Barley – The Super Grain: Connecting the Classroom and the Cafeteria

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by Steffanie Sandoval

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AUTHORIZATION TO SUBMIT THESIS

This thesis of Steffanie Sandoval, submitted for the degree of Master of Science with a Major in Family and Consumer Sciences and titled, "Barley – The Super Grain: Connecting the Classroom and the Cafeteria" has been reviewed in final form. Permission, as indicated by the signatures and dates given below, is now granted to submit final copies to the College of Graduate Studies for approval.

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ABSTRACT

Two elementary schools (grades 1-5), participated in a two week study called, Barley – The Super Grain: Connecting the Classroom and the Cafeteria. Six classrooms participated in the nutrition education activities at the intervention school (N=107). The study focused on (1) changes in taking a barley recipe served in the cafeterias, (2) changes in liking a barley recipe from repeated exposure, (3) changes of barley consumption at home, and (4) increases in knowledge of barley. A paired samples sign test quantitative analysis was used to analyze the data. From pre to post study, there was a significant increase in the 1st-3rd grade children's knowledge of barley, reported consumption of barley at home, and the liking of barley. From pre to post study, there was a significant increase in the 4th-5th grade children's knowledge of barley, and the liking of barley, but no significant increase in reported consumption of barley at home.

ACKNOWLEDGEMENTS

I would like to thank all my committee members, Dr. Safaii-Waite, Dr. Katie Miner, and Joey Peutz for their guidance and encouragement throughout this thesis. I would like to extend a special thank you to Dr. SeAnne Safaii-Waite and Dr. Katie Miner for selecting me for this research project which aligned with my long term and career goals. This barley education material is based upon work developed by the University of Idaho Dietetic students of the Spring 2017 graduating class. A special thank you is extended to the Idaho Barley Commission for funding this project and to Barbara Bumgardner and her staff for facilitating the barley recipe component of this study.

DEDICATION

My thesis is dedicated to all my friends and family who were supportive and offered me words of encouragement throughout this process.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE: INTRODUCTION

Every five years, the Dietary Guidelines for Americans are released to provide current evidenced based recommendations on food choices that would promote health in the United States population (U.S. Department of Health and Human Services, 2017). According to the new 2015-2020 Dietary Guidelines, individuals should aim to consume whole grains and limit their consumption of refined grains (U.S. Department of Health and Human Services, 2017). Whole grains offer a variety of nutrients including: Fiber, b-vitamins, iron, and others (U.S. Department of Health and Human Services, 2017). Almost all the United States Population consumed less than the recommended amount for whole grains (NHANES 2007-2010). Consumption of whole grains have the potential to reduce the risk of cardiovascular disease and to promote healthy weight in individuals (U.S. Department of Health and Human Services, 2017).

Barley, a specific type of whole grain, offers the highest fiber content of all the whole grains (Whole Grains Council, 2017). Soluble β-glucan fiber, the specific type of fiber found in barley, is linked with the reduction of cholesterol, better control of blood sugars, and improvement of the immune system (Rondanelli, Opizzi, & Monteferrario, 2009). In 2005, the FDA published their final ruling authorizing barley and barley products to use the health claim that they reduce the risk of coronary heart disease (Food and Drug Administration, 2006).

The study, Barley - The Super Grain: Connecting the Classroom and the Cafeteria, focused on (1) changes in taking a barley recipe served in the cafeterias, (2) changes in liking a barley recipe from repeated exposure, (3) changes of barley consumption at home, and (4) increases in knowledge of barley.

Statement of the Problem

A multitude of research exists for repeated exposure for fruits and vegetables. Unlike exposure to different fruits and vegetables, there is limited research supporting repeated exposure with whole grains such as barley. There is research related to the health benefits of barley, but there is limited research in relation to nutrition education and increased consumption of barley. Available nutrition education related to whole grains is limited to exposure to a variety of whole grains and not to specific benefits of the barley grain.

Significance of the Problem

Barley, a type of grain that offers multiple health benefits, is not a highly consumed in the average diet. Repeated exposure to fruits and vegetables have been shown to increase acceptance for different fruits and vegetables and nutrition education has also been shown to increase acceptance for different foods through knowledge and behavior changes. Limited research is available on repeated exposure of barley grains and nutrition education of barley grains. The study aims to test the hypothesis that combining repeated exposure and nutrition education on the health benefits of barley would help increase acceptability of barley, increase liking of barley, as well as increasing knowledge of barley through lessons and material presented through an educational series.

Definition of Terms

Repeated exposure

Presenting items, in this instance, food, as an effective way to increase the liking, intake, or acceptance of the food (Caton, Ahern, Remy, Nicklaus, Blundell, & Hetherington., n.d.)

Nutrition Education

"Programs [which] attempt to increase knowledge and awareness, change attitudes, improve skills, or alter behaviors, to positively impact health measures" (Berlin, Norris, Kolodinsky, & Nelson, 2013).

Plate Waste Study

The volume of percentage of food that is not eaten, but discarded instead (Connors & Rozell, 2004).

Fiber

The nondigestible, intact plant components (Mahan, Escott-Stump, & Raymond, 2012, p. 36).

Soluble Fiber

"[S]oluble fiber forms gels, slow[s] GI transit time, bind other nutrients such as cholesterol and minerals and decrease their absorption" (Mahan, Escott-Stump, & Raymond, 2012, p. 38).

Insoluble Fiber

Insoluble fiber help to increase "water-holding capacity of undigested material, increase fecal volume, increase number of stools per day, and decrease GI transit time" (Mahan, Escott-Stump, & Raymond, 2012, p. 38).

CHAPTER TWO: REVIEW OF LITERATURE

Introduction

Idaho is among the major producers of barley in the United States (National Barley Foods Council). Often recognized as an ingredient for making beer or as feed for cattle, the nutritional benefits of barley are not as well known to the public. Further, the effects of sensory attributes that lead to acceptance of whole-grain intakes in children are limited (Chu, Warren, Sceets, Murano, Marquart, & Reicks, 2011). Schools are important for increasing whole-grain intakes in children and adolescents as schools can provide at least one serving of whole-grains in a day (Chu et al., 2011). The Nation School Lunch Program (NSLP) requires schools to serve whole grain rich foods as one component of the meal to children on a daily basis (U.S. Department of Agriculture). Whole grain rich foods can include 100% whole grain products, or at minimum 50% whole grain components with 50% enriched grain components (U.S. Department of Agriculture). Most whole-grain consumed in the United States and in schools are breads and cereals. There are hundreds of other types of grains available for consumption but people tend to be limited in their purchasing habits. Lesser known grains are not as common in the average diet (Chu et al., 2011).

Health Benefits of Barley

According to the Centers for Disease Control and Prevention, heart disease and diabetes are ranked in the top ten leading causes of death in the United States. Two factors, among others, contributing to the risk of heart disease are being overweight/obese and poor diet (Center for Disease Control, 2016). One factor contributing to the risk of developing type II diabetes is being overweight (Center for Disease Control, 2015). Consumption of whole

grains have the potential to reduce the risk of cardiovascular disease and to promote healthy weight in individuals (U.S. Department of Health and Human Services, 2017).

Diets high in fiber can be an important component for preventing heart disease (Centers for Disease Control, 2015). Barley, a specific grain, contains a type of fiber known as β-glucan soluble fiber. Of its total mass, dry barley contains 3.5%-3.9% β-glucan fiber (Talati, Pabilonia, White, & Coleman, 2009). Important to obese and/or diabetic individuals, β-glucans lead to a slower rate of carbohydrate and lipid absorption in the body (Liefschitz, Grusak, Butte, 2002). Other grain types such as wheat and rice do not contain this type of fiber (Talati et al., 2009) but instead contain insoluble fiber which are not as effective in lowering cholesterol (Behall, Scholfield, & Hallfrisch, 2004). β-glucan's soluble nature and polysaccharide structure have the potential for a cholesterol lowering effects (Liefschitz et al., 2002). A meta-analysis of barley's effect on serum lipids concluded participants consuming barley had a significant reduction of total cholesterol, LDL cholesterol, and triglycerides compared to control participants (Talati et al., 2009). In 2005, the FDA published their final ruling authorizing barley and barley products to use the health claim that they reduce the risk of coronary heart disease (Food and Drug Administration, 2006).

Improving lipid and glucose control assists with management of type II diabetes (Liefschitz et al., 2002). Reduction in the risk of type II diabetes and cardiovascular disease has been associated with foods high in nondigestible carbohydrates (Priebe et al., 2010). Foods high in β-glucans may reduce carbohydrate digestibility and lead to sustained glycemic responses in the body (Liefschitz et al., 2002). In the study done by Priebe et al. 2010, barley kernels were compared to white bread as part of an evening meal. The researchers concluded that evening meals high in nondigestible carbohydrates such as barley, lead to an increase in

tissue glucose uptake the following morning more so than evening meals with low nondigestible carbohydrates such as white bread.

Food Exposure

The fear associated with new food experiences is known as food neophobia (Schindler, Corbett, & Forestell, 2013). Increasing acceptance of foods can be done through exposure of food (Wardle, Herrera, Cooke, & Gibson, 2003) and disliked foods can become liked foods through repeated exposure (Lakkakula et al., 2011). Repeated exposure is the simplest way to increase flavor acceptance and preference towards foods (Birch & Anzman-Frasca, 2011). Exposure to food at an early age can lead to the promotion and intake of healthier food options (Anzman-Frasca, Savage, Marini, Fisher, Birch, 2012). Children's liking of new foods can be done through familiarization which helps to overcome their food neophobias (Birch & Anzman-Frasca, 2011).

Another way to increase liking of food is through familiarization or associated conditioning outside of the laboratory setting (Birch & Anzman-Frasca, 2011). Birch and Anzman-Frasca discuss specific types of food familiarization techniques including flavor-flavor learning which pairs a liked flavor with a novel, or unknown flavor to increase children's acceptance towards a food. Birch and Anzman-Frasca noted both repeated exposure and flavor-flavor learning can lead children to increase liking of a previously disliked vegetables. In a previous study, the researchers presented a disliked vegetable to children and compared their liking to the vegetable paired with a liked dip which lead to increased liking for both conditions (Anzman-Frasca et al., 2012). Increases in liking of the vegetable were noted after six exposures (Anzman-Frasca et al., 2012). These conclusions are supported by another study conducted by Caton et al. 2012 in which children showed

increased liking of artichokes through repeated exposures was sufficient to increase liking compared to flavor-flavor learning and flavor nutrient learning. Children showed maximum intake of the artichoke at the fifth exposure out of ten exposures (Caton et al., 2012). In their research, Canton et al. noted flavor-flavor learning, flavor-nutrient learning, and repeated exposures were all effective methods to increase vegetable intake in children.

Cafeteria Exposure

School cafeterias have the potential to impact food choices made by children during the school day. A comparison review of two studies, the Wise Mind and LA Health, was conducted by Williamson, Han, Johnson, Martin, & Newton, 2013. A strong positive relationship between food selection and food intake was noted in each study as types and quantities of different foods were modified, so was intake (Williamson et al., 2013). Schools not only have the potential to modify types and quantities of food offered to students, but have the opportunity to increase liking of foods being served. Elementary students participating in cafeteria-based tasting program increased their liking for fruits and vegetables offered to students in the lunch line (Lakkakula et al., 2011). Children were divided into two groups: 1) children who did not like a particular fruit/vegetable and 2) children who liked a fruit/vegetable. Changes to children's liking of fruits and vegetables were observed after an average of two and five tastings respectively in children who previously did not like the fruit/vegetable (Lakkakula et al., 2011).

Schools in Texas and Minnesota who received USDA commodity whole grain pancake and tortilla products participated in a study designed to test students' acceptance of whole grain versus refined grain products (Chu et al., 2011). Refined grain products were served prior to the whole grain products and on average each product was served an average

of four times at each school (Chu et al., 2011). The results of the study showed there was little impact of substituting the refined grain products with the whole grain products (Chu et al., 2011). The study used three varieties of whole grain pancakes: 100% red whole wheat, 51% red whole wheat, and 100% white whole wheat. Sensory attribute ratings showed no difference between elementary students' liking of the 100% white whole wheat and the refined pancake which suggests acceptance was influenced by flour type (Chu et al., 2011). Two varieties of whole grain tortillas were used with varying whole wheat percentages, 66% and 100%, both of which had overall liking compared to the refined tortilla (Chu et al., 2011). As students are often limited to the choices available to them in the school environment, they are likely to eat the whole grain foods even if they are not as liked compared to the refined grain products (Chu et al., 2011).

Nutrition Education and Consumption

Nutrition education can be defined as "[p]rograms [which] attempt to increase knowledge and awareness, change attitudes, improve skills, or alter behaviors, to positively impact health measures" (Berlin et al., 2013). A study by Osborne & Forestell, 2012, noted children were marginally more likely to try unfamiliar fruits when they had been exposed to information about the food, but made no difference with liking of vegetables. The use of repeated exposures, in the context of flavor exposures or information exposures, may be one strategy to increase liking of fruits (Osborne & Forestell, 2012). A study by Schindler et al., aimed to identify children's acceptance of fruits and vegetables at a school which participated in the USDA's Fresh Fruit and Vegetable Program in conjunction with a School Health Initiative Program compared to children at a school which only participated in the USDA's Fresh Fruit and Vegetable Program. Both groups of children were able to identify more foods

at the end of the study, but the children who participated in the School Health Initiative Program tried more fruits at the end of the study (Schindler, Corbett, & Forestell, 2013). Children in both groups did not increase the number of vegetables tried at the end of the study suggesting increases in knowledge does not influence eating behaviors of some foods such as vegetables (Schindler et al., 2013).

Prelip, Kinsler, Thai, Erausquin, & Slusser, 2012, designed a study where a convenience sample of students in the Los Angeles Unified School District (LAUSD) were assigned to three experimental conditions. The first condition consisted of traditional Network LAUSD program, standardized nutrition curriculum, teacher training workshops, and parent nutrition education workshops; the second condition consisted of the traditional Network-LAUSD program and teacher training workshops; the third condition did not receive additional nutrition education aside from individual school requirements (Prelip et al., 2012). Results from the study did not show increases in fruit and vegetable consumption in the intervention groups (Prelip et al., 2012). However, a significant increase in knowledge were seen in the first condition, slight increase in knowledge was seen in the second condition, while the third condition showed a decrease in knowledge (Prelip et al., 2012). The study noted positive attitudes towards fruits and vegetables in students in the first condition, but attitudes did not reflect behavior changes (Prelip et al., 2012). The researchers in Prelip et al., 2012, suggested increases of fruits and vegetables could be improved by providing nutrition education in conjunction with changes in the school food environment to encourage behavior changes.

In another approach to increase fruit and vegetable knowledge, preference, and consumption, students were assigned into three treatment groups: 1) nutrition education +

gardening, 2) nutrition education, and 3) control (Parmer et al., 2009) . The nutrition education + gardening group and the nutrition education group both increased their knowledge of fruits and vegetables at the end of the study, but the nutrition education + gardening group were more likely to increase vegetable intake (Parmer, Salisbury-Glennon, Shannon, & Struempler, 2009). Both students in the nutrition education + gardening group and nutrition education group increased their preference for the vegetables served, but the nutrition education + gardening group had a larger increase at the end of the study and were more likely to choose vegetables in the lunchroom (Parmer et al., 2009).

The study done by Leines, Gold, & VanOffelen, 2014, children 8-10 years old (n=4,128) participated in six nutrition education lessons in a series called, *Go Wild with Fruits and Vegetables!* The curriculum was based on the Social Cognitive Theory and encouraged children to try fruits and vegetables through observational learning. The school cafeteria was used to reinforce concepts presented in the nutrition education lessons to encourage fruit and vegetable consumption in the children. Families were also encouraged to reinforce the concepts presented in the nutrition education lessons by providing family newsletters and take home challenges. The researchers noted statistically significant increases in self-reported fruit consumption ($P<.001$) and vegetables ($P<.001$) (Leines et al., 2014). The participants also reported engaging in positive health behaviors such as more physical activity and decreasing screen time (Leines et al., 2014). The researchers in this study suggest that exposure to engaging curricula, food taste tests, positive environmental components, parental connections, and active learning can lead to positive behavior changes (Leines et al., 2014).

One study developed by Somsri, Satheannoppakao, Tipayamongkholgul, Vatanasomboon, & Kasemsup, 2016, investigated the use of nutrition education and

increasing fruit and vegetable consumption in high schools in Thailand. The researchers developed survey questions around general information, knowledge, attitudes towards consumption, and a three day diary intake of fruits and vegetables. The researchers assigned schools into different intervention groups which consisted of the following: a cosmetic-based nutrition education program, a health based nutrition education program, and no nutrition education program. The cosmetic based nutrition education program focused on fruits and vegetables' effects on outward bodily appearance such as skin, body shape, and weight. The health based nutrition education program, focused on fruits and vegetables effects on preventing specific diseases. In this study, the researchers noted positive attitudes and liking of fruits and vegetables in both the cosmetic based nutrition education intervention group and health based nutrition education group. However, they noted a greater increase in the amounts and varieties of fruits and vegetables in the cosmetic based nutrition education intervention group.

Plate Waste

Plate waste is defined as food selected or taken by a student, but is not eaten or consumed, or the percentage or volume of food waste (Gase, McCarthy, Robles, Kuo, 2014) & (Connors & Rozell, 2004). Many studies have been conducted in order to understand reasons for plate waste and ways in which to reduce plate waste. Multiple validated methods for collecting plate waste data are available. Aggregate plate waste is one such method described by Adams, Pelletier, Zive, and Sallis, 2005, Gase et al., 2014 and Yon, Johnson & Stickle, 2012. In the study done by Adams et al., 2005 which addressed salad bar plate waste, aggregate plate waste of fruits and vegetables were measured using gram scales. Non fruit or vegetable items and nonfood items such as trays, cups or plates were excluded from the

recorded weight. In the aggregate plate waste study done by Yon et al., 2012, researchers stood near food disposal sites to collect data. Researchers did not encourage participants to consume more of their food and used the average of two weights from a calibrated scale for recorded data (Yon et al., 2012). Data collections from a fruit and vegetable plate waste study used mean weights of five individual fruit and vegetable samples in order to compare with the collected waste from students (Gase et al., 2014).

Visual plate waste using a six point scale is another method of plate waste described in the research done by Connors & Rozell, 2004. Visual plate waste methods offer many benefits over weighted plate waste methods including: low costs, limited need for soiled tray holding, and reduced handling of soiled trays (Connors & Rozell, 2004). Measuring the pre and post weight of a plate is the most accurate way to assess plate waste, but it is time consuming (Adams et al.,2005). One method to decrease time from weighing each plate individually is to use standardized food items that were pre-weighed prior to service (Byker, Farris, Marcenelle, Davis, & Serrano, 2014). Pre tared collection bins can then be used to collect the plate waste (Byker et al., 2014). For accuracy of final weights, current research use similar protocols such as two independent researchers weighing plate waste in grams (Byker et al., 2014) or weighing the food item twice (Yon et al., 2012).

Social Cognitive Theory

Social cognitive theory (SCT) model is based on the three principles described by Bandura, 1988: appropriate skills are modelled to convey basic competencies; people receive guided practice under simulated conditions to perfect skills; and the newly learned skills are applied into work situations for success. In relation to nutrition education, it aims to address the relationship between the learner's environment, personal characteristics, and personal

experience to gain knowledge and implement health behavior changes (Berlin et al., 2013). In SCT, nutrition behavior changes occur when learners have high self-efficacy levels (Anderson, Winett, & Wojcik, 2007). Higher self-efficacy levels are obtained by using positive reinforcement for newly learned behaviors (Berlin et al., 2013).

In the study done by Leines et al., 2014, SCT was used to develop the nutrition education program, *Go Wild with Fruits and Vegetables!* The concepts of SCT used in the development of the program were reciprocal determinism which promotes behavior changes through engaging behavioral, personal, and environmental factors and observational learning which modeled good nutritional habits by taste testing fruits and vegetables (Leines et al., 2014). By using these SCT concepts, the *Go Wild with Fruits and Vegetables!* program aimed to make improvements to the children's environments and increase fruit and vegetable knowledge and self-efficacy (Leines et al., 2014).

Conclusion

Consumption of whole grains have the potential to reduce the risk of cardiovascular disease and to promote healthy weight in individuals (U.S. Department of Health and Human Services, 2017). Intake of whole grains are below national recommendations in children (Chu et al., 2011). Barley, a specific type of whole grain, offers the highest fiber content of all the whole grains (Whole Grains Council, 2017). Data from a meta-analysis of seven school based nutrition programs implies school-based interventions produced moderate increases in fruit and vegetable consumption (Howerton et al., 2007). The researchers in a study using multiple education strategies such as exposure to engaging curricula, food taste tests, positive environmental components, parental connections, and active learning suggest these strategies can lead to positive behavior changes (Leines et al., 2014). The concepts of social cognitive

theory were used in the development of the program and included reciprocal determinism which promotes behavior changes through engaging behavioral, personal, and environmental factors and observational learning which modeled good nutritional habits by taste testing fruits and vegetables to make improvements to the children's environments and to increase fruit and vegetable knowledge and self-efficacy (Leines et al., 2014).This has the potential to be applied to increased consumption of whole grain foods such as barley. Plate waste studies can lead to a deeper understanding of consumption in students. Therefore, the purpose of this study is to evaluate the barley curriculum, based on the social cognitive theory, called "*Barley – The Super Grain." I*n addition to providing students with the opportunity to try barley in the school cafeteria, this curriculum will be evaluated to assess knowledge, liking, and acceptance of barley through a variety of data collection methods.

CHAPTER THREE: JOURNAL ARTICLE

Abstract

Objective

To develop and implement nutrition education material using the social cognitive theory on the health benefits of barley and to test the impact of the education on acceptance and liking of a barley recipe in the school cafeteria.

Methods

Two nutrition education curricula were developed by dietetic students using the social cognitive theory and were edited by a graduate student co-researcher. The nutrition education material were developed based on the age groups 1st through 3rd grade and 4th through 6th grade. Protocol development through literature and researcher input was followed by protocol training for dietetic students who assisted with data collection. Lunchroom data collection sessions were done at 2 elementary schools, one control school and one intervention school, for 1st through 4th graders on two occasions: prior to nutrition education activities, and after nutrition education activities. SPSS Paired sample sign tests with a significance level of P ≤0.0 5were used to measure changes in survey responses for students participating in the nutrition education activities at the intervention school.

Results

From pre to post study, there was a significant increase in the first through third grade children's knowledge of barley, a significant increase in the reported consumption of barley at home, and a significant increase in the liking of barley. From pre to post study, there was a significant increase in the fourth grade children's knowledge of

barley, no significant increase in reported consumption of barley at home, and a significant increase in the liking of barley.

Conclusions and Implications

At the end of nutrition education activities, students at the intervention school reported an increase in knowledge and liking of barley. Results suggest, providing nutrition education with cafeteria exposure of a barley recipe may lead to increase acceptability and liking of a barley recipe.

Introduction

Idaho is among the major producers of barley in the United States (National Barley Foods Council). Often recognized as an ingredient for making beer or as feed for cattle, the nutritional benefits of barley are not as well known to the public. Consumption of whole grains have the potential to reduce the risk of cardiovascular disease and to promote healthy weight in individuals (U.S. Department of Health and Human Services, 2017). According to the new 2015-2020 Dietary Guidelines, individuals should aim to consume whole grains and limit their consumption of refined grains (U.S. Department of Health and Human Services, 2017). Whole grains offer a variety of nutrients including: Fiber, b-vitamins, iron, and others (U.S. Department of Health and Human Services, 2017). Almost all the United States Population consumed less than the recommended amount for whole grains (NHANES 2007-2010). Most whole-grains consumed in the United States and in schools are breads and cereals (Chu et al., 2011).

According to the Centers for Disease Control and Prevention, heart disease and diabetes are ranked in the top ten leading causes of death in the United States. Two factors, among others, contributing to the risk of heart disease are being overweight/obese and poor

diet; one factor contributing to the risk of developing type II diabetes is being overweight (Center for Disease Control, 2015). Consumption of whole grains have the potential to reduce the risk of cardiovascular disease and to promote healthy weight in individuals (U.S. Department of Health and Human Services, 2017). Diets high in fiber can be an important component for preventing heart disease (Centers for Disease Control, 2015). Barley offers the highest fiber content of all the whole grains (Whole Grains Council, 2017). Barley contains a type of fiber known as β-glucan soluble fiber. Of its total mass, dry barley contains 3.5%-3.9% β-glucan fiber (Talati et al, 2009). Foods high in β-glucans may reduce carbohydrate digestibility and lead to sustained glycemic responses in the body (Liefschitz et al., 2002). β-glucan's soluble nature and polysaccharide structure have the potential for cholesterol lowering effects (Liefschitz et al., 2002). A meta-analysis of barley's effect on serum lipids concluded participants consuming barley had a significant reduction of total cholesterol, LDL cholesterol, and triglycerides compared to control participants (Talati et al., 2009). In 2005, the FDA published their final ruling authorizing barley and barley products to use the health claim that they reduce the risk of coronary heart disease (Food and Drug Administration, 2006).

The Nation School Lunch Program (NSLP) requires schools to serve whole grain rich foods as one component of the meal to children on a daily basis (U.S. Department of Agriculture). Whole grain rich foods can include 100% whole grain products, or at minimum 50% whole grain components with 50% enriched grain components (U.S. Department of Agriculture). Schools are important for increasing whole-grain intakes in children and adolescents as schools can provide at least one serving of whole-grains in a day (Chu et al., 2011). Schools not only have the potential to modify types and quantities of food offered to

students, but have the opportunity to increase liking of foods being served. Increasing acceptance of foods can be done through exposure of food (Wardle et al., 2003). Exposure to food at an early age can lead to the promotion and intake of healthier food options (Anzman-Frasca et al, 2012). Children's liking of new foods can be done through familiarization which helps to overcome their food neophobias (Birch & Anzman-Frasca, 2011), the fear associated with new food experiences (Schindler et al., 2013). Repeated exposure is the simplest way to increase flavor acceptance and preference towards foods (Birch & Anzman-Frasca, 2011). Elementary students participating in cafeteria-based tasting program increased their liking for fruits and vegetables offered to students in the lunch line (Lakkakula et al., 2011).

A study by Osborne and Forestell noted children were marginally more likely to try unfamiliar fruits when they had been exposed to information about the food, but made no difference with liking of vegetables. The use of repeated exposures, in the context of flavor exposures or information exposures, may be one strategy to increase liking of fruits (Osborne & Forestell, 2012). A study by Schindler et al., aimed to identify children's acceptance of fruits and vegetables at a school which participated in the USDA's Fresh Fruit and Vegetable Program in conjunction with a School Health Initiative Program compared to children at a school which only participated in the USDA's Fresh Fruit and Vegetable Program. Both groups of children were able to identify more foods at the end of the study, but the children who participated in the School Health Initiative Program tried more fruits at the end of the study (Schindler et al., 2013). Children in both groups did not increase the number of vegetables tried at the end of the study suggesting increases in knowledge does not influence eating behaviors (Schindler et al., 2013). However, researchers in a study using multiple education strategies such as exposure to engaging curricula, food taste tests, positive

environmental components, parental connections, and active learning suggest these strategies can lead to positive behavior changes and increases of fruits and vegetables (Leines et al., 2014). The concepts of social cognitive theory were used in the development of the program and included reciprocal determinism which promotes behavior changes through engaging behavioral, personal, and environmental factors and observational learning which modeled good nutritional habits by taste testing fruits and vegetables to make improvements to the children's environments and to increase fruit and vegetable knowledge and self-efficacy (Leines et al., 2014). In regards to acceptance of whole grains, the effects of sensory attributes that lead to acceptance of whole-grain intakes in children are limited (Chu et al., 2011).

Consumption of whole grains have the potential to reduce the risk of cardiovascular disease and to promote healthy weight in individuals (U.S. Department of Health and Human Services, 2017). Intake of whole grains are below national recommendations in children (Chu et al., 2011). Data from a meta-analysis of seven school based nutrition programs implies school-based interventions produced moderate increases in fruit and vegetable consumption (Howerton et al., 2007). This has the potential to be applied to increased consumption of whole grain foods such as barley. Therefore, the purpose of this study is to evaluate the barley curricula, developed using the social cognitive theory, called "*Barley – The Super Grain."* In addition to providing students with the opportunity to try barley in the school cafeteria, this curriculum will be evaluated to assess knowledge, liking, and acceptance of barley.

Materials and Methods

Barley – The Super Grain nutrition education material, is a pilot curricula, consisting of two 4 lesson curricula, which targets two elementary grade groups of children: 1st – 3rd graders, and 4th – 5th graders. The 30 to 40 minute lessons teach children about barley and its

nutritional benefits. The curricula were developed by dietetic students, at the University of Idaho as part of their coursework. The curricula were developed for different elementary age groups aimed to deliver age appropriate nutrition education which met the common core standards for each grade group. Using the social cognitive theory model, the curricula were based on the three principles described by Bandura, 1988: appropriate skills are modelled to convey basic competencies; guided practice under simulated conditions is used to perfect skills; and the newly learned skills are applied into situations for success. Through the nutrition education lessons, elementary students are provided information related to the barley lesson, then given an opportunity to apply the information through an activity incorporated into the lesson, and provided an opportunity to use skill or knowledge gained in the lesson through the take home lesson component.

Children attending these classes learned about the history of barley, barley growth and production, the nutritional benefits of barley, and the use of barley in recipes. Each lesson was paired with a parent take home component to encourage reinforcement of knowledge outside of the classroom setting. The take home component consisted of a lesson overview and a barley recipe that could be tried at home.

For the 1st -3rd grade group, the lessons were labeled: *Sowing the Seeds of Change, Growing is learning, Barley Seed Components, and Barley on Our Plate*. In the *Sowing the Seeds of Change* lesson, students were taught barley is a type of plant that is grown for food. In this lesson, students were given an opportunity to plant their own barley plant to see how plants grow from seeds. In the *Growing is learning* lesson, students were taught plants needs water, soil, and sunlight to grow. In this lesson, students were taught a poem about the steps to grow barley to assist the students in memorizing plant's requirements for growth. In the

Barley Seed Components lesson, students were taught the three components of the barley grain which makes it a whole grain: the bran, the germ, and the endosperm. Students were given the opportunity to identify the barley grain by counting barley grains in a hands on activity. In the *Barley on Our Plate lesson*, students were taught where barley could be used in our food by coloring pictures of food in the hands on activity component of the lesson.

For, the 4th- 5th grade group, the lessons were labeled: *The History of Barley, Barley and Our Bodies, How it is Used and Grown*, and *Barley in the Kitchen*. In the *History of Barley* lesson, students were given a brief overview of the domestication of barley and its uses. Students demonstrated increases in knowledge of the history of barley by drawing pictures of barley in different significant points in its history of production. In the *Barley and Our Bodies* lesson, students were taught about the health benefits of barley including the importance of fiber and vitamins and minerals found in barley. At the end of this lesson, students demonstrated knowledge changes by being able to add barley foods into breakfast, lunch and dinner meals by completing the in class activity worksheet. In the lesson, *How it is Used and Grown*, students were taught how barley needs soil, water, and sunlight to grow. Students demonstrated knowledge of how barley is grown by planting their own barley plant. Finally, in the *Barley in the Kitchen* lesson, students were taught how barley could be used in a recipe. Students demonstrated understanding of the lesson, by reading through a barley recipe and measuring barley grains to be used in the recipe.

The Barley – The Super Grain nutrition education program was taught over a two consecutive week period by the senior dietetic students at the University of Idaho. Elementary students attended face-to-face classes on Tuesdays and Thursdays of both weeks and were served the same barley recipe on Mondays and Fridays during the two week study. The school

cafeteria offered the barley recipe as part of the lunch meal to all students who went through the lunch line at both the control and intervention schools and used standardized serving utensils to ensure each student received the same portion of the recipe.

The dietetic students were also provided with two hours of training to review the barley plate waste protocols. Plate waste protocol handouts were provided to each student after the training to review. Plate waste protocols were reviewed with the dietetic students the day of the pre plate waste data collection day of the study.

Researchers were present in the cafeteria at both the control and intervention schools for the first and the last exposure of the barley recipe served in the cafeteria. Dietetic students assisted the researchers on collecting aggregate barley plate waste from students who took the barley recipe. Before the students arrived for lunch, trays were weighed twice prior to the barley recipe being plated and given an average weight. After the trays were weighed, the food service staff pre-plated five trays with the barley recipe as described in the methodology in Gase et al., 2014. Each tray was weighed twice in grams to ensure accurate weights by independent researchers as described by Byker et al., 2014. The barley recipe and trays were then averaged to provide and average weight of the barley recipe and tray. Finally, the tray weight was subtracted to provide the average weight of the barley recipe on its own.

Elementary students' trays were marked with colored sticker dots to identify the grade groups of: Red = 1^{st} – 3^{rd} grade and Blue = 4^{th} -5^{th} grade. Pre-weighted buckets were used to collect the barley waste from the students and were labeled as follows: 1^{st} – 3^{rd} grade Girls, 1^{st} – 3^{rd} grade Boys, 4^{th} – 5^{th} grade Girls, and 4^{th} – 5^{th} grade Boys. Plate waste from all elementary students who took the barley recipe were gathered from the control school on a plate waste collection form (Appendix C). Only elementary students participating in the

nutrition education activities at the intervention school had the colored dot stickers placed on their trays. Barley plate waste was only collected from the students with the identifying dot stickers. Dietetic students collecting plate waste data followed the same procedures described in the research by Yon, Jonson, & Stickle, 2012 in which plate waste was gathered near the areas students discarded their food. Students were not encouraged to eat additional amounts of food and only students participating in the study had their plate waste collected (Yon et al., 2012). Dietetic students were instructed to carefully scrape only the barley waste from the plate and leaving other components of the meal on the tray. After all of the plate waste was collected, the buckets were weighed twice by two independent research assistants following the methodology by Byker et al., 2014. The bucket weight was subtracted to obtain the aggregate barley waste. The aggregate weight was then divided by the number of students who took the recipe to get the average plate waste per student which was recorded on the appropriate form.

During the first exposure of barley in the cafeteria, elementary students at both the control and intervention schools who took the barley recipe were asked to identify their liking of the barley recipe through the use of a dot liking survey (Appendix B). Only elementary students who were participating in the nutrition education activities were asked on their liking of the barley recipe. The dot liking survey was administered at both the control and intervention schools at the last exposure in the cafeteria during the study in the same manner as described for the first exposure.

Prior to the nutrition education lesson activities, dietetic students were given the revised curricula to review prior to teaching the material at the intervention elementary school. Prior to starting the first nutrition education lesson, elementary students completed a

pre survey related to barley (Appendix A). A post survey was administered following the conclusion of the fourth nutrition education lesson. Unique IDs were used to match pre and post surveys. During the face-to-face classes, elementary students learned about the history of barley and its use, the growth and production of barley in Idaho and throughout the world, the nutritional and health benefits of barley, and how barley is used in recipes. During each face-to-face class, elementary students completed activities related to the barley topic discussed in the class.

Table 1

Study Timeline

	Monday	Tuesday	Wed	Thursday	Friday
Study Week 1	Barley Served in C. & I. Schools at Lunch Plate Waste Pre	Nutri. Ed. Lesson 1 I. school only		Nutri. Ed. Lesson 2 I. school only	Barley Served in C. & I. Schools at Lunch
Study Week 2	Barley Served in C. & I. Schools at Lunch	Nutri. Ed. Lesson 3 I. school only		Nutri. Ed. Lesson 4 I. school only	Barley Served in C. & I. Schools at Lunch Plate Waste Post

*Notes. *C. = Control School, I.= Intervention School*

Table 1 Study Timeline

The Barley – The Super Grain project was approved by the University of Idaho (UI) Institutional Review Board (IRB) in September 2016. Twenty-two University of Idaho senior dietetic students were trained on the research protocol, eight of which taught the nutrition education materials to the intervention school in November 2016.

Participants

Two elementary schools, one control school and one intervention school, located in Southern Idaho, volunteered to participate in this two week study. As the schools were both from the same school district and region in Idaho, they shared similar geographic and demographic data A convenience sample of (N= 122) students participated in the nutrition education activities at the intervention school and (N= 107) students completed the pre and post surveys. The students were divided into grade groups based on the curricula used. Of the 107 students who completed both pre and post surveys, 1st -3rd grade students (N=70), and 4th grade students (N = 37). 5th grade classes pulled out of the study prior to it starting. The principle at the intervention school wrote a letter of consent to allow *Barley- The Super Grain* curricula to be presented to students in the classroom.

Data Collection

The *Barley – The Super Grain* curricula was evaluated using pre- and post- surveys in the classroom and plate waste collection and recipe liking surveys in the cafeteria. The following types of data were collected:

Knowledge of barley: Students at the intervention school completed pre and post survey questions on their knowledge/ability to identify barley. "*Do you know what barley is?"*

Consumption of barley at home: Students at the intervention school completed pre and post survey questions on their consumption of barley at home. *"Do you eat barley at home?"*

Liking of barley: Students at the intervention school completed pre and post survey questions on their liking of barley. *"Do you like barley?*

Recipe Liking: Students were asked to rate their liking of the barley recipe in the cafeteria on their first and last exposure. A smiley face scale of Happy, *"I like it,"* Neutral, *"It was ok,"* or Sad, *"I don't like it."* was used to assess liking of the recipe.

Plate Waste: Aggregate plate was on the first and last exposure of the recipe in the cafeteria was collected at both the control and intervention schools. Waste collected according to the grade groups: 1^{st} - 3^{rd} and 4^{th} – 5^{th}. Each grade group was then separated into Boys and Girls.

Statistical Analyses

Quantitative analyses were used to analyze the data. SPSS Paired sample sign test for uneven distributions was used to test the difference in survey responses from pre to post test at the intervention school. Significance was set at an alpha level of ≤ 0.05. Descriptive statistics was gathered for recipe liking for pre and post exposures of the barley recipe at the control and the intervention schools.

Results

Table 2

Changes in Barley Survey Responses

Question on barley survey (Knowledge Q1), (Consumption at home Q2), (Liking of barley Q3)	Pre-test response # and Percentage (%)	Post-test response # and Percentage (%)	Sign Test P value Significance
1 Do you know what barley is? [a, b]	Response #: 1 (41.4%) 2 (35.7%) 3 (22.9%)	Response #: 1 (8.6%) 2 (10%) 3 (81.4%)	.000
2 Do you eat barley at home? [a, b]	1 (55.7%) 2 (34.3%) 3 (10%)	1 (32.9%) 2 (20%) 3 (47.1%)	.000
3 Do you like barley? [a, b]	1 (27.1%) 2 (57.1%) 3 (15.7%)	1 (14.3%) 2 (32.9%) 3 (52.9%)	.000
1 Do you know what barley is? [a, c]	1 (54.1%) 2 (35.1%) 3 (10.8%)	1 (5.4%) 2 (0%) 3 (94.6%)	.000
2 Do you eat barley at home? [a, c]	1 (62.2%) 2 (29.7%) 3 (8.1%)	1 (48.6%) 2 (27%) 3 (24.3%)	.143
3 Do you like barley? [a, c]	1 (21.6%) 2 (70.3%) 3 (8.1%)	1 (18.9%) 2 (27%) 3 (54%)	.000

Notes. [a] = choices include: 1= No, 2 = I'm not sure, 3= Yes
[b] = 1st – 3rd graders
[c] = 4th graders

Table 2 Changes in Barley Survey Responses

Knowledge of Barley

In the 1st – 3rd grade group, there was a significant positive increase in responses from the pre survey where students were reporting, *Yes* (22.9%), *I'm not sure* (35.7%), and *No* (41.4%), they knew what barley was compared to the post survey, *Yes* (81.4%), *I'm not sure* (10%), and *No* (8.6%). In the 4th grade group, there was a significant positive increase in responses from the pre survey where students were reporting, *Yes* (10.8%), *I'm not sure*

(35.1%), and *No* (54.1%), they knew what barley was compared to the post survey, *Yes* (94.6%), *I'm not sure* (0%), and *No* (5.4%).

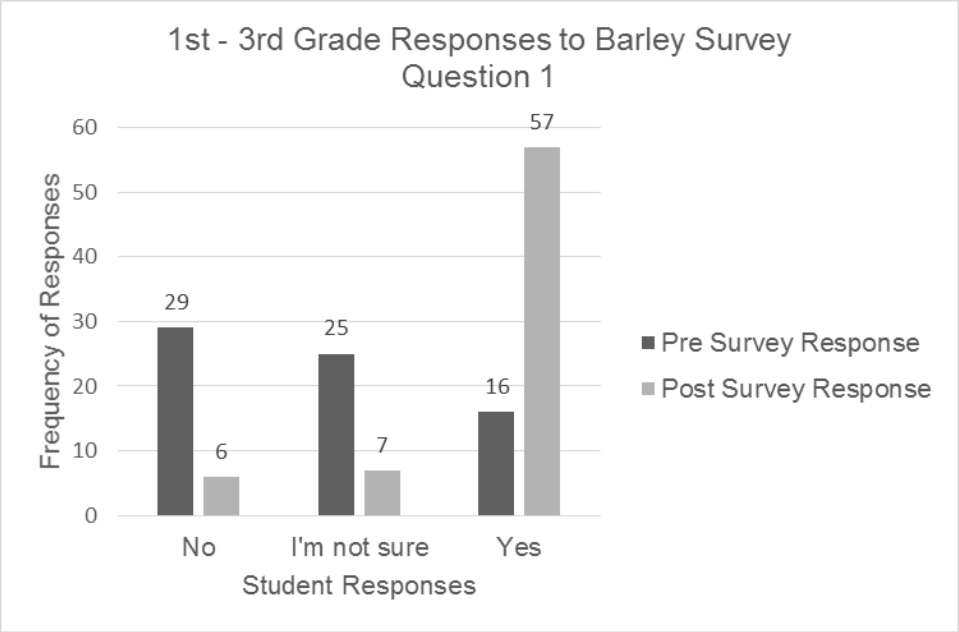

Figure 1. 1st – 3rd Grade Responses to Barley Survey Question 1. This figure shows changes in responses from pre to post survey 1st – 3rd grade group.

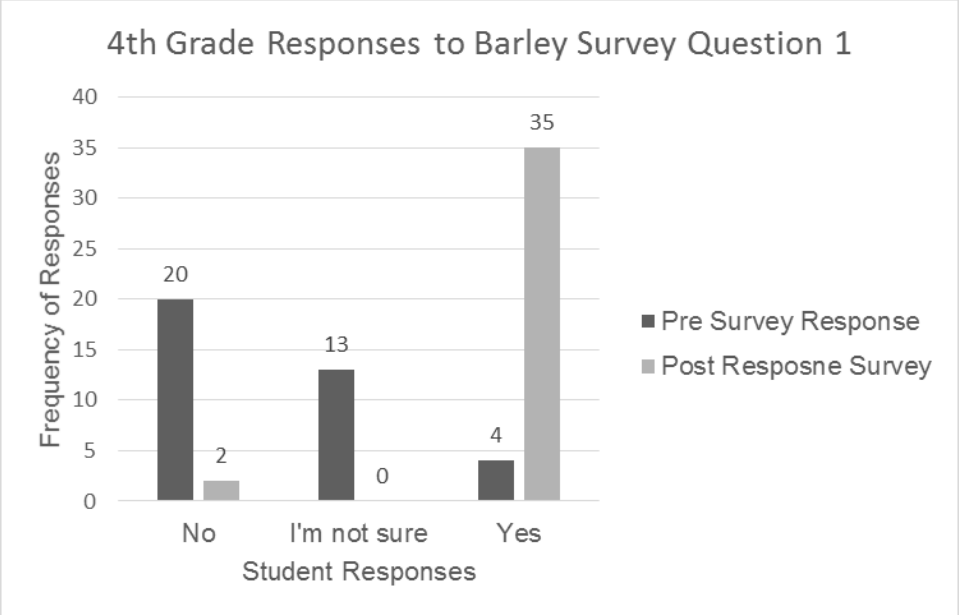

Figure 2: 4th Grade Responses to Barley Survey Question. This figure shows changes in responses from pre to post survey in the 4th grade group.

Consumption of Barley at Home

In the 1st – 3rd grade group, there was a significant positive increase in responses from the pre survey where students were reporting, *Yes* (10%), *I'm not sure* (34.3%), and *No* (55.7%), they ate barley at home compared to the post survey, *Yes* (47.1%), *I'm not sure* (20%), and *No* (32.9%). In the 4th grade group, there was a positive increase in responses from the pre survey where students were reporting, *Yes* (8.1%), *I'm not sure* (29.7%), and *No* (62.2%), they ate barley at home compared to the post survey, *Yes* (24.3%), *I'm not sure* (27%), and *No* (48.6%), but it was not statistically significant.

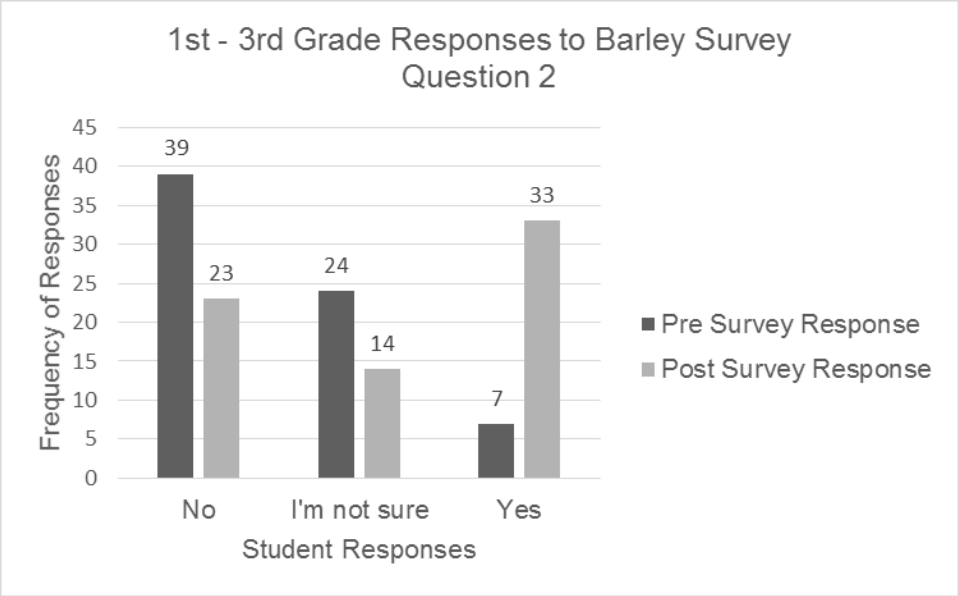

Figure 3: 1st – 3rd Grade Responses to Barley Survey Question 2. This figure shows changes in responses from pre to post survey in the 1st – 3rd grade group.

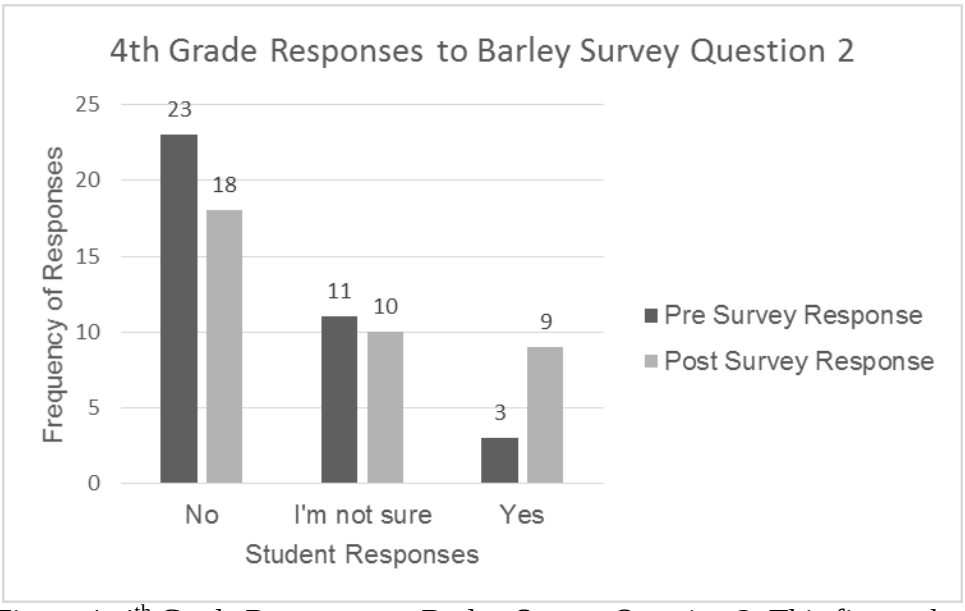

Figure 4: 4th Grade Responses to Barley Survey Question 2. This figure shows changes in responses from pre to post survey in the 4th grade group.

Liking of Barley

In the 1st – 3rd grade group, there was a significant positive increase in responses from the pre survey where students were reporting, *Yes* (15.7%), *I'm not sure* (57.1%), and *No* (27.1%), they liked barley compared to the post survey, *Yes* (52.9%), *I'm not sure* (32.9%), and *No* (14.3%). In the 4th grade group, there was a significant positive increase in responses from the pre survey where students were reporting, *Yes* (8.1%), *I'm not sure* (70.3%), and *No* (21.6%), they liked barley compared to the post survey, *Yes* (54%), *I'm not sure* (27%), and *No* (18.9%).

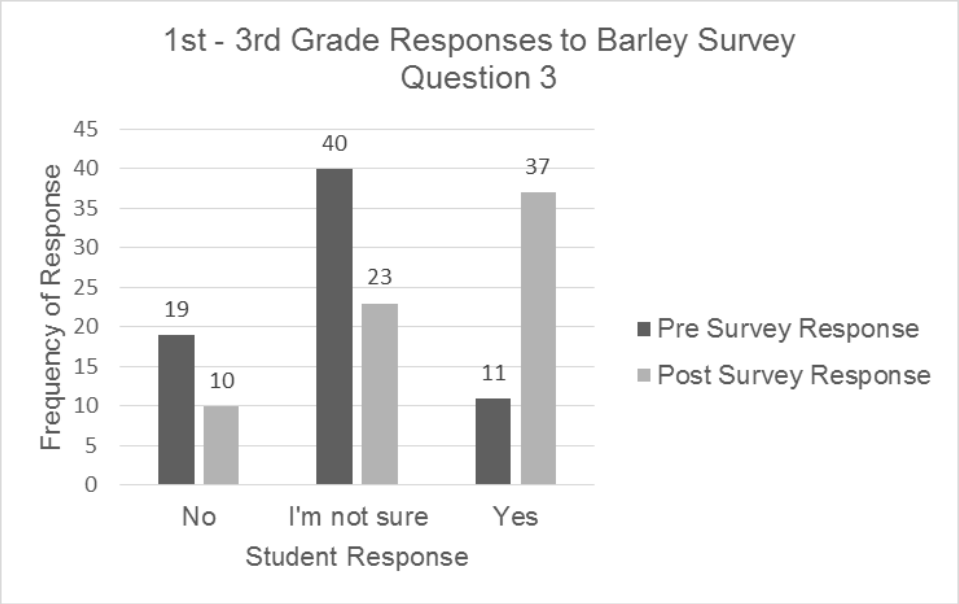

Figure 5: 1st – 3rd Grade Responses to Barley Survey Question 3. This figure shows changes in responses from pre to post survey in the 1st - 3rd grade group.

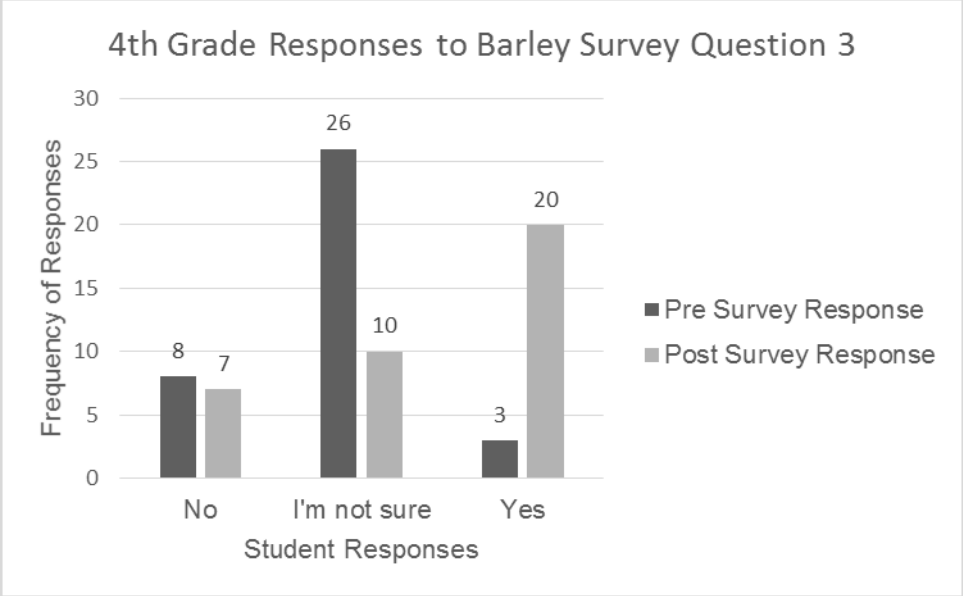

Figure 6: 4th Grade Responses to Barley Survey Question 3. This figure shows changes in responses from pre to post survey in the 4th grade group.

Barley Plate Waste

Table 3

Plate Waste Data

Age Group/ Gender	Number of Students: First Exposure	First Exposure Aggregate Waste	Number of Students: Second Exposure	Last Exposure Aggregate Waste
1st – 3rd Boys [a]	9	53 g	27	57 g
1st – 3rd Girls [a]	6	68 g	26	56 g
4th – 5th Boys [a]	24	53 g	21	86 g
4th – 5th Girls [a]	24	54 g	35	60 g
1st – 3rd Boys [b]	9	27 g	13	43 g
1st – 3rd Girls [b]	7	22 g	12	55.8 g
4th – 5th Boys [b]	0	n/a	10	29 g
4th – 5th Girls [b]	1	3 g	14	38.9 g

[a] = Control School
[b] = Intervention School

Table 2 Plate Waste Data

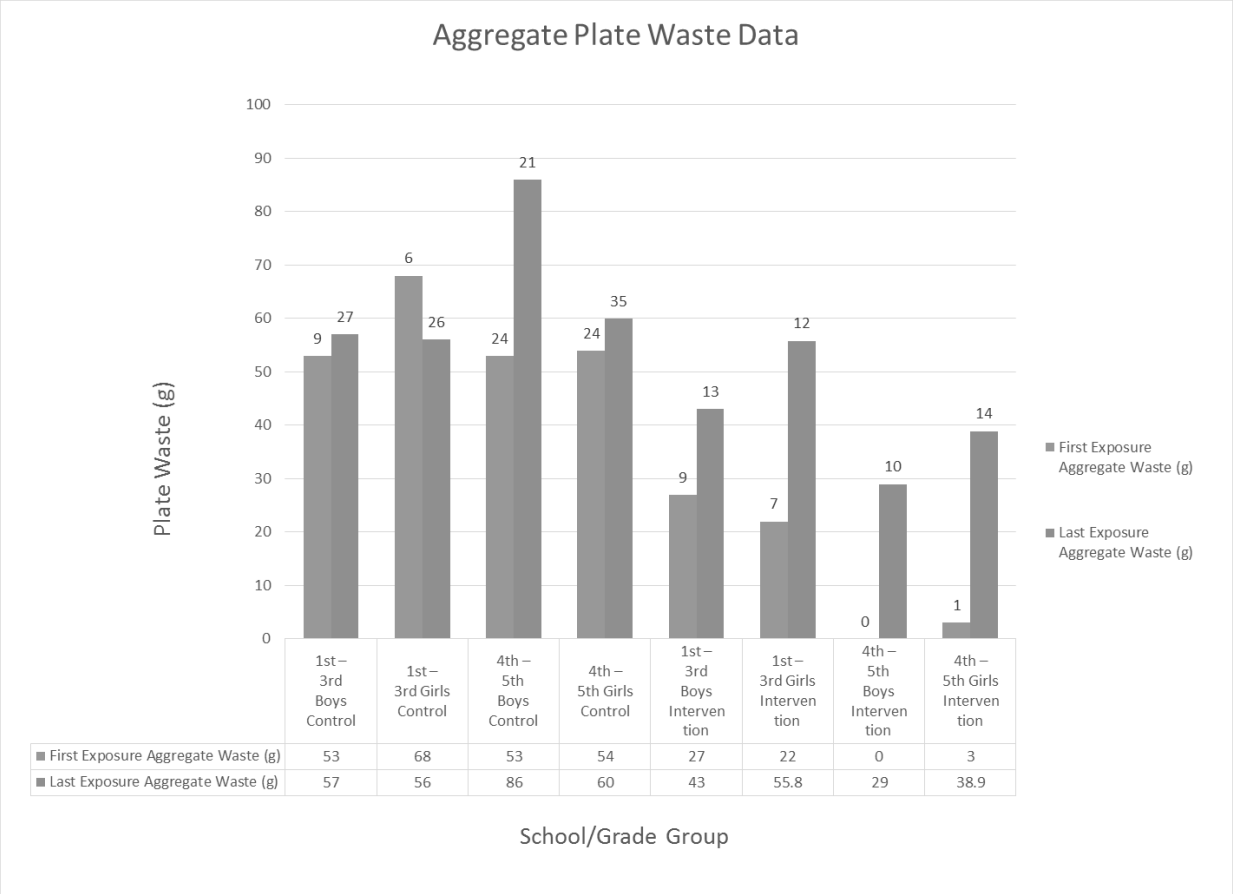

Figure 7: Aggregate Plate Waste Data by School, Grade Group, Gender. This figure shows the average barley waste by students. The numbers above the graphs are the numbers of students who took the barley recipe.

From the first exposure of the barley recipe in the cafeteria, to the final exposure of the barley recipe in the cafeteria, plate waste of the barley recipe did not generally decrease at either the control or the intervention schools. With the exception of the 1st – 3rd grade girls control group, decreases were not seen in the different age groups or between genders. With the exception of the 4th grade boys control group, the number of students taking the recipe at both schools, did increase from the first to the last exposure of the barley recipe in the cafeteria, in the grade groups and in both genders.

Barley Recipe Liking

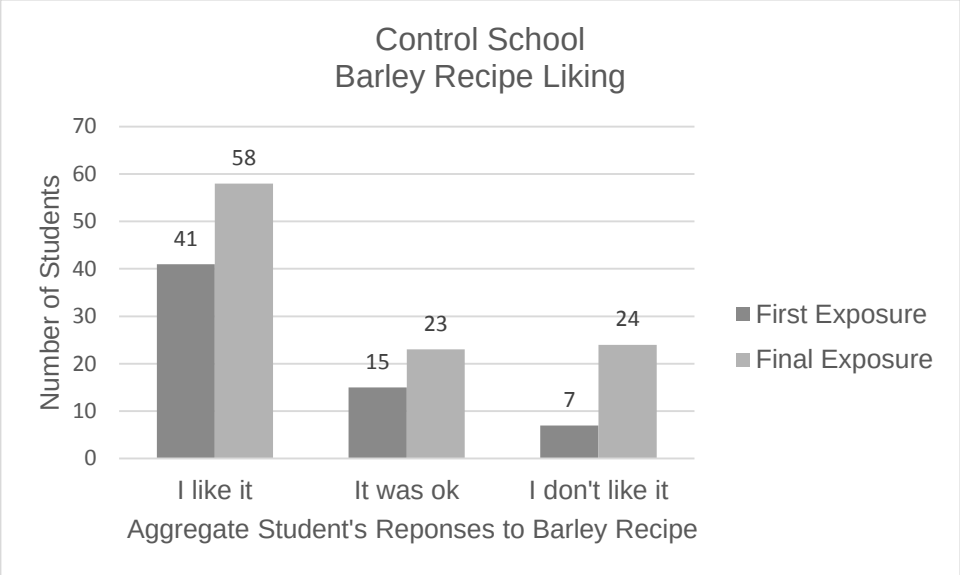

Figure 8: Control School Barley Recipe Liking. This figure shows student responses at the control school to liking of the barley recipe from the first to final exposure of the recipe in the cafeteria.

From the first to the last exposure of the barley recipe in the cafeteria, there was an increase in the number of students taking the recipe. Aggregate data was gathered from students participating in the lunch service.

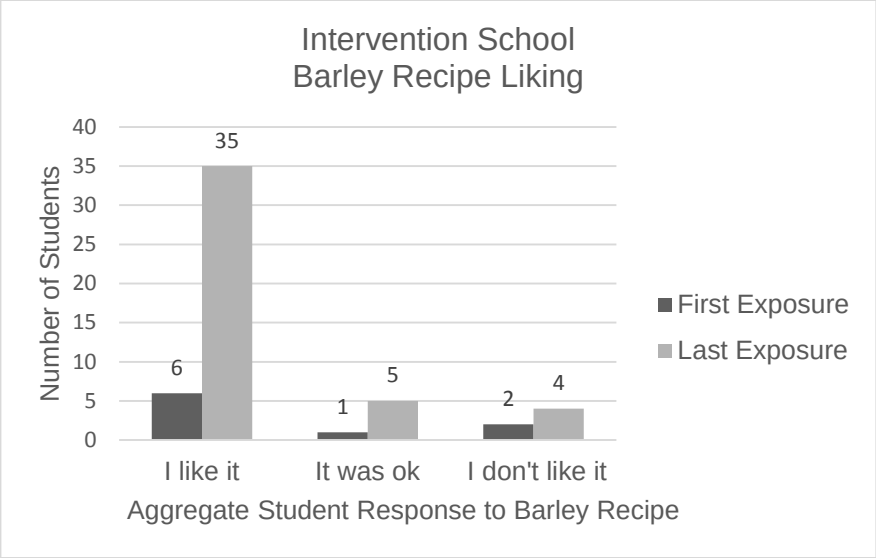

Figure 9: Intervention School Barley Recipe Liking. This figure shows student responses at the intervention school to liking of the barley recipe from the first to final exposure of the recipe in the cafeteria.

Only students identified by the colored dot stickers, who received nutrition education in the classroom and who participated in the lunch service were asked on their liking of the barley recipe in the cafeteria. From the first to the last exposure of the barley, there was an increase in the number of students taking the recipe.

Discussion and Limitations

The purpose of this study was to test the difference between barley liking through repeated exposure and barley liking through repeated exposure with nutrition education at a control school and intervention school respectively. From the first to last exposure of the barley recipe at each school, there was an increase in the number of students taking the recipe and the number of students reporting they liked the recipe. These results are consistent with work done by Birch & Anzman-Frasca, 2011, in which they state that repeated exposure is the simplest way to increase flavor acceptance and preference towards foods. In the work done by Canton et al., 2012, the researchers noted children showed maximum intake of the artichoke

at the fifth exposure out of ten exposures. This current study had a maximum of four exposures. Even with the limited exposures, increases in taking of the barley recipe were noted. However, since the data collected for the liking of the barley recipe was not with matched pairs, it is difficult to understand changes of students' individual liking of the barley recipe.

Aggregate plate waste data was gathered at both schools. From the first to the last exposure of the barley recipe, the plate waste did not decrease in either group. This could be due to menu choices paired with the barley recipe or over exposure to the recipe within the short two week study. Though both schools followed the same recipe procedure and portioning of the recipe, it is difficult to control for variances in serving sizes of different food service workers. Similar to the study done by Schindler et al., 2013 which looked at changes in fruit and vegetable consumption in the USDA Fresh Fruit and Vegetable Program in conjunction with nutrition education or no education, children in both the control and intervention groups did not increase the number of vegetables tried at the end of the study. This suggests increases in knowledge does not influence eating behaviors. As grains tend to be bitter like vegetables, this could explain no changes in consumption of the barley recipe. Overall, the number of students taking the recipe from the first to the last exposure increased or remained the same which suggests acceptance of the barley recipe.

At the intervention school, students in both grade groups were observed to increase their knowledge of barley from the pre to post surveys. Results on the topic of consumption of barley at home varied between the 1st – 3rd grade group, who showed a significant increase, and the 4th grade group, who did not show a significant increase. The limited responses of increased consumption could be due to the short duration of the study which did not allow for

changes at home. These results are consistent with the work done by Prelip et al.,2012 and Parmer et al., 2009 in which nutrition education helped to increase the amount of vegetables consumed in children exposed to nutrition education and repeated exposure of food. Further research could look into the effectiveness of the parent take home component of each barley lesson. Similar to the study done by Prelip et al., 2012, which noted positive attitudes towards fruits and vegetables in students who were exposed to a variety nutrition education measures, both grade groups at the intervention school reported a positive increase in liking of barley following the nutrition education. Only students at the intervention school were surveyed between the first and last exposure of barley in the cafeteria. Future research could look into changes of knowledge, consumption at home, and liking of barley at both control and intervention schools.

The study was conducted from a convenience sample of students in one city in southern Idaho which may not be representative to other cities in Idaho or to other cities throughout the United States. Classrooms volunteered to participate in the nutrition education activities at the intervention school so the sample was not randomized. Though the content of the lessons remained the same, different senior dietetic students taught each classroom which may have exposed children to differences in teaching styles. Future studies should aim to gather a random sample of students, from different regions, using the same instructors when implementing the barley curriculum. Not all students who participated in the classroom nutrition education activities, participated in the school lunch program. Future studies should aim to gather data solely from students who participate in both the nutrition education activities and the school lunch program to gain a stronger understanding of the impacts of nutrition education of barley on consumption and liking of barley.

Implications for Research and Practice

Barley – The Super Grain, was a series of educational material developed to test the effectiveness of nutrition education in the classroom and consumption of barley in the cafeteria. This study used researched based methodologies that have been shown to increase consumption of fruits and vegetables in children such as repeated exposure. Using these methodologies is important to test for effectiveness with increasing consumption of other nutrient dense foods of nutritional concern. Between the first and last exposure of the barley recipe in the cafeteria, students at the intervention school were provided nutrition education lessons based around barley. Findings from the pilot program in this study demonstrated an increase in the number of students taking the barley recipe in the cafeteria from the first to the last exposure. Similar to a study done by Prelip et al., 2012 which noted children participating in nutrition education had positive attitudes towards fruits and vegetables after the education activities, nutrition education of barley resulted in reported liking of barley. Future studies should aim to provide the same curricula to elementary age students with different demographics to test the reliability of the educational content.

Other curricula, for different age groups, were also developed and should be piloted to test for similar criteria presented in this study: knowledge of barley, consumption of barley at home, and liking of barley. Providing nutrition education of barley in the classroom may be one method to increase acceptance and liking of barley in the cafeteria in conjunction with repeated exposure of barley. Though plate waste of barley did not decrease from the first exposure to the last exposure increased liking of the recipe were noted.

Acknowledgements

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APPENDICES

Appendix A: Pre and Post Survey

Unique ID: _____ _____ _____ _____ _____ _____ Pre:_____ Post: _____

(First and Last Initial) (Birth Month) (Birth Date)

1. Do you know what barley is?	Yes	I'm Not Sure	No
2. Do you eat barley at home?	Yes	I'm Not Sure	No
3. Do you like barley?	Yes	I'm Not Sure	No
Comments:			

Appendix B: Recipe Liking Survey

 I Like It	 It is Ok	 I Don't Like It

Appendix C: Data Collection Tool

Plate Waste Recording Form								
Name of School:					**Date:**			
Pre	**Post**							
Tray Weight 1: Tray Weight 2:	Tray Weight w/ Barley	#1:	#2:	#3:	#4:	#5	Average:	Average – Tray:

1-3 Boys Bucket Weight	**1-3 Girls Bucket Weight**	**4-5 Boys Bucket Weight**	**4-5 Girls Bucket Weight**

1-3 Boys Trash Bin			**1-3 Girls Trash Bin**		
Number of Students:			Number of Students:		
Barley Waste	First Weight	Second Weight	Barley Waste	First Weight	Second Weight
Observer1			Observer 1		
Observer 2			Observer 2		
Final Average Waste			Final Average Weight		
Average Plate Waste / Total Number of students			Average Plate Waste / Total Number of students		
Average Plate Waste Per student			Average Plate Waste Per student		

4-5 Boys Trash Bin			**4-5 Girls Trash Bin**		
Number of Students:			Number of Students:		
Barley Waste	First Weight	Second Weight	Barley Waste	First Weight	Second Weight
Observer1			Observer 1		
Observer 2			Observer 2		
Final Average Waste			Final Average Weight		
Average Plate Waste / Total Number of students			Average Plate Waste / Total Number of students		
Average Plate Waste Per student			Average Plate Waste Per student		