process. Some of the food samples were spiked with 500 □l active *Lactobacillus* culture isolated from homemade yogurt in MRS media. The four control samples were: autoclaved yogurt, autoclaved milk, autoclaved yogurt spiked with active *Lactobacillus* culture, and autoclaved milk spiked with active *Lactobacillus culture*. The active culture was also plated directly onto MRS plates. As expected, only the food samples spiked with the active culture showed growth.

Limitations

The methodological limitation is the MRS agar and media used selects for *Lactobacillus* bacteria. Other probiotic bacteria may be present in the food but will not be accounted for with this method. For the foods with high probiotic content, more accurate results would have been obtained with further dilution of the samples as the number of colonies per plate were quite high, making accurate counting challenging.

Chapter IV: Results

This chapter will discuss the results in two sections; 1) the results from the questionnaire that examined the knowledge and usage of probiotics by food pantry participants, and 2) the results from the analysis of probiotic bacteria in cheese and yogurt.

Part 1: The Awareness and Usage of Probiotics by Food Pantry Participants

This part of the study will explain the details of the results of the questionnaire.

Demographic Data of Participants

A total of 205 individuals participated in the questionnaire. The knowledgeable group was total of 90 participants, and the unknowledgeable group consisted of 113 participants. Two participants skipped the knowledge and usage questions on the questionnaire.

General population had a mean age of 43.6 years with the statistics displayed in Table 1, with two missing values. Knowledgeable group (M= 41.11) had a smaller mean compared to unknowledgeable group (M= 45.6).

Table 1

Age of Questionnaire Respondents

	N	Minimum	Maximum	Mean	Std. Deviation
General population	203	18.00	84.00	43.61	16.72
Knowledgeable group	90	18.00	72.00	41.11	17.20
Unknowledgeable group	112	19.00	84.00	45.6	16.25

The general population of the questionnaire were 63.9% female and 36.1% male; the majority of the knowledgeable group were female, and female participants in the unknowledgeable group

were slightly different than male participants. Detailed statistics of the gender of the participants are found in Table 2.

Table 2

Biological Sex of Questionnaire Participants

	General Population		Knowledgeable Group		Unknowledgeable Group	
	Frequency (N=205)	Percentage	Frequency (N=90)	Percentage	Frequency (N=113)	Percentage
Female	131	63.9%	64	71.1%	67	59.3%
Male	74	36.1%	26	28.9%	46	40.7%

Table 3 shows the marital status of the participants. Majority of the general population (46.3%) were single. Marital status distributions of the knowledgeable and unknowledgeable group display in Table 4.

Table 3

Marital Status of Questionnaire Participants

	General Population		Knowledgeable Group		Unknowledgeable Group	
	Frequency (N=205)	Percentage	Frequency (N=90)	Percentage	Frequency (N=113)	Percentage
Single	95	46.3%	37	41.1%	58	51.3%
Married	52	25.4%	32	35.6%	20	17.7%
Divorced	39	19.0%	12	13.3%	25	22.1%
Widowed	13	6.3%	7	7.8%	6	5.3%
Other	6	2.9%	2	2.2%	4	3.5%

A total of nine participants did not respond to the race/ethnicity question. Therefore race(s)/ethnicity(ies) variable had 196 participants. Table 4 summarizes the characteristics of the

sample population regarding race and ethnicities for all participants, and the majority of participants were white for general population (84.1%), knowledgeable group (90.6%) and unknowledgeable group (80%).

Table 4

Race(s)/Ethnicity(ies) of Questionnaire Participants

	General Population		Knowledgeable Group		Unknowledgeable Group	
	Frequency (N=196)	Percentage	Frequency (N=85)	Percentage	Frequency (N=110)	Percentage
White	165	84.1%	77	90.6%	88	80%
Black	6	3.1%	1	1.2%	5	4.5%
Hispanic	5	2.5%	0	0.0%	4	3.6%
Native American	5	2.5%	2	2.4%	3	2.7%
Asian	12	6.1%	4	4.7%	8	7.3%
Pacific Islander	1	0.5%	0	0.0%	1	1.1%
Other	2	1.0%	1	1.2%	1	1.1%

Also, Table 5 displays the education level of the participants, with one missing data point. The education level “some college” is predominant with 45.6% of the knowledgeable group while the majority of the unknowledgeable group (39.3%) was high school graduates. The questionnaire was conducted in two student food pantries and three regular food pantries. That would impact the distribution of the education level categories.

Table 5

Education Level of Questionnaire Participants

	General Population		Knowledgeable Group		Unknowledgeable Group	
	Frequency (N=204)	Percentage	Frequency (N=90)	Percentage	Frequency (N=112)	Percentage
Some High School	10	4.9%	0	0.0%	9	8.0%
High School Graduate	68	33.3%	23	25.6%	44	39.3%
Some College	76	37.3%	41	45.6%	35	31.3%
Associate Degree	22	10.8	13	14.4%	9	8.0%
Bachelor's Degree	18	8.8	10	11.1%	8	7.1%
Other	10	4.9	3	3.3%	7	6.3%

In addition, one of the demographic questions asked participants to report their current occupation. Total of 183 participants answered the occupation question. A wide variety of occupations were reported on the questionnaires. As a summary, 12 participants (6.5%) were unemployed, 23 participants (12.6%) were retired and the rest of the participant work in many different areas and locations. Also, 26 participants (14.2%) were students, and 14 participants (7.6%) reported that they are disabled.

Health Condition and Supplement/Herbal Use of General Population

Questionnaire respondents were asked to self-report any diagnosed disease(s)/condition(s) that they have ever had. Ten participants skipped this question thus a total of 195 participants reported diagnosed disease(s)/condition(s) which are shown in Figure 2. Of

those, 91 participants (46.7%) reported that they do not suffer from any diseases/conditions. Some people had one disease/conditions while others had multiple disease/conditions. Self-described “others” included ADHD, anxiety, depression, diabetes, cancer, and rheumatoid arthritis. Also, some of the participants reported that they occasionally suffer from chronic pain, acid reflux, depression, and anxiety.

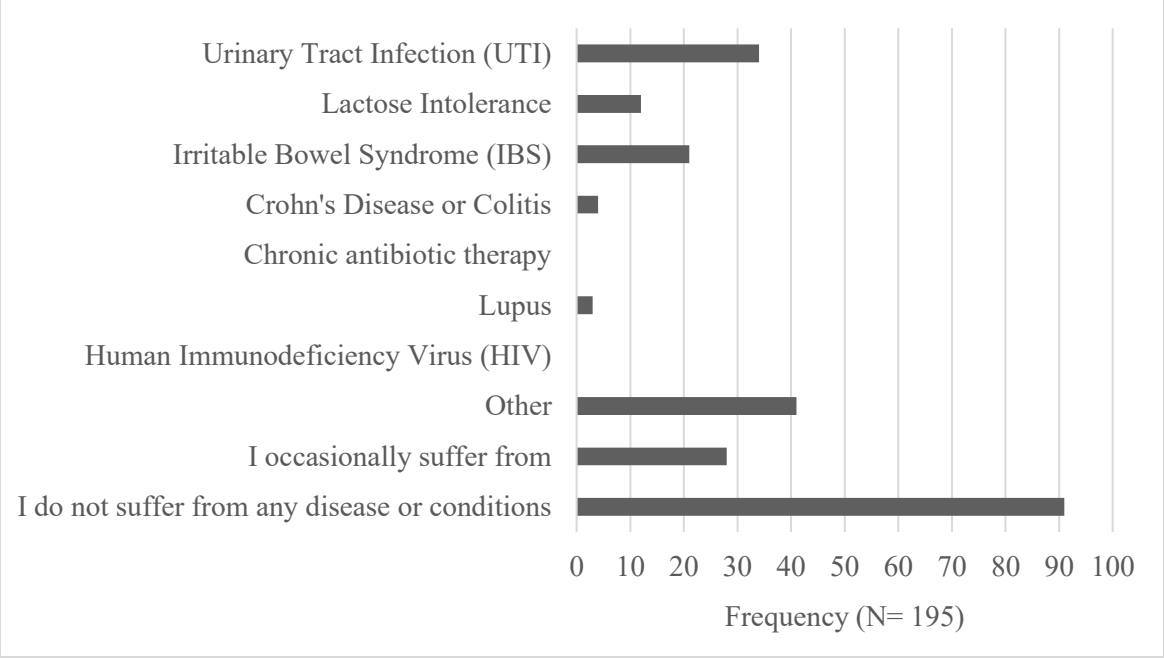

Figure 2. Selected choice for diagnosed disease(s)/condition(s) of questionnaire participants (Multi-select).

Questionnaire participants were also asked to self-report any supplement/herbal use. This question was a multi-select question, so some people reported that they take more than one type of supplement. Figure 3 summarizes what supplement(s)/herbal product(s) participants use regularly and/or occasionally, with ten missing data values. Most of the participants (44.1%) reported that they do not take any supplement/herbal product regularly. Regularly, 64 people (32.8%) take a multivitamin with minerals, and 39 participants (20.0%) take fish oil. Self-

reported “others” includes cactus juice, chia seed, lemon oil extract, melatonin, vitamin B12, and vitamin D.

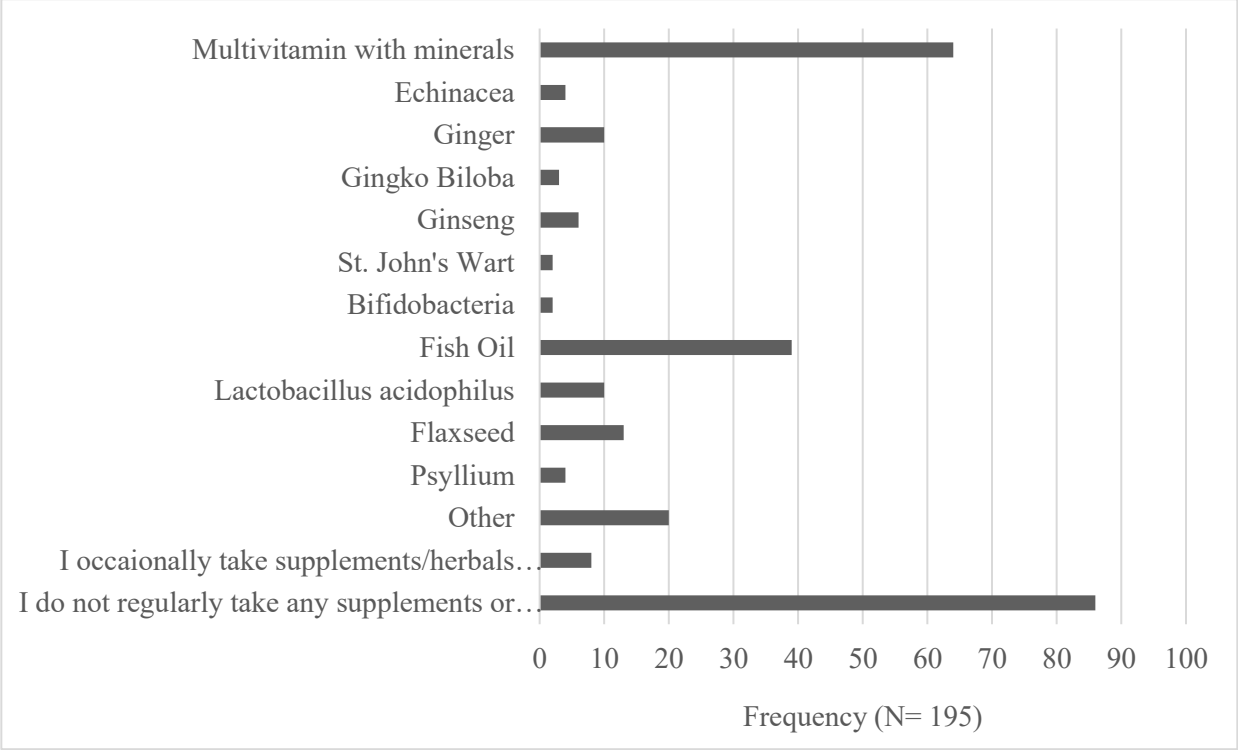

Figure 3. Selected choice for taking of supplement(s)/herbal products (Multi-select).

General Knowledge on Probiotics of the Participants

Although 170 questionnaire participants (82.9%) self-reported that they have heard the word “probiotics,” a total of 90 participants (44%) were identified as knowledgeable on probiotics, and 113 participants (55.1%) were identified unknowledgeable on probiotics based on the criteria (Table 6). Two participants (0.9%) failed to answer the knowledge, and usage of probiotics questions thus they were not placed in any of the groups. A total of 203 participants were placed into either category.

Participants also were asked to report what sources that they have heard the word “probiotics.” Figure 4 shows the sources of probiotics’ knowledge of the knowledgeable and unknowledgeable groups. The sources of knowledge about probiotics were television programs,

television commercials, healthcare providers, magazines or newspapers, and others (Figure 4). Self-reported "others" include internet. Some of the participants selected multiple sources while others selected only one source.

Table 6

Selected Responses on who Have Heard the Word "Probiotics" by Participants

	General Population		Knowledgeable group		Unknowledgeable Group	
	Frequency (N=205)	Percentage	Frequency (N=90)	Percentage	Frequency (N=113)	Percentage
Yes	170	82.9%	89	98.9%	80	70.8%
No	24	11.7%	1	1.1%	22	19.5%
Not sure	11	5.4%	0	0.0%	11	9.7%

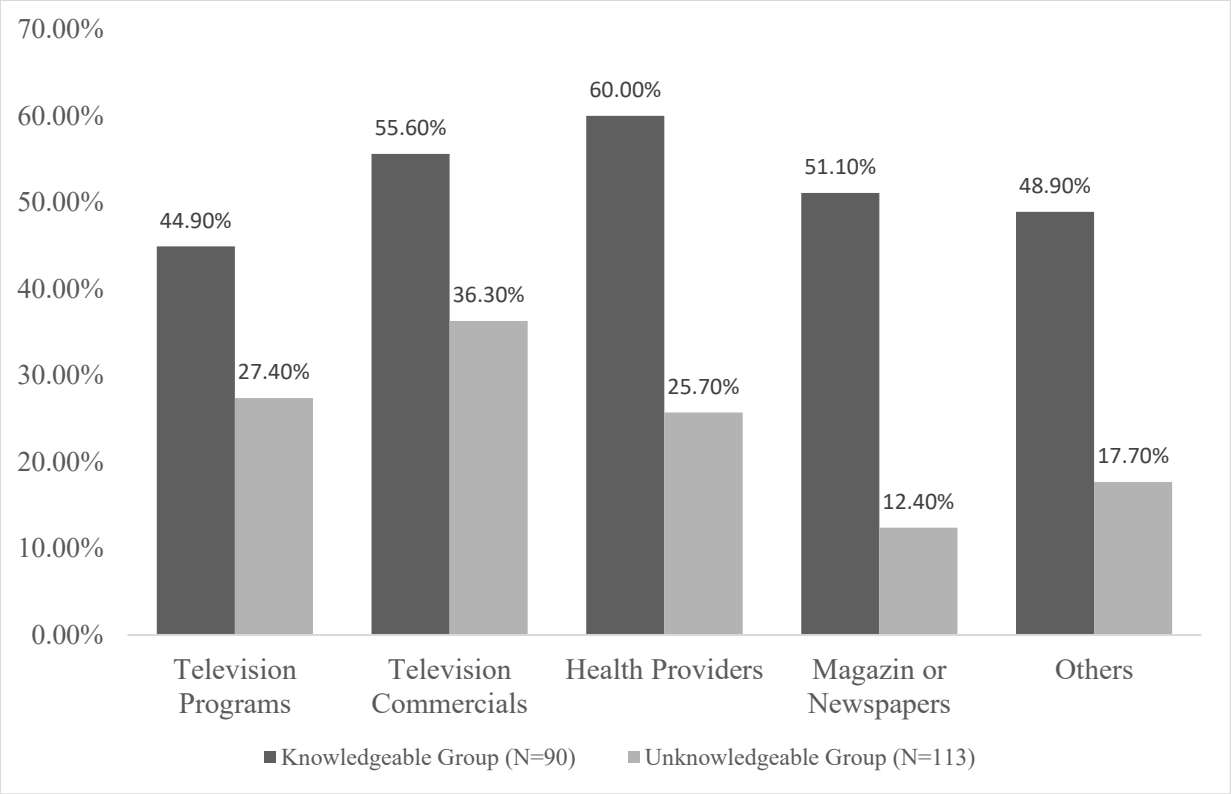

Figure 4. Sources of knowledge about probiotics by groups (Multi-Select).

The knowledgeable group answered the definition of probiotics (Table 7) and one health benefit of probiotics questions (Table 8) correctly. Although participants were selected into the unknowledgeable group, some of the participants answered some of the knowledge questions correctly. Thus, 80 unknowledgeable participants (70.8%) reported that they had heard probiotics and of those, 39 participants (34.4%) stated that they knew the definition of probiotics. In addition, 52 unknowledgeable participants (46.5%) answered the definition of probiotics correctly (Table 7); only 24 participants (21.2%) responded correctly to the health benefit question (Table 8).

Table 7

Selected Choices for the Definition of Probiotics by Participants

	General Population		Knowledgeable Group		Unknowledgeable Group	
	Frequency (N = 202)	Percentage	Frequency (N = 90)	Percentage	Frequency (N = 112)	Percentage
Technological structure having mechanical parts	2	1.0%	0	0.0%	2	1.8%
Live microbial cultures consumed or applied for health benefits*	142	70.3%	90	100%	52	46.4%
Harmful chemical found in foods	10	5.0%%	0	0.0%	10	8.9%
Don't know	48	23.8%	0	0.0%	48	42.9%

Note. * = correct selection (bold choice)

Table 8

Selected Choices for One of the Health Benefits of Probiotics by Participants

	General Population		Knowledgeable Group		Unknowledgeable Group	
	Frequency (N = 202)	Percentage	Frequency (N = 90)	Percentage	Frequency (N = 112)	Percentage
Decreased risk of stroke	12	5.9%	0	0.0%	11	9.8%
Increased energy	14	6.9%	0	0.0%	11	9.8%
Increased immune function*	114	56.4%	90	100%	24	21.4%
Increased intelligence	2	1.0%	0	0.0%	2	1.8%
Don't know	63	31.2%	0	0.0%	63	56.3%

Note. * = correct selection (bold choice)

Comparison of the Demographics of the Knowledgeable and Unknowledgeable Groups

The participants self-reported their age, gender, marital status, race, education level, and their occupation. The demographic data of the participants were demonstrated and explained earlier in the general population, and in the groups; knowledgeable and unknowledgeable. Also, three Pearson Chi-Squared tests were completed to further examine the relationship between knowledge and some of the demographics such as gender, marital status, and race.

A Chi-squared test of independence was calculated comparing the marital status and the frequency of being knowledgeable on probiotics. As can be seen, by the frequency cross-tabulated in Table 9, there was a significant relationship between marital status and being

knowledgeable on probiotics, $X^2(4, N = 203) = 10.25$, $p < 0.05$. As a result, married participants knew probiotics better than those who are in other marital statuses.

Table 9

Crosstabulation of Marital Status and Knowledge of Probiotics for Groups

	Marital Status						
	Single	Married	Divorced	Widowed	Other	X^2	*P*
Knowledgeable Group	37	32	12	7	2	10.248	0.036*
Unknowledgeable Group	58	20	25	6	4		

Note. * = Statistical significant p < .05

However, another Chi-squared test of independence which analyzed the gender and knowledge indicated that there was no significant difference between being knowledgeable on probiotics and gender, X^2 (1, N= 203) = 3.06, p = .080 (Table 10). Additionally, a last Chi-squared test of independence was performed to examine the relation between race/ ethnicity and being knowledgeable on probiotics. The relation between these variables was not significant, X^2 (7, N= 195) = 3.06, p = 0.357. The crosstabulation of race/ethnicity and being knowledgeable on probiotics are found in Table 11.

Table 10

Crosstabulation of Gender and Knowledge of Probiotics for Groups

	Gender			
	Female	Male	X^2	*p*
Knowledgeable Group	64	26	3.058	0.080
Unknowledgeable Group	67	46		

Table 11

Crosstabulation of Race/Ethnicity and Knowledge of Probiotics for Groups

	Race/Ethnicity								
	White	Black	Hispanic	Native American	Asian	Pacific Islander	Other	X^2	*p*
Knowledgeable Group	77	1	0	2	4	0	1	7.732	0.357
Unknowledgeable Group	87	5	4	3	8	1	1		

Comparison of the Disease/Condition and Supplement/Herbal Product Use of the Groups

The participants were asked to report diagnosed diseases and conditions they have, and supplement and/or herbal products use. The main purpose of those questions to identify if there is a relationship between knowledge of probiotics and the gastrointestinal tract related diseases and supplement/herbals use. Gastrointestinal tract related disease and conditions identified were Urinary Tract Infection (UTI), Lactose Intolerance, Irritable Bowel Syndrome (IBS), Crohn's Disease or Colitis, Chronic Antibiotic Therapy, Lupus, and Human Immunodeficiency Virus (HIV). Figure 5 displays the differences and similarities on the diagnosed diseases/conditions of the knowledgeable and unknowledgeable groups. As is shown below, there are no major

differences between the groups; thus, knowledge on probiotics does not directly relate to the health conditions of the participants. Figure 6 is shown the comparison of supplement and herbal product use of both groups. Surprisingly, the unknowledgeable group (53.3%) has a higher percentage of not taking any supplement/herbals in comparison to the knowledgeable group (32.6%). Also, the knowledgeable group regularly takes supplement/herbals slightly more than the unknowledgeable group. Therefore, this shows that there is not much effect of being knowledgeable on probiotics on supplement/herbal use. Detailed information on the type of disease/conditions and the supplement/herbal products can be found in Figure 2 and Figure 3 which are under the title: "Health Condition and Supplement/Herbal Use of General Population."

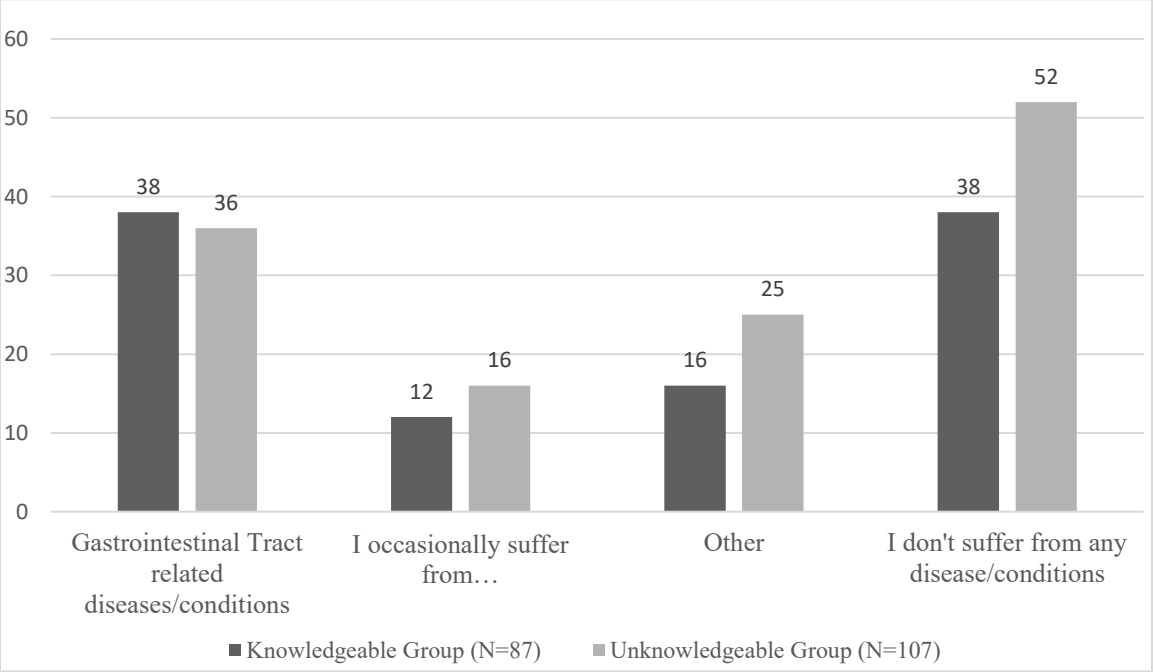

Figure 5. Comparison of disease(s)/condition(s) of groups (Multi-Select).

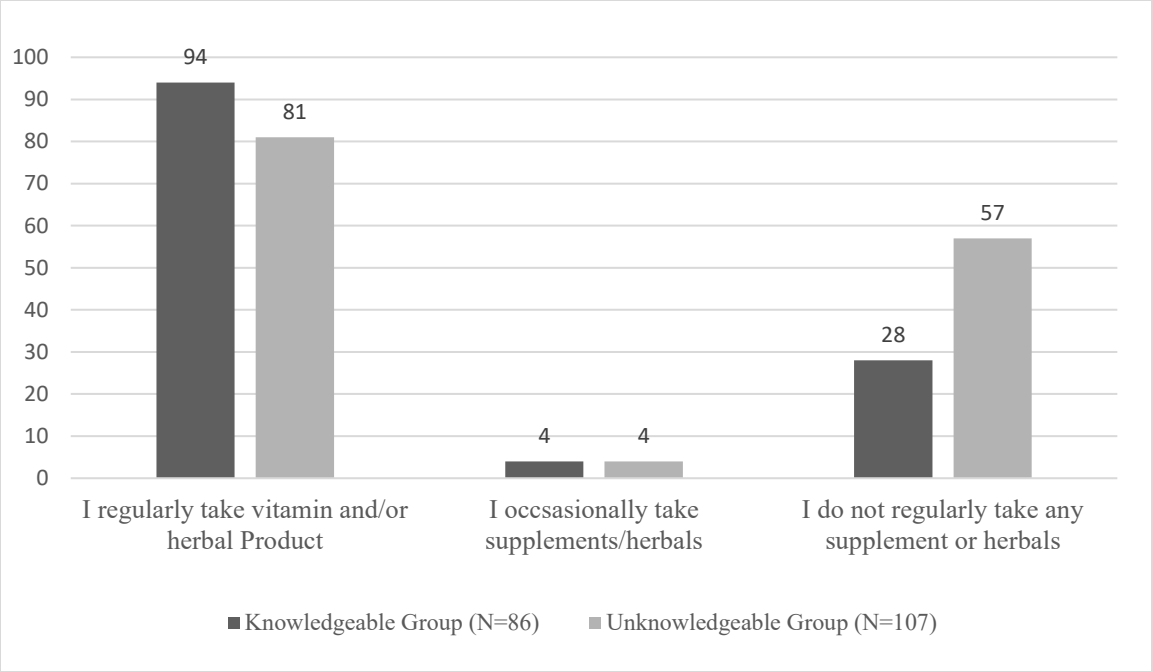

Figure 6. Comparison of supplement/herbal products use of groups (Multi-Select).

Comparison of the Knowledge on Probiotic Food Sources of Both Groups

The participants were asked to identify the food sources of the probiotics. The probiotics containing foods on the survey were cheese, yogurt, and pickles. The knowledgeable participants identified at least one of the food sources of probiotics while some of the unknowledgeable participants identified one or some of them. As seen in Figure 7, the knowledgeable group was better able to identify the food sources. Yogurt was the most known probiotic sources for both groups, especially for the knowledgeable group (95.6%). Also, there is a misconception about the probiotic nature of fruit and vegetables because fruit and vegetables were reported as probiotic sources by 26 knowledgeable participants (28.9%), and 24 unknowledgeable participants (21.2%).

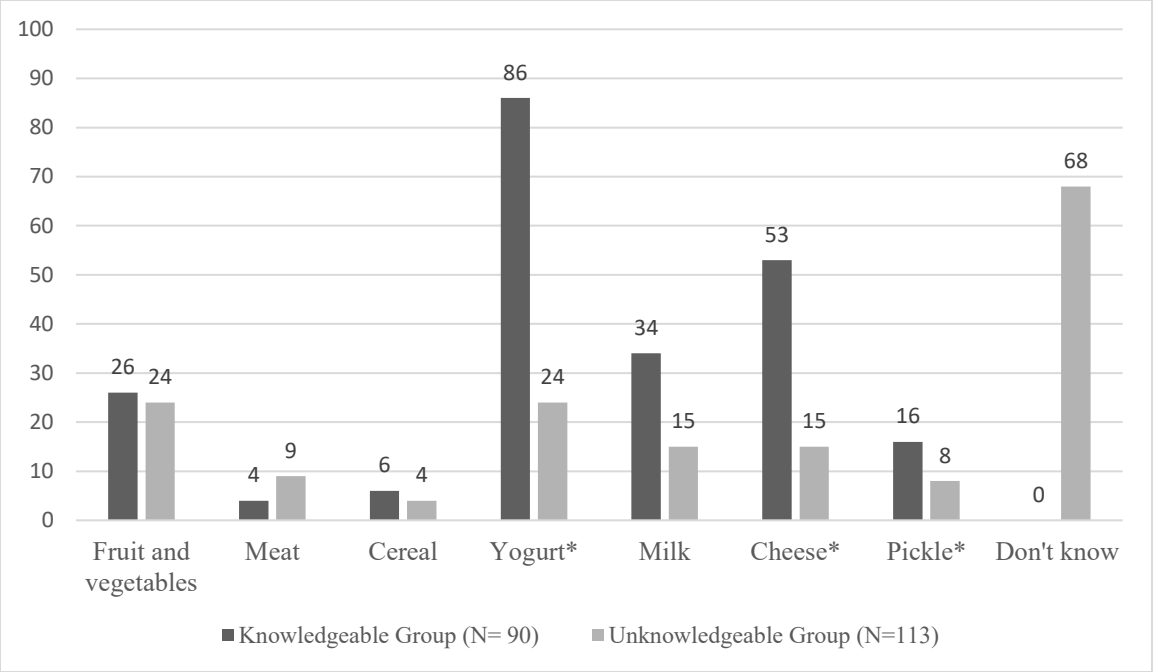

Figure 7. Selected choices of probiotic food sources by groups (Multi-Select). *Note.* * = correct selection.

Comparison of the Consumption of Probiotic Foods by the Both Groups

Participants were asked to report how much cheese, yogurt, and pickles they eat in their diet because those foods are a source of probiotics. Descriptive statistics were done to determine the frequency of cheese, yogurt, and pickle consumptions. Also, three Independent sample t-tests were completed to examine further the relationship between knowledge and consumption. First, participants were grouped on their knowledge of probiotics as the knowledgeable group and the unknowledgeable group and compared the mean on the intake of cheese, yogurt, and pickle in each group. Regarding yogurt consumption, individuals who are in the knowledgeable group (M=2.23, SD= 0.91) had significantly higher yogurt intake (average a few times per week) compared to those who are in the unknowledgeable group (average a few times per months) (M=2.82, SD= 0.98), t(172)=-4.12, p= 0.00. Table 12 displays the relationship between

knowledge on probiotics and yogurt consumption. Also, the frequency of cheese consumption by the both knowledgeable and the unknowledgeable groups are found in Figure 8 for more details.

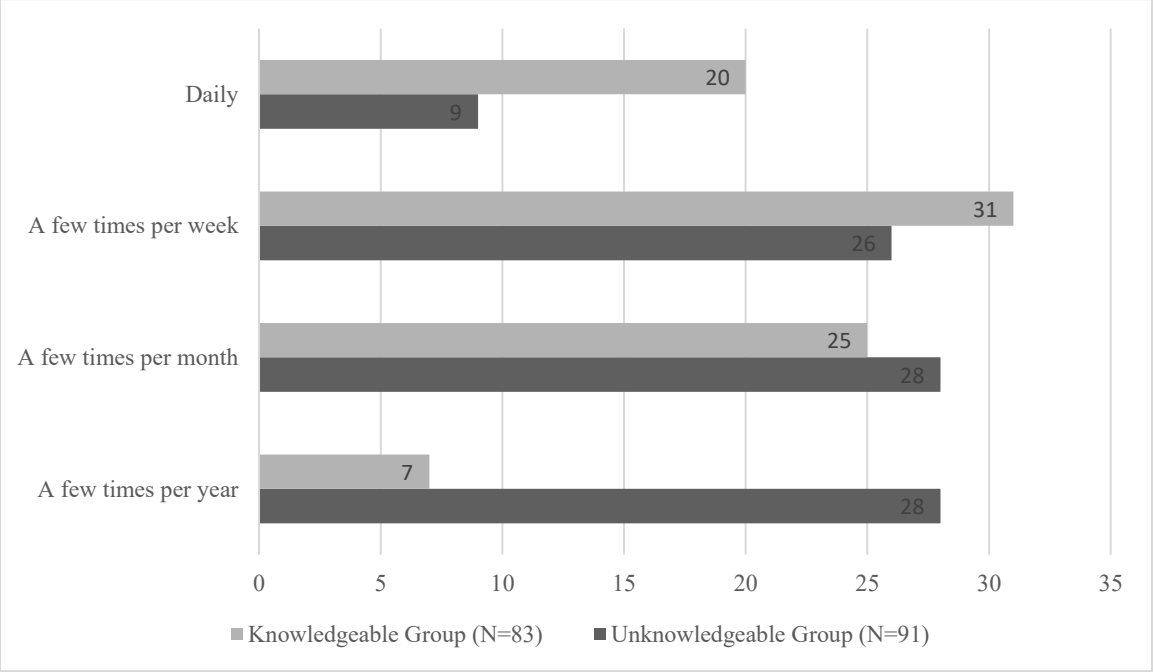

Figure 8. Frequencies of yogurt consumption by groups.

Table 12

Comparison of the Yogurt Consumption by Groups

	N	Mean	SD	t-cal	Df	*P*
Knowledgeable Group	83	2.23	0.91	-4.120	172	0.000*
Unknowledgeable Group	91	2.82	0.98			

Note. * = Statistical significant p < .05

Conversely, in regard to cheese consumption, individuals who are in the knowledgeable group (*M*=1.84, *SD*=0.68) did not have a significantly different cheese consumption than those who are in the unknowledgeable group (*M*=2.00, *SD*=0.82); *t*(194)=-1.48, *p*= 0.141. Table 13 summarizes the t-test results for the relationship between knowledge on probiotics and cheese

consumption. Also, the frequency of cheese consumption of both knowledgeable group and unknowledgeable group are compared in Figure 9.

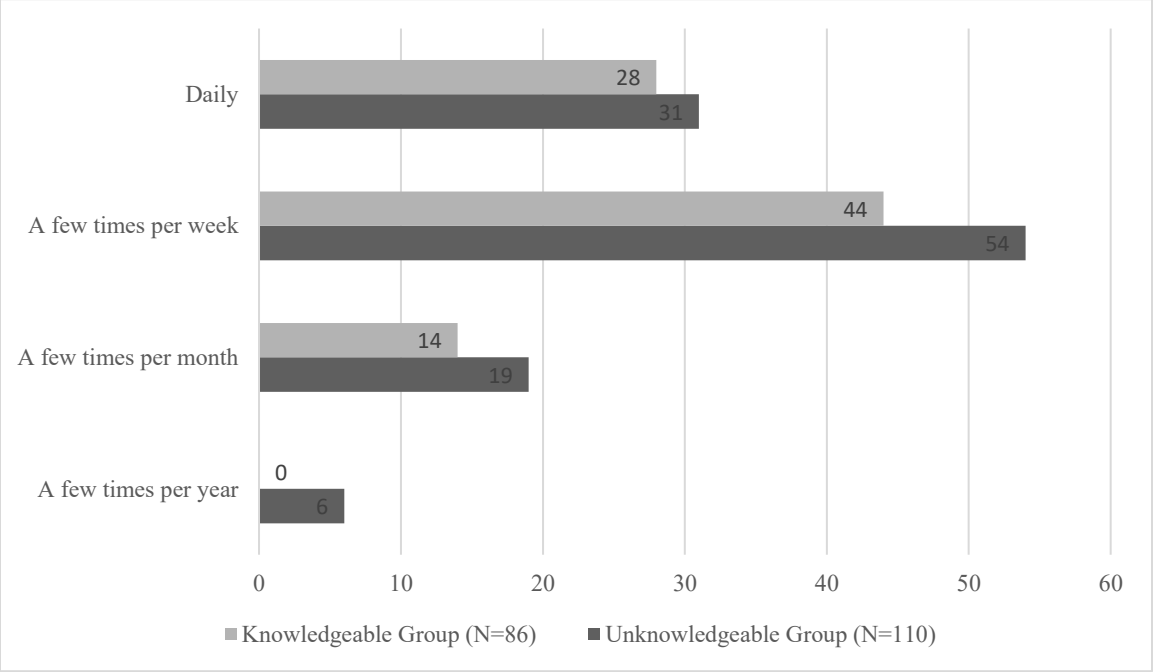

Figure 9. Frequencies of cheese consumption by groups.

Table 13

Comparison of the Cheese Consumption by Groups

	N	Mean	SD	t-cal	df	P
Knowledgeable Group	86	1.84	0.68	-1.477	194	0.141
Unknowledgeable Group	110	2.00	0.82			

Moreover, those who are in the knowledgeable group (M= 2.83, SD=0.75) did not have a significantly different pickle intake in comparison to those who are in the unknowledgeable group (M= 2.80, SD= 0.95), $t(175)$= 0.192, p= 0.85. T-test result of pickle consumption by both groups is shown in Table 14. The frequency of pickle consumption by the knowledgeable and unknowledgeable groups was also found in Figure 10 for a detailed comparison.

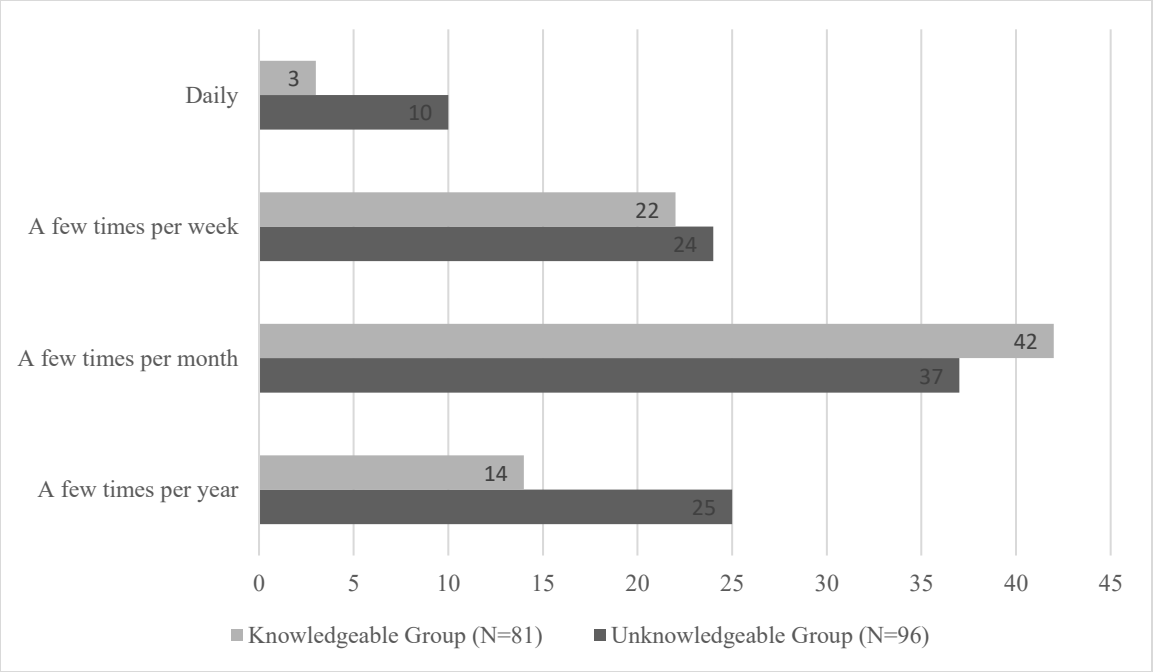

Figure 10. Frequencies of pickle consumption by groups.

Table 14

Comparison of the Pickle Consumption by Groups

	N	Mean	SD	t-cal	df	P
Knowledgeable Group	81	2.83	0.75	0.192	175	0.848
Unknowledgeable Group	96	2.80	0.95			

Part 2: Availability of Probiotics in Food Pantries for the Participants

In the beginning, the available brands and types of cheese and yogurt were monitored and documented (by taking photos of each item) for four days in a two months period. As seen in table 16, the brands and types of cheese and yogurt items varied, and the amount of the items was quite limited. On some days, there were many different brands and types of cheese and yogurt available in the food pantry while on other days, no yogurt or cheese items were available in the food pantries. Food pantries do not have many options for dairy products from food banks;

the majority of dairy products come from donations from the local grocery stores such as Walmart, Co-op grocery store, Aldi. The stores usually make donations once a week. Based on the cheese and yogurt analysis, there are some of the cheese and yogurt items have probiotics in this local food pantry even though the amount of the items are limited (Figure 11).

Availability of probiotic foods in the food pantry was examined by analyzing and comparing of cheese and yogurt which present in the food pantry and high-probiotic content cheese and yogurt bought from the grocery store and homemade yogurt. Two kinds of cheese, five kinds of yogurt, and homemade yogurt were examined in the laboratory. Cheese items were Ellsworth cheddar cheese curds and Bongard's cheese. Yogurt items were Dannon Light & Fit Greek vanilla low-fat yogurt, Great Value Original vanilla low-fat yogurt, Siggi's vanilla (strained non-fat) yogurt, Yoplait Gogurt and homemade yogurt. Those cheese and yogurt items are available in the food pantry time to time as a quite limited amount while Bongards Pasteurized Process American cheese is part of senior commodity box, so it is always available for seniors. Ellsworth cheddar cheese curds ($0.70/oz.) and Siggi's vanilla (strained non-fat) yogurt ($0.53/oz.) were the most expensive items, and Great Value Original vanilla low-fat yogurt ($0.07/oz.) and Dannon Light & Fit Greek vanilla low-fat yogurt ($0.09/oz.) were the cheapest items (Table 15). Also, Yoplait Gogurt and Bongards American cheese were the highly processed dairy items among the analyzed items.

Date	Available Items
First week (04/18/2017)	• Ranchero- Queso Fresco cheese • Gilman Jalapeno Peppers Pasteurized process cheese • Blaser's Antonella garden veggie and sweet basil cheese • Chipotle Onion cheese • Wisconsin Premium mild shredded cheddar cheese ❖ ***NO YOGURT***
Second week (04/25/2017)	• Frigo Cheese Heads light string and swirls • Burnett Dairy-Pepperoni Pizza string cheese • Kraft Twists mozzarella & cheddar string cheese • Crystal farms Wisconsin cheddar stick cheese • Great Value low-fat cottage cheese • Breakstone's low-fat cottage cheese • Belgioioso fresh mozzarella cheese pearls • Bifrost Farms Chevre cheese: plain, garlic-dill, smoked pepper ❖ **Siggi's low-fat blueberry yogurt (Added live culture)** ❖ **Dannon Oikos triple zero strawberry yogurt** ❖ **Yoplait peach yogurt** ❖ **Wallaby organic low-fat yogurt: black cherry, raspberry, strawberry (Added live culture)** ❖ **Mountain High low-fat vanilla yogurt** ❖ **Great value low-fat Strawberry Banana yogurt** ❖ **Dannon light & fit vanilla yogurt** ❖ **Chobani low-fat Greek yogurt "flip" Almond coco loco, Blackberry, Mango (Added live culture)** ❖ **Lala yogurt smoothie pecan cereal** ❖ **Greek yogurt parfait with apple from the co-op store**
Third week (05/02/2017)	• Bifrost Farms Chevre cheese: smoked pepper, garlic dill • Belgioioso fresh mozzarella cheese pearls

	• Cheese snack tray from a local grocery store • Becki's Mediterranean olive salsa jalapeño cream cheese • Wisconsin Premium mild shredded cheddar cheese ❖ **Wallaby organic low-fat yogurt: strawberry, black cherry, raspberry (Added live culture)** ❖ **Noosa raspberry yogurt (Added live culture)** ❖ **Fage non-fat Greek strained yogurt (Added live culture)**
Fourth week (05/30/2017)	• Masters Gallery Select cheddar cheese • Belgioioso fresh mozzarella cheese pearls • Dean's cottage cheese 45 milkfat minimum • Dante Lamb sheep milk cheese ❖ **Siggi's non-fat vanilla yogurt** ❖ **Redwood Hill Farm plain goat milk yogurt** ❖ **Liberte organic whole milk lemon yogurt** ❖ **Stonyfield organic whole milk plain yogurt (Added live culture)**
***Bongards processed American cheese is added to the commodity boxes for the seniors**	

Figure 11. The available cheese and yogurt items in a local food pantry.

Table 15

The Price of the Yogurt and Cheese Items

Items	Price (per ounce)
Ellsworth Cheddar Cheese Curds	$0.70
Bongards cheese	Provided by Food pantry
Siggi's yogurt	$0.53
Homemade yogurt	----
Dannon yogurt	$0.09
Great Value yogurt	$0.07
Yoplait Gogurt	$0.15

Item Analysis for Probiotic Strains

The *Lactobacillus* bacteria in the cheese and yogurt items were counted to find whether cheese and yogurt items contain adequate probiotic strains to provide health benefits to the humans. As mentioned earlier, probiotic bacteria must survive in food products above a threshold level of 10^6 colony forming unit/gram (cfu/g) in the fermented milk products and survive harsh condition of the gastrointestinal tract to offer health benefits (Al Khalaileh & Ajo, 2013; Nagpal et al., 2012; Talwalkar & Kailasapathy, 2004).

Table 16 displays the analyzed food items and their bacteria amounts (average CFU's). All of the food items except Yoplait gogurt were examined in triplicate and then the average CFU's were calculated.

Table 16

The Viability of Lactobacillus Bacteria in Cheese and Yogurt Items

Food items	Average CFUs
Ellsworth Cheddar Cheese Curds	$83*10^6$
Bongard's cheese	0
Siggi's yogurt	$16*10^7$
Homemade yogurt	5*10
Dannon yogurt	$64*10^6$
Great Value yogurt	$10*10^7$
Gogurt	0
Homemade yogurt (lower heat)	$11*10^6$

Note. The threshold level is at least 10^6 colony forming unit/gram (cfu/g) of probiotic bacteria.

Table 17 displays the viability of probiotic bacteria in the cheese and yogurt items during the storage period. The viability of probiotic bacteria (*Lactobacillus*) of the cheese and yogurt items which reached the threshold increased throughout the storage period. Also, there is no significant viability of probiotic bacteria difference between the Ellsworth cheddar cheese and the yogurt samples which reached the threshold. However, homemade yogurt which was analyzed with sodium citrate (incubated at 45°C overnight) showed very low *Lactobacillus* content. The results from homemade yogurt analysis were inconsistent and needed further research for a conclusion. When the temperature of the sodium citrate was decreased, viable *Lactobacillus* increased in number and reached the threshold CFU level. This result shows that heat may be a reason for not growing bacteria but obviously, storage period was not the reason.

Table 17

The Viability of Probiotic Bacteria in Cheese and Yogurt Items Over Storage Time

Food items	Average CFU's			
	Batch 1 (1^{st} day)	Batch 2 (6^{st} day)	Batch 3 (19^{th} day)	Batch 4 (42^{nd} day)
Ellsworth Cheddar Cheese curds**	$13*10^3$	$75*10^6$	$83*10^6$	--*
Bongard's cheese	0	0	0	--*
Siggi's yogurt**	$76*10^6$	$18*10^7$	$23*10^7$	--*
Homemade yogurt	0	16*10	0	--*
Dannon yogurt**	--*	$68*10^6$	$44*10^6$	$81*10^6$
Great Value yogurt**	--*	$83*10^6$	Impossible to count	$12*10^7$
Gogurt	--*	--*	--*	0
Homemade yogurt (lower heat) **	--*	--*	--*	$11*10^6$

Note. * = The samples did not run in those batches. *Note*. ** = The threshold level is at least 10^6 colony forming unit/gram (cfu/g) of probiotic bacteria.

Table 18 summarizes all of the food items' average CFU's. Ellsworth Cheddar cheese curds, Siggi's yogurt, Dannon yogurt, and Great Value yogurt have an adequate amount of *Lactobacillus* bacteria to offer health benefits to humans. However, Bongard's, processed cheese and Gogurt had no viable*Lactobacillus,* so those items do not provide probiotic health benefits to humans.

As seen in Table 18, most of the cheese and yogurt items are available in the food pantry from time to time but in a quite limited quantity. The notable exception is the Bongards Pasteurized Process American cheese which is not a probiotic food according to this analysis.

Table 18

The Summary of the Availability of Probiotic Bacteria in the Cheese and Yogurt Items

Food items	Average CFU's	Probiotic	Food pantry availability
Ellsworth Cheddar Cheese curds	$83*10^6$	++++++	Yes
Bongard's cheese	0	--	Yes
Siggi's yogurt	$16*10^7$	+++++++	Yes
Homemade yogurt	5*10	--	No
Dannon yogurt	$64*10^6$	++++++	Yes
Great Value yogurt	$10*10^7$	+++++++	Yes
Gogurt	0	--	Yes
Homemade yogurt (lower heat)	$11*10^6$	++++++	No

Note. To be considered probiotic food, the food item should contain at least 10^6 colonies forming unit/gram (cfu/g) bacteria.

Chapter V: Discussion, Conclusion, and Recommendation

This study examined the availability, awareness, and usage of probiotic-containing food by food pantry participants. The study consisted of two parts: Part 1- Awareness and usage of probiotic foods by the food pantry participants was evaluated by a questionnaire, and Part 2- Availability of probiotic foods in the food pantry was examined by a survey of product availability in the pantry and quantification of *Lactobacillus* bacteria representative products. The survey was conducted with participants from four different food pantries in Wisconsin in September-October 2017 and food pantry participants were asked verbally to participate in the questionnaire. Analysis of food items was done in through December 2017-February 2018. This chapter compares the findings to related research, reviews the limitations of the study, and draws conclusions from the results. This chapter will conclude with a recommendation for future research.

Discussion

Results of this study indicate some similarities and differences to previous research in this field. One of the objectives of the study was to examine food pantry participants' knowledge and usage of probiotics in their diet.

First, the study shows that most (82.9%) of the food pantry participants are familiar with the word "probiotics," but only 44% of them demonstrated knowledge. Many probiotic foods are fermented dairy products, and Wisconsin is the "America's Dairyland" thus it could be expected that a higher number of Wisconsin people have heard of probiotics in comparison to those in the other areas of the United States. However, actual knowledge of probiotics includes knowing the definition and health benefits of probiotics and identifying food sources of probiotics. As noted

above 44% of participants proved knowledgeable on probiotics, which is low compared to ~half of those saying they had heard of probiotics.

Second, this study examined the relationship between knowledge and probiotic food consumption. In this study, the foods surveyed were cheese, yogurt, and pickle. There was no statistically significant difference between pickle consumption and knowledge on probiotics. According to the USDA Economic Research Center-Vegetable and Melon Outlook report, Midwest residents consume more pickles than any other regions of the United States. The report shows that 4.3 pounds of pickling cucumber were used by Midwestern consumers (Lucier & Jerardo, 2007). Thus, pickles are one of the cultural foods, so people consume it in their diet without needing any knowledge of probiotics. Also, there was no statistically significant association between knowledge and cheese consumption. Wisconsin still is the number one producer of American, cheddar, and total cheese production in the United States (Bussler, Hubbell, Joyner, & Woodstock, 2017) and cheeses are one of the staple foods for Midwesterners (Food in Every Country, 2018). Therefore, they do not specifically consider the health benefits or probiotic source of cheese in order to include it in their diet. However, there was a statistically significant relationship between probiotic knowledge and yogurt consumption. 95.6% knowledgeable group identified yogurt as a food source of probiotics. Yogurt is a fermented dairy product and the well-known food containing probiotics. The origin of yogurt is Middle Eastern (Fisberg & Machado, 2015) and it is not a cultural food for Americans. According to the article written by Fisberg and Machado, 6% of Americans consume yogurt in their diet (Fisberg & Machado, 2015). Knowledgeable participants may consume yogurt due to its reported probiotic health benefits.

Last, this study assessed the association between knowledge and the demographics of the two groups. There was only a statistically significant association between knowledge and marital status. Married participants were much more knowledgeable on probiotics than those who had other marital statuses. It is unclear as the reason for this association.

Another objective of this study was to find out whether probiotic foods are available in the food pantries and if so, is there any difference in the viability of probiotic bacteria in the cheese and yogurt compared to the high-quality store-bought ones. First, this study found that is a very limited amount and selection of dairy products available in the food pantries. As mentioned earlier, amount, healthfulness, and type of food products, especially dairy products, varies in the food pantries because they rely on the donations as well as the food choices of the person placing food bank orders (Cureton et al., 2017). 2) In our study, there was no significant difference in the viability of *Lactobacillus* bacteria in the expensive, store-bought yogurt, which advertises live bacteria (Siggi's) in comparison to the cheap yogurt (Walmart brand Great Value). Also, when compared the cheddar cheese and yogurt samples, this study did not find any significant difference between yogurt and cheddar cheese, indicating that both are relatively equivalent sources of probiotic bacteria. These findings were different than a study conducted by Sharp et al. which suggests that cheese may provide a better environment for probiotic viability compared to yogurt (Sharp, McMahon, & Broadbent, 2008). Importantly, this study confirms that processing the dairy items destroys the probiotic content. Both highly processed cheese (Bongard's) and yogurt (Gogurt) did not contain any viable *Lactobacillus.* This result confirms a review study conducted by Castro et al. that emphasize the adverse effect of processing on the viability of probiotic culture in the food product (Castro, Tornadijo, Fresno, & Sandoval, 2015).

Limitations

There are several limitations to this research study. The first limitation of this research study was the sample size (205 participants) Secondly, the participants are from five different food pantries in Western Wisconsin. Thus, the finding may not be representative to all of Wisconsin or the United States. Moreover, the participants of the study live in a west-central region of Wisconsin and do not consist of a racially or ethnically diverse community. The study population reported 84.1% White, 3.1% Black, 2.5% Hispanic, 2.5% Native American, 6.1% Asian, 0.5% Pacific Islander, and 1.0% "other." According to the Hunger in America 2014-State Report for Wisconsin, the race/ethnicity of food bank including food bank participants including food pantry in Wisconsin consisted of 56.5% White, 23.0% Black, 9.1% Hispanic, and 11.4% some other race (Mills et al., 2014).

Another limitation of this research study was that *Lactobacillus* was the only probiotic bacteria assessed to identify the availability of probiotic content of the cheese and yogurt in the food pantries.

Conclusions

Overall finding from this research study answered all the assigned research questions. First of all, probiotics could be found in the food pantries but only in a limited quantity and frequency. Also, the majority of food pantry participants have heard the word probiotics, but about half of the participants were actually knowledgeable on probiotics. Married people were more knowledgeable on probiotics than those in other marital statuses. Moreover, knowledgeable group consumes more yogurt than the unknowledgeable group.

Recommendations

Some recommendations are suggested for future interventions and studies. This study did not assess the reason(s) for cheese, yogurt, and pickle consumption by the questionnaire participants. Cheese and pickles are common foods that many people include in their diet simply because they are part of the culture. Therefore, a question should be added to the questionnaire for evaluating whether people consume those foods due to the probiotic content or not. Also, results of this study are not broad enough to generalize to the general population due to small sample size and the demographic characteristics of the participants. The sample size should be increased in future studies and cover a wider area in order to generalize the conclusions. In addition, only 44% of the participants are knowledgeable on probiotics so future studies could use this study as a base to develop nutrition education and interventions on probiotics and healthy diet to educate the food pantry participants. Moreover, the present study did not examine the probiotic bacteria other than *Lactobacillus*, so bacteria selection and/or further identification should be expanded in future research. More cheese varieties should also be included in order to exam the effect of cheese variety on probiotic content. In addition, this study found inconsistent results with homemade yogurt. The temperature of the citrate extraction solution was set at 45°C for the first three trials with the homemade yogurt, and a minimum count of *Lactobacillus* was observed. However, in the 4^{th} trial, the temperature of the solution was lowered, and the threshold (10^6 CFU) of *Lactobacillus* was observed. The inconsistency of these results shows that further research is needed in order to assess the probiotic content of homemade yogurt and potentially other probiotic foods.

Finally, dairy products are usually limited in the food pantries. Nutritional education and interventions to educate the food pantry directors on the importance of dairy and probiotic foods may increase the healthfulness of available products in the food pantry.

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Appendix A: UW-STOUT Institutional Review Board (IRB)

UNIVERSITY OF WISCONSIN
STOUT
WISCONSIN'S POLYTECHNIC UNIVERSITY

Office of Research and Sponsored Programs
152 Vocational Rehabilitation
University of Wisconsin-Stout
P.O. Box 790
Menomonie, WI 54751-0790
Phone: 715-232-1126

May 23, 2017

Aysegul Baltaci
Food & Nutritional Science
University of Wisconsin-Stout

RE: Awareness and Usage of Probiotic Food among Food Pantry Participants in Wisconsin

Dear Aysegul:

The IRB has determined your project, *"Awareness and Usage of Probiotic Food among Food Pantry Participants in Wisconsin"*, is **Exempt** from review by the Institutional Review Board for the Protection of Human Subjects. The project is exempt under **Category #2** of the Federal Exempt Guidelines and holds for 5 years. Your project is approved from **May 23, 2017** through **May 22, 2022**. If a renewal is needed, it is to be submitted at least 10 working days prior to the approvals end date. Should you need to make modifications to your protocol or informed consent forms that do not fall within the exemption categories, you will need to reapply to the IRB for review of your modified study.

Informed Consent: All UW-Stout faculty, staff, and students conducting human subjects' research under an approved "exempt" category are still ethically bound to follow the basic ethical principles of the Belmont Report: 1) respect for persons; 2) beneficence; and 3) justice. These three principles are best reflected in the practice of obtaining informed consent from participants.

If you are doing any research in which you are paying human subjects to participate, a specific payment procedure must be followed. Instructions and form for the payment procedure can be found at http://www.uwstout.edu/rs/paymentofhumanresearchsubjects.cfm

If you have questions, please contact the IRB office at 715-232-1126, or buchanane@uwstout.edu, and your question will be directed to the appropriate person. I wish you well in completing your study.

Sincerely,

[redacted]

Elizabeth Buchanan
Interim Director of Office of Research and Sponsored Programs and Human Protections Administrator,
UW-Stout Institutional Review Board for the Protection of Human Subjects in Research (IRB)

CC: Marcia Miller-Rodeberg

***NOTE: This is the only notice you will receive – no paper copy will be sent.**

Appendix B: Assessment of the Knowledge and Beliefs of Participants of Food Pantries in Wisconsin Regarding Probiotic Use

Assessment of the Knowledge and Beliefs of Participants of Food Pantries in Wisconsin Regarding Probiotic Use

This research study is being conducted to determine the knowledge and beliefs of participants of food pantries in Wisconsin regarding probiotic use. All information provided will remain confidential.

1. Age: _____

2. Gender (circle one): Male Female

3. Marital Status (circle one): Single Married Divorced Widowed Other

4. Race (circle one): Asian Black Hispanic Native American Pacific Islander White Other

5. Education level (circle one):
   a. Some High School
   b. High School Graduate
   c. Some College
   d. Associates Degree
   e. Bachelors Degree
   f. Graduate Degree
   g. Other_____

6. Occupation:

7. Which of the following diseases/conditions have you been diagnosed with? (circle all that apply):
   a. Urinary Tract Infections (UTI)
   b. Lactose Intolerance
   c. Irritable Bowel Syndrome (IBS)
   d. Crohn's disease or Colitis
   e. Chronic antibiotic therapy
   f. Lupus
   g. Human Immunodeficiency Virus (HIV)
   h. Other
   i. I occasionally suffer from: _____
   j. I do not suffer from any diseases or conditions

8. Which of the following supplements/herbal products do you take regularly? (circle all that apply):
   a. Multivitamin with minerals
   b. Echinacea
   c. Ginger
   d. Gingko Biloba
   e. Ginseng
   f. St. John's Wart
   g. Bifidobacteria
   h. Fish Oil
   i. Lactobacillus acidophilus
   j. Flaxseed
   k. Psyllium
   l. Other_____
   m. I occasionally take supplements/herbals including:
   n. I do not regularly take any supplements or herbal products

9. Have you ever heard the word "probiotics"? (circle one): Yes No Not sure

10. Do you know what probiotics are? (circle one): Yes No Not sure

11. Where have you heard of probiotics (circle all that apply)
    a. Television programs
    b. Television commercials
    c. Healthcare providers
    d. Magazines or newspapers
    e. Others

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12. What are probiotics? (circle one)
    a. Technological structures having mechanical parts
    b. Live microbial cultures consumed or applied for health benefit
    c. Harmful chemical found in foods
    d. Don't know

13. What is one benefit of probiotics? (circle one)
    a. Decreased risk of stroke
    b. Increased energy
    c. Increased immune function
    d. Increased intelligence
    e. Don't know

14. What foods are sources of probiotics? (circle all that apply)
    a. Fruits and vegetables
    b. Meat
    c. Cereal
    d. Yogurt
    e. Milk
    f. Cheese
    g. Pickle
    h. Don't know

15. How often do you consume probiotics or foods containing probiotics? (circle one)
    a. Daily
    b. Weekly
    c. Monthly
    d. Never
    e. Don't know

16. How often on average do you eat cheese?
    a. Daily
    b. A few times per week
    c. A few times per months
    d. A few times per year
    e. Never

17. How often on average do you eat yogurt?
    a. Daily
    b. A few times per week
    c. A few times per months
    d. A few times per year
    e. Never

18. How often on average do you eat pickles?
    a. Daily
    b. A few times per week
    c. A few times per months
    d. A few times per year
    e. Never

19. For what reason/reasons do you consume probiotics or foods containing probiotics? (circle all that apply):
    a. I do not consume probiotics
    b. Taste/Flavor
    c. Intestinal Benefits
    d. Improved immune system response
    e. To ease the side effects of medications
    f. Prevention
    g. None of the above:

18. Would you try a probiotic product if it were recommended to you by a health professional?
    a. Yes
    b. No
    c. Maybe
    d. Don't know

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Appendix C: Implied Consent

Consent to Participate In UW-Stout Approved Research

Title: *Awareness and Usage of Probiotic Food among Food Pantry Participants in Wisconsin*
The purpose of the study: *The purpose of this research study is to determine the awareness and consumption of probiotic food products among the food pantry participants in Wisconsin.*
Procedures to be followed: *You will be explained what the research study about is and then asked to answer questions on this survey. Also, you may choose to place your name in a raffle provided by the investigator.*
Risks: *There is no risk in participating in this research beyond those experienced in everyday life.*
Benefits: *This research will offer feedback to researchers on how the food pantry participants perceive the probiotic foods and its usage. The results may be used in the development of future studies to improve pantry food selection and nutrition education opportunities.*
Time commitment and Payment: *It will take about 10 minutes to complete the survey. All the individuals who agreed to participate in the survey will have a chance to put their names into a raffle box provided by the investigator after their participation. Three of those will win raffle prizes which will be $5, $10, and $15 gas card from Kwik Trip.*
Confidentiality: *Your name will not be included on any documents. You will not be identifiable from any information you provide in the survey. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared because your name is not linked to your responses. Names for the raffle will be destroyed before data analysis begins.*
Right to Withdraw: *Your decision to be in this research is voluntary. You may stop at any time. You do not have to answer any questions you do not wish to answer. Refusal to take part in or withdrawing from this study will involve no penalty or loss of benefits you would receive otherwise. Completion and return of the survey are considered your implied consent to participate in this study. Please keep this form for your records.*
IRB Approval: *This study has been reviewed and approved by The University of Wisconsin-Stout's Institutional Review Board (IRB). The IRB has determined that this study meets the ethical obligations required by federal law and University policies. If you have questions or concerns regarding this study, please contact the Investigator or Research Advisor. If you have any questions, concerns, or reports regarding your rights as a research subject, please contact the IRB Administrator.*

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Statement of consent:

You must be 18 years of age or older to take part in this research study.
Completion of the following survey entitled, ***"Assessment of the Knowledge and Beliefs of Participants of Food Pantries in Wisconsin Regarding Probiotic Use"*** *implies that you have read the information in this form and you agree to participate in the project entitled* ***"Awareness and Usage of Probiotic Food among Food Pantry Participants in Wisconsin****."*
Please keep this form for your records or future reference.

Appendix D: Permission to Use Modified Knowledge of Probiotics Questionnaire

Email received on March 4th, 2017

From Anas A. Al-Nabulsi (anas_nabulsi@just.edu.jo)

To: Baltaci, Aysegul

Dear Baltaci

A self-administrated questionnaire that composed of two main parts was used. The first part was developed by the us to collect information about students' socio demographic and academic characteristics (student age, weight, height, gender, marital status, educational level, school year, major, pocket money and current residence). The second part of the questionnaire was adapted from published, reliable, and valid questioner with some modifications (the coefficient of reliability was 0.89) to assess knowledge and beliefs about probiotics (Stanczak and Heuberger , 2009). The second part of the questionnaire included data about sources of knowledge about probiotic (TV programs, magazines, etc…), frequency of probiotic consumption, questions to assess participants beliefs' regarding probiotic consumption, as well as questions to assess knowledge about probiotic. All this information are attached.

Please let me know how I can help you

Regards

Anas

Dr. Anas Al-Nabulsi

Professor of Food Microbiology

Department of Nutrition and Food Technology

Faculty of Agriculture

Jordan University of Science and Technology

Irbid - Jordan

Email sent on March 2th, 2017

From: Baltaci, Aysegul

To: Richard A. Holley and Reyad R. Shaker

Dear Dr. Holley and Dr. Shaker,

My name is Aysegul; I am a graduate student in the Food and Nutrition Science at the University of Wisconsin-Stout. My thesis topic is "probiotic foods" including, cheese, yogurt, and pickles. I want to use the survey that you used in your study titled "Knowledge of Probiotics and Factors Affecting Their Consumption by Jordanian College Students." If you do not mind sending me the survey, I would really appreciate it!

Please let me know if you need more information.

Regards,

Aysegul Baltaci