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ENHANCING FLAVOR: UTILIZING HERBS AND SPICES TO PROMOTE FRUIT AND VEGETABLE CONSUMPTION AMONG CHILDREN

A Thesis in

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by

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ABSTRACT

Despite the overwhelming benefits of adequate fruit and vegetable consumption, few children are meeting the USDA dietary guidelines for these food groups. Research has demonstrated that only 30% of children are meeting the USDA dietary recommendations for fruits and 36% are meeting the USDA dietary recommendations for vegetables. For many children, close to half of all fruit consumption is driven from fruit juices and 23% of total vegetable consumption constituted of french fries. With the rate of obesity having tripled from 1980 to 2002, and increases in other diet related diseases, the importance of increasing healthy eating behaviors in children is becoming a necessity. This study evaluated the possibility of using fruit and vegetable dips enhanced with herbs and spices as a vehicle to increase fruit and vegetable consumption. A series of fruit and vegetable dips were developed, including plain and herb and spice enhanced versions. Objective of the dip development process was to develop a dip that was high in flavor and low in calories, fat, and sugar. Food preference testing was conducted on 34 preschool children between the ages of 3-5. Level of acceptance and change in consumption of the vegetables were measured. Results demonstrated that the addition of a spiced dip increased the acceptance of disliked vegetables, specifically vegetables previously rated as disliked ($p<.001$). The impact of a spice dip on consumption level was tested among 27 preschool aged children from the same population. Results concluded that the addition of a spice dip increased consumption of disliked vegetables ($p=.001$).

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Chapter 1

INTRODUCTION

The Center for Nutrition Policy and Promotion, an agency within the United States Department of Agriculture (USDA), recommends that two to three-year-old children consume at least two servings of both fruits and vegetables per day, with one serving equaling ½-cup of either in chopped fresh, frozen, or canned form (USDA, 2008).

Recent research evaluating the diets of children 5 years and younger has shown that children's fruit and vegetable intake falls well below the USDA's recommendation of two cups of each per day (Dennison, Rockwell, & Baker, 1998; Krebs-Smith et al., 1996; USDA & ARS, 1999). In fact, data retrieved from the 1994-1996, 98 *Continuing Survey of Food Intakes by Individuals (*CSFII*)* revealed that on average, 25% of children 5 years and younger did not consume any measurable level of vegetables. The percentage of children consuming less than one serving of fruit was 27%. Further analyzing average fruit consumption revealed that fruit consumption was obtained largely from fruit juice intake. In fact, the average total fruit consumption was 237g; the average total grams of fruit juice consumption were over 100g (USDA & ARS, 1999).

Similar results were found in an analysis of 3,022 twenty-four hour recall reports of children between the ages of 4-24 months as part of the *Feeding Infants and Toddlers Study* (FITS). Results of the FITS study demonstrated that 19.4% of all 19-24 month olds consumed less than 1 serving of vegetables. Additionally, 25% of all children between 19-24 months in this study consumed at least 1 serving of french fries Fruit consumption

for 19-24 month olds participating in the FITS study reported was also low with 33% consuming less than 1 serving (Fox, Pac, Devaney, & Jankowski, 2004).

Analyzing the breakdown of total fruit and vegetable consumption is equally discouraging. The 1989-1991 CSFII revealed that one-third of all reported vegetables consumed were prepared without fat or as part of a mixture (e.g. sauces). It is also noteworthy to mention that total vegetable consumption is reduced significantly when starchy vegetables such as potatoes are removed; in fact, 23% of total vegetable consumption reported in this study consisted of French fries (Krebs-Smith et al., 1996).

According to the USDA, virtually every part of the body can benefit from consuming adequate amounts of fruits and vegetables. Specifically, the consumption of fruits and vegetables can boost the immune system, maintain healthy vision, subdue cholesterol levels, and provide nutrients necessary for bone development (Schmitz, 2005). The National Research Council, in collaboration with the Food and Nutrition Board, firmly states that diets containing high levels of fruits and vegetables have a strong correlation with reduced risks of non communicable diseases such as cardiovascular heart disease, Type II diabetes, and obesity (Steinmetz & Potter, 1991; Schmitz, 2005). Additionally, the strong prevalence of fruits and vegetables in the diet are associated with reducing the risk of cancers such as lung, breast, and bladder (Steinmetz & Potter, 1991; Schmitz, 2005).

Although many of the previously listed health threats do not manifest themselves until individuals enter post-adolescence or early adult years, research has shown that eating behaviors developed at young ages are fairly accurate predictors of eating patterns

in adulthood (Krebs-Smith, Heimendinger, Patterson, & Subar, 1995). If the habit of consuming fruits and vegetables does not form at a young age, lack of habit and the presence of risk factors can lead to the development of poor nutritional eating behaviors. Birch, Fisher, and Cowart have shown that children innately prefer sweet foods and reject bitter foods as a safety mechanism. The rejection of sour foods helps prevent babies from consuming toxins and harmful substances (Birch 1998a, Birch & Fisher, 1998; Cowart, 1981); however, a predisposition to sweet, energy-rich foods can lead to the consumption of unhealthy quantities of high-calorie foods and an initial avoidance of vegetables.

Food preferences have been shown to be strong predictors of human consumption patterns. Because of children's innate predisposition to reject bitter foods, it is important that food preferences toward vegetables are learned through repeated exposure (Baranowski, 1999; Birch & Marlin, 1982; Birch, 1992). As the gatekeepers and often the primary food providers for children between the ages of 2 and 5, parents play a very influential role in the development of their children's eating behaviors. Skinner and colleagues demonstrated this concept by analyzing pairs of mother and child food preference reports. The results revealed that mothers' likes and dislikes often mirror their child's preferences and suggested that mothers rarely introduce foods to their children that they dislike themselves (Skinner, Carruth, Bounds, & Ziegler, 2002).

Low availability, exposure, and cost are other factors that have been considered in studies that seek to increase vegetable consumption among children in their early years. For example, Dennison and colleagues' analysis of three-day dietary records of children between the ages of 2 and 5 found that children consuming more than .one-half a

serving of vegetables per day were exposed to vegetables more than once a day. Children with vegetable consumption levels of less than one-half a serving per day had lower exposure to vegetables, usually only having exposure at one meal per day (Dennison, Rockwell, & Baker, 1998).

The cost of increasing and maintaining a high availability of fruits and vegetables is a limiting factor for many families in the United States. There is no question that low fruit and vegetable consumption among preschool-aged children is influenced by the high cost of fruits and vegetables and cheap abundance of high-energy processed snack foods. Several government programs currently in place have attempted to increase the accessibility of fruits and vegetables for families of low socioeconomic status. The National School Lunch Program, the Fresh Fruits and Vegetables Program and other school-centered programs, for example, are constantly being refined in an attempt to incorporate more fruits and vegetables into children's diets at reduced or no cost (Burghardt, Gordon, & Fraker, 1995).

Despite these efforts, additional interventions need to take place in order to increase the availability of, and exposure of fruits and vegetables for children between the ages of 2 and 5. Further, any efforts to increase the consumption of fruits and vegetables should be done in a manner that increases the influence parents have on the development of their children's eating behaviors.

Purpose

The purpose of this study is to develop a greater understanding of the role that acceptability of fruits and vegetables plays in preventing children from consuming their

daily recommended amount of fruits and vegetables. Specifically, this study will analyze the impact that fruit and vegetable dips enhanced with herbs and spices have on increasing both acceptability and consumption levels of fruits and vegetables. Dr. Leann Birch, distinguished professor and director of the Center for Childhood Obesity Research at The Pennsylvania State University, was principal investigator of the project; Dr. Peter Bordi, associate professor and director of the Center for Food Innovation at The Pennsylvania State University, was co-investigator. Funding for the study was provided by the McCormick Science Institute.

The primary goal of the study was to increase fruit and vegetable consumption among preschool aged children in the home. Research has demonstrated the strong impact that parents and daycare providers have on the eating behaviors of children; therefore, this study also sought to prepare the fruits, vegetables, and dips, in easily formulated methods that can be adapted in home settings.

The study accomplished these goals by using food preference tasting to evaluate preschool children's level of acceptance of selected fruits and vegetables with and without dips. A series of fruit and vegetable dips, some plain and some enhanced with herbs and spices, was developed., and thirty-four children between the ages of 3 and 5 then participated in food preference testing of selected fruits and vegetables, and a change in their level of acceptance and consumption of these vegetables was measured with the addition of a preferred spice dip.

The following variables were measured and used to address the research questions and hypotheses listed below:

Variables

Independent Variables

Select Vegetables (celery, carrots, green beans, potatoes, broccoli, red peppers, yellow squash, cucumbers)

Select Fruits (apples, grapes, strawberries, blueberries, lychee, cantaloupe, blueberries, mandarin oranges)

Vegetable Dips (plain, pizza, garlic, ranch, and homemade flavors)

Fruit Dips (plain, cinnamon, cardamom, and mint flavors)

Dependent Variables

Acceptance of Fruits and Vegetables Alone

Acceptance of Fruit and Vegetable Dips Alone

Acceptance of Paired Fruits and Vegetables and Dips

Consumption Levels of Fruits and Vegetable Alone

Consumption Levels of Fruits and Vegetables with Dip

Research Questions

1. How acceptable are the selected fruits and vegetables to preschool-aged children without dip?

2. Can flavor be added to a low-calorie, low-fat, dip base without incurring substantial amounts of calories and fat while increasing the acceptability of fruits and vegetables?

3. How does the acceptability of the selected fruits and vegetables change with the addition of dips?

4. Do consumption levels of fruits and vegetables increase when paired with dips?

5. How does the acceptability and consumption levels of fruits and vegetables enhanced with herbs and spices compare to the acceptability of the fruits and vegetables paired with plain dips?

Research Hypotheses

1. Developing a flavorful dip that has less than 70 calories and 5g or less of fat can be achieved through the addition of herbs and spices.

   1.a. A low-calorie, low-fat dip enhanced with herbs and spices can contribute positively to children's acceptability of fruits and vegetables.

2. The addition of dip improves the acceptability of selected fruits and vegetables alone.

   2.a. Fruits and vegetables rated as "yummy" alone will maintain a rating of "yummy" with the addition of a dip.

   2.b. Fruits and vegetables rated "just okay" alone will have a higher rating when paired with a dip.

2. c. Fruits and vegetables rated as “yucky” alone will have a higher rating when paired with a dip.

3. The addition of a preferred spice dip improves the acceptability of the selected fruits and vegetable more than a plain dip.

   3.a. Fruits and vegetables rated “yummy” alone will maintain their rating with the addition of a spice dip.

   3.b. Fruits and vegetables rated “just okay” alone will have a higher rating when paired with a spice dip than with a plain dip.

   3.c. Fruits and vegetables rated “yucky” alone will have a higher rating when paired with a spice dip than paired with a plain dip.

4. Consumption levels of fruits and vegetables are greater when paired with an herb and spice flavored dip than when consumed alone.

Dip Development

A set of various fruit and vegetable dips was developed prior to conducting preference testing with the participants. The objective was to create products with a neutral base that were enhanced by various blends of herbs and spices functioning as the seasoning component. Keeping the caloric and fat contents of the dips at a reasonable level was important. Since the goal of the study was to increase fruit and vegetable consumption, using dips that were high in calories, fat, salt, and sugar as a vehicle for increasing consumption of fruits and vegetables would compromise the intent. Along

with making the dips healthy and tasty, it was equally important that the recipes include ingredients that are easily accessible to home food providers and are easy to prepare.

The development process was broken into three stages: base development, development of herb and spice combinations, and consistency and texture manipulation. Once the bases were selected and the seasoning formulations were introduced, tastings were scheduled approximately one time per week to ensure that the full flavor of the herbs and spices were released into the dip. Final formulations for vegetable testing included ranch, garlic, homemade, and pizza-flavored dips, while the two final formulations used for fruit testing were pumpkin spice and cinnamon dips. The caloric values of all these dips ranged from 50-60 kcal per 1.5oz of dip.

Phase 1-Acceptance

Round 1 Part A: Food preference testing was conducted at the daycare in order to gauge the participant's acceptability of each of the selected fruits, vegetables, and dips alone. The fruits, vegetables, fruit dips, and vegetable dips were ranked by preference on four separate days. Participants ranked each of the food items using a graphic smiley face scale that included yummy, yucky, or just okay faces (See Appendix). Results of the first round of preference testing indicated that the seasoning in the dips was overpowering; the dips' spice content was then reformulated and preference testing was conducted a second time with a limited number of dips. The sweet dips for that second round were limited to cinnamon, pumpkin, and pumpkin spice, plain, while the vegetable dips were limited to ranch, pizza and plain. These were the only dips that were used for the remainder of the study.

Part B: The participant's acceptability of fruits and vegetables determined in Part A was then measured for change by adding a preferred dip. The change in acceptability of vegetables when paired with a preferred dip was then measured by comparing the level of preference for the foods by themselves/plain (Part A) to the level of preference given to fruit or vegetable when paired with dip. At this point all testing using the fruits and fruit dips was ended because initial acceptance of the fruit was so high that the impact of adding dip was not worth measuring.

Phase 2-Consumption

The two vegetables that participants indicated they liked the least in Phase 1, celery and yellow squash, were prepared in 1/2c servings for Phase 2. Using a "2x2 Within Subjects" design, consumption of celery and squash alone was compared to consumption of the same vegetables paired with the participant's most preferred dip. Consumption of the vegetables was measured by weighing each participant's vegetable and dip samples before and after the snack period.

Definitions of Terms

Energy Density: a measure of the energy a food provides relative to the amount of food (kcalories per gram) (Whitney & Rolfes, 2005).

Food neophobia: reluctance to eat or avoidance of novel foods (Pliner & Hobden, 1992).

Gatekeeper: individual in a family that makes purchasing decisions regarding food. Additionally, gatekeepers usually control food preparation and determine what

foods family members consume (Whitney & Rolfes, 2005).

Nutrient: chemical substances obtained from food and used in the body to provide energy, structural materials, and regulating agents to support growth, maintenance, and repair of the body's tissues (Whitney & Rolfes, 2005).

Phytochemical: non-nutrient compounds found in plant-derived foods that have biological activity in the body (Whitney & Rolfes, 2005).

Satiation: the feeling of satisfaction and fullness that occurs during a meal and halts eating. Satiation determines how much food is consumed during a meal. (Whitney & Rolfes, 2005)

Satiety: the feeling of fullness and satisfaction that occurs after a meal and inhibits eating until the next meal. Satiety determines how much time passes between meals. (Whitney & Rolfes, 2005)

Serving size of fruit: One serving for a child between the ages of 2 and 5 is equivalent to one-half of a cup of fresh, frozen, or canned fruit. Half a cup of dried fruit also constitutes one fruits serving. (USDA, 2008)

Serving size of vegetables: One serving for a child between the ages of 2 and 5 is equivalent to one-half of a cup of fresh or frozen vegetables. One full cup of dark leafy green vegetables is needed to account for one vegetable serving (USDA, 2008).

Chapter 2

LITERATURE REVIEW

Children's Fruit & Vegetable Consumption Levels

Although the USDA and many nutritionists and health professionals have stressed the importance of consuming at least five servings (1/2c) of fruits and vegetables a day, few children reach these goals. The magnitude of this discrepancy was highlighted in a study conducted by Munoz, et al. who evaluated the three-day dietary records of 3309 youth between the ages of 2 and 19 that participated in the 1989-1991 CSFII. By segregating the youths' reported food consumption into groups that correspond with the USDA's 1996 Food Pyramid dietary guidelines, Munoz, et al. determined that only 1% of the youth met the USDA dietary recommendations for all food groups. Thirty percent of the participants met the dietary recommendations for fruit intake and 36% met the dietary recommendation for vegetable intake. Even more alarming was the fact that 16% of the youth did not meet any of the dietary recommendations (Munoz, Krebs-Smith, Ballard-Barbash, and Cleveland, 1997).

Dennison, et al. further examined the 1989-1991 CSFII focusing specifically on children between the ages of 2 and 5. The researchers determined that only 20% of the children in this age range met the USDA's dietary recommendation of five servings of fruit and vegetables a day. The average daily vegetable consumption for children in this age range was less than two servings per day (Dennison, Rockwell, & Baker,1998).

Both of the studies mentioned above also indicated that children whose diets met the USDA's dietary guidelines in most or all food categories also exceeded the USDA's

recommended guidelines regarding fat and sugar intake. This was confirmed in a cross-sectional study conducted by Krebs–Smith, et al. that analyzed the seven-day dietary records of 196 children between the ages of 2 and 5. About 80% of the children met or exceeded the recommended daily allowance (RDA)g for fruit; however, they were satisfying a significant portion (41.5%) of their fruit RDA through fruit juices (Krebs-Smith et al., 1996). Similarly, Dennison, et al. reported in their 1989-1991 CSFII analysis noted that 54% of the fruit juice consumption of children between the ages of 2 and 5 was via fruit juices. Thirty percent of the fruit servings came solely from apple juice (Dennison, Rockwell, & Baker,1998).

Children's consumption levels of vegetables were equally discouraging. An analysis of more than 429 three-day dietary records of children between the ages of 2 and 5 indicated that 27% of all children consumed less than one serving of vegetables per day. After eliminating fried vegetables from the equation, the percentage of children consuming less than one serving of vegetables per day increased to 39%. Most of the vegetables consumed by the children were starchy vegetables such as potatoes and corn; very few leafy green vegetables were consumed. Approximately 23% of the children's total vegetable intake in children consisted of french fries and only 1/3 of all the vegetables consumed were prepared without fat (Krebs-Smith, et al., 1996).

Children's reluctance to consume vegetables can be traced in part to human's predisposition from infancy for sweet, high energy foods (Birch, 1998a; Birch & Fisher 1998; Cowart 1981). Birch further suggests that this preference for sweet foods is merely a defense mechanism designed to guide children toward safe, energy rich eating habits

(1999). In order for these inclinations to persist, taste preferences must be developed and refined (Birch, 1992; Birch & Marlin 1982).

While the consumption of fruit juices and starchy vegetables does result in higher fruit and vegetable intake among children, the significant amounts of sugar and fat found in these products can result in serious health problems for children that consume these products as their primary source of fruits and vegetables.

Benefits of Fruit and Vegetable Intake

A number of studies have shown the positive health benefits of diets that are rich in fruits and vegetables. The World Health Organization (WHO), for example, has indicated that 2.7 million deaths could be prevented simply by supplying people with the recommended daily amount of fruits and vegetables (World Health Organization, 2003).

A lack of fruits and vegetables ranks among the ten leading risk factors for global mortality, cancer, coronary heart disease, and obesity (World Health Organization, 2003).

Cancer

The World Cancer Research Fund (WCRF) and the American Institute for Cancer Research (AICR) have identified dietary patterns as one of the most influential factors in cancer prevention; both organizations indicate that consuming 7% or more of daily energy from fruits and vegetables could prevent 20% of all cancer types (Glade, 1999).

Several studies have supported the assertion that diet alone can have a positive impact on reducing the risk of lung, breast, stomach, bladder, retinal, esophageal, ovarian, and many other types of cancer. An extensive literature review conducted by Block, et al. evaluated the link between fruit and vegetable consumption and reduced

cancer risks The review identified 156 studies, of which 128 showed that adequate intake of fruits and vegetables had a preventative effect on cancer. Further, the review noted that study participants who consumed at least 400g of fruit and vegetables a day reduced their risk of developing cancer by half (Block, Patterson & Subar, 1992).

Coronary Heart Disease

High fruit and vegetable intake has also had promising effects in reducing the risk of cardio vascular disease. According to a study analyzing the dietary records of 84,251 females that participated in the 1976 Nurses' Health Study and males from that participated in the follow-up Health Professionals' Study in 1986 reported an inverse relationship between consumption levels of fruits and vegetables and risk of heart disease. Green leafy vegetables and fruits high in vitamin D were shown to have the greatest risk-reducing effects. The study also showed that blood pressure levels decreased for most participants as their consumption of fruits and vegetables increased. As a result, the authors of the study determined that increasing fruit and vegetable consumption to 400g/day could reduce an individual's risk of coronary heart disease by 5-15% (Joshipura et al, 2001).

Obesity

Increased fruit and vegetable consumption has also been shown to have a significant effect on obesity prevention.. The number of overweight and obese children in the United States tripled between 1980 and 2002 (Ogden et al., 2006). An data analysis of the 2004 National Health and Nutrition Examination Survey (NHANES) revealed that 16% of all female and 18.2% of all male children and adolescents were overweight

(Ogden et al., 2006).

The relationship between increased consumption of high-high fat, high-sugar foods and low fruit and vegetable intake is one of the primary factors that researchers believe has contributed to the childhood obesity epidemic. (St-Onge, Keller, and Heymsefield, 2003). Data collected from the 1994-1996 CSFII revealed that 19.3% of food consumption occurred in restaurants or food-outlets where soda, fried foods and other foods high in fat and sugar are prevalent (Lin, Guthrie & Frazão, 1999). Children's consumption of snacks and other foods high in fat and sugar have also increased through a la carte school lunches, full school lunches, and even at home (St-Onge, Keller, & Heymsefield, 2003). Another review of 107 24-hour recall reports of children between the ages of 7 and\14 indicated that 46% of the food consumed by these children contained added fat or sugar as defined by the 2000 USDA Food Pyramid (Brady, Lindquist, Goran, & Goran, 2000). St-Onge, et al. suggest that children be introduced to healthier eating habits early in life and their exposure to foods with large amounts of sugar and fat be reduced as a step toward reducing the prevalence of overweight children in the United States (2003).

A separate study addressed the impact of increased fruit and vegetable consumption on an individual's discretionary consumption of high-fat, high-sugar foods. In the study – which included 30 families with at least one obese parent – half of the subjects were randomly assigned a diet with increased fruit and vegetable levels while the other half were assigned a diet with reduced levels of high–sugar, high-fat foods. Results indicated that parents who consumed increased levels of fruits and vegetables naturally

reduced their intake of high–sugar, high-fat foods. Conversely, adults whose diets reduced their intake of high–fat, high-sugar foods did not show significant increases in fruit and vegetable consumption (Epstein, 2001).

Antioxidants and Phytochemicals: Disease Prevention

The reduced risk of various chronic diseases as the result of increased fruit and vegetable consumption is largely a function of the antioxidants they contain (Liu, 2003). Antioxidants are derived from phytochemicals, anon-nutrient substance abundantly found in fruits and vegetables. Antioxidants balance cells that have been oxidized by necessary natural functions such as breathing, or by harmful actions such as smoking and the consumption of charred foods, to name a few. If the number of oxidized cells are not balanced, oxidative stress occurs and produces highly reactive free radicals that have been shown to be closely related to degenerative diseases (Temple, 2000). High levels of oxidation also cause “damage to large biomolecules such as proteins, DNA and lipids, resulting in an increased risk for cancer and cardiovascular disease” (Liu, 2003 p517S-518S). Oxidative stress has also been associated with high risk of infectious disease, cancer, diabetes, respiratory diseases, retinal damage, schizophrenia, and degenerative disorders such as Alzheimer’s disease (Temple, 2000).

Vegetables that are good sources of antioxidants also normally have high levels of p-carotene, vitamin C, vitamin E and selenium (Temple, 2000).

Fruit and Vegetable Accessibility

Despite the overwhelming benefits of adequate fruit and vegetable consumption, the current lack of fruit and vegetable consumption worldwide has encouraged the study

of fruit and vegetable accessibility. Although children's food preferences have been shown to be the greatest predictor of consumption patterns, preferences have been shown to be adapted through repeated exposures (Baranowski,Cullen, & Baranowski, 1999; Birch & Marlin, 1982; Nicklas, Baranowski, Cullen, Rittenberry, and Olvera, 2001). Research has shown that children develop eating behaviors centered on foods to which they have been highly exposed during childhood (Birch & Fisher, 1998). Low availability and low use of fruits and vegetables in households can lead to low exposure to these foods which, in turn, can lead to lower preference for and consumption of these foods (Birch & Marlin, 1982). Similarly, children with greater access to a variety of vegetables as children have a greater chance of maintaining adequate vegetable consumption as adults.

Regardless of the amount of vegetables available to children in a household, the children's inability to access them can create barriers to in their vegetable consumption. Baranowski, et al., also noted that children's food preparation knowledge can also have an impact on their consumption of fruits and vegetables readily available to them (1999). Two qualitative studies also demonstrated that children's lack of knowledge on preparing certain fruits and vegetables can deter them from consuming them (Baranowski et al., 1993) Children also reported through interviews that they are more likely to consume ready-to-eat foods rather than taking the time to prepare unfamiliar fruits and vegetables for snacks and meals (Nicklas et al., 2001).

Foods that are available to children at school also have a significant impact on their consumption patterns. Baranowski and colleagues reviewed the seven-day dietary

records of third grade students from 48 elementary schools (1997). Focusing primarily on fruit and vegetable consumption, the study indicated that on average, one serving of vegetables was consumed by each student during each lunch period during the week. At home during the weekend, however, only 0.4 servings were consumed during lunch . Further analysis revealed that children consumed most of their fruits and vegetables at lunch (ranked first), and dinner (ranked second); very few fruits and vegetables were consumed for breakfast or as a snack (Baranowski, et al., 1997). Most school-age children spend a significant portion of their day away from home and rely on the school system for at least one meal per day. This research demonstrates the lack of vegetable consumption that is taking place at home and how important it is for schools to provide adequate amounts of fruits and vegetables for their students.

Studies also have shown the impact that increased freedoms in school eating environments have on children's eating preferences. Cullen and Zacheri performed a cross-sectional analysis of lunch reports of 430 fourth-grade and 422 fifth- grade students (2004). The fourth graders only had access to lunches provided by the National School Lunch Program, while the fifth graders had additional access to a snack bar during their lunch period (Cullen & Zacheri, 2004). Records were taken during four time periods with five consecutive days comprising each time period (Cullen & Zacheri, 2004). The records included what types of foods the children consumed as well as the serving size and source (NSLP/home/snack bar) of each food. The analysis indicated that between 30% and 40% of the lunches consumed school by the fifth graders were purchased from the snack bar. Additionally, the servings of fruit, vegetables (not fried) and milk consumed

by the fifth graders decreased by more than 30% while their consumption of sugary beverages and fried vegetables increased by more than 60%. These results suggest that, in order to encourage healthy eating habits amongst school aged children, the availability of fruits and vegetables as well as the availability of high-fat, high-sugar foods should be managed (Cullen & Zacheri, 2004).

These studies and other evaluations of the impact of school lunches expose the vulnerability of children's eating behaviors outside the home. Despite the reflections of children's consumption of vegetables in schools, research reports that vegetable consumption is sometimes lower at home (Baranowski et al., 1997). Therefore, efforts to increase fruit and vegetable consumption at home are essential.

Influences of Parents & Daycare Providers on Childhood Eating Behaviors

For many children, parents and daycare providers are the greatest influences on their eating behaviors. As the primary food suppliers, parents and daycare providers play an important role in choosing what foods and behaviors children should be exposed to. As previously discussed, children innately prefer sweet, savory, energy-dense foods, especially when first switching from formula/breast milk to solid food (Birch 1999; Cowart 1981). Studies have shown that food behaviors developed at a young age are often predictors of adult eating behaviors (Dennison et al., 1998; Krebs-Smith et al., 1996; Skinner et al., 2002). Therefore, it is necessary that food providers intervene and encourage the consumption of whole fruits and vegetables at a young age (Birch, 1999).

Researchers have suggested that greater emphasis should be placed on the role

that parents play in their children's development of eating behaviors (Golan, 2006; Fisher, Mitchell, Smicklas-Wright, & Birch, 2002). Various studies have shown that parents who practice restrictive feeding styles may actually increase their children's risk of becoming overweight or obese (Faith, et al. 2004; Fisher et al., 2002). One study researched parents' use of pressure via demanding verbal instruction and its influence on changing childhood consumption of fruits and vegetables. The study concluded that when parents tried to motivate their children to finish their vegetables rather than demanding that they finish them, children reported lower consumption levels of fruits and vegetables (2002). Fisher and Faith found that the use of pressure to have children finish their fruits and vegetables was less influential than the parent's own eating behaviors. In fact, children of parents that consumed greater quantities of fruits and vegetables were paired with children who also consumed higher levels of fruits and vegetables (Faith, et al. 2004; Fisher et al, 2002).

Skinner and colleagues reported similar findings in a separate longitudinal analysis of children's food preferences and the close-knit relationship between parents (mothers especially) and their children. Skinner found that although mothers accurately reported their children's preferences, rarely did they introduce foods to their children that they disliked (Skinner, Carruth, Bounds, & Ziegler, 2002).

Parents are also control the meals that children consume in restaurants and food outlets. According to the U.S. Bureau of Labor Statistics, the portion of overall income spent on food consumption outside the home reached 41% in 2003. Although they provide parents with greater convenience, these meals often come in larger portion sizes

and, in many cases, contain higher levels of fat than similar meals prepared at home. A cross-sectional study comparing the body mass index (BMI) of children who frequently consume fried foods away from home to children who frequently do not consume fried food away from home showed a much larger increase in BMI for children reporting frequent consumption of fried foods (Taveras et al., 2005). The study also revealed that a reduced intake of fruits and vegetables and an increased consumption of sugary beverages and *trans* fats often go hand-in-hand with an increased consumption of fried foods (Taveras et al., 2005).

Childhood Eating Preferences

Food preference is another factor that influences children's levels of fruit and vegetable consumption. A plethora of research studies have been conducted studying food preferences of both children and adults. Before changing eating behaviors and patterns, why and what children are currently eating must be reviewed. The belief is, if how and why people consume certain foods can be realized, then enhancing disliked foods to make them more preferred can increase healthy eating habits.

A longitudinal food preference study conducted by Skinner et al, compared the similarities and differences of children's food preferences/intakes with those of their mothers. Seventy children and their mothers participated. The children were tested at age 2-3, 4, and lastly at age 8, which allowed the children's preferences and intakes to be tracked over time. The study followed changes in the children's food intake/preferences of 196 foods as they aged (Skinner et al, 2002).

Results revealed that, of the 196 foods tested, 17 of the 24 most disliked were vegetables. The four most disliked foods were raw onions, summer squash, tomatoes, and mushrooms. Foods in the "most liked" and "well accepted" categories were breads, pastas, and desserts; fruit juices, dairy products, meats, and cereals were also well-received. These preferences may reflect children's natural preference for sweet and savory foods over bitter, more astringent tastes (Birch & Fisher 1998; Cowart 1981).

There is a perception that children are not exposed to enough to vegetables and other foods and therefore develop a dislike for them out of ignorance. Skinner does not refute this idea, but showed that over the period of the study the percentage of never-tried veggies decreased by 9% while the percentage of liked veggies only increased 2%. Additionally, the initial food evaluations exposed the influence that parents have on their children's eating behaviors and preferences. Many of the foods that were recorded as being disliked by mothers were similarly recorded as being disliked or never tried by their children. The study also indicated that the number of food exposures required to change a preference was 2.2-2.6, compared to earlier research which suggested that 8-15 introductions were necessary. Children's preferences began to stabilize at age, 3 suggesting that the formation of eating behaviors may take place at an even earlier age. The longevity of the study also reinforced the theory that childhood eating behaviors, specifically those formed at ages 2 and 3, can predict consumption patterns later in life (Skinner et al, 2002).

In addition to demonstrating that preference is a strong predictor of consumption, Skinner, et al.'s study noted the importance of developing a preference for fruits and

vegetables preferred in children at early ages.

Current Initiatives to Increase the Consumption of Fruits and Vegetables

Several programs are currently in place within the United States that seek to increase the level of fruit and vegetable consumption among children. The USDA sponsors many programs that focus on increasing nutritious diet behaviors of children. Three of those programs incorporate specific efforts to increase the level of fruit and vegetable consumption among children: the National School Lunch Program, the School Breakfast Program, and the Fresh Fruits and Vegetables Program.

The National School Lunch Program (NSLP), the second largest food assistance program in the United States, operates in more than 96,000 schools. The purpose of the program is to provide lunches at little or no cost, which it currently does so for 30,000 children each day. To qualify for program assistance, families must be at 130% of poverty to receive free lunches and between 130% and 185% of poverty to receive a reduced price lunch (United States Department of Agriculture, 2009b). NSLP dietary qualifications mandate that cafeterias incorporate 1/3 of the RDA of vitamins A& C, maintain the percentage of the meal's fat calories at less than 30%, and provide at least two servings of fruit and vegetable at each meal (United States Department of Agriculture, 2009b; Burghardt, Gordon, & Fraker, 1995).

The School Breakfast program provides breakfast to students at more than 81,518 schools already instituting the NSLP. Approximately 10% of the breakfast meals served are at a reduced rate, and 71% are free. Similar to the NSLP, the School Breakfast

Program must include one serving of fruit or vegetables in each meal offered (Burghardt, 1995).

More recently, the USDA used $6 million from the 2002 Farm Act to develop a pilot program encouraging the consumption of fresh fruits and vegetables as snacks in school systems. The program, introduced in 107 schools across five states and within the Zuni Indian Tribal Organization, persisted in researching lucrative methods to increase fruit and vegetable consumption among students (Buzby, Guthrie, & Kantor, 2003). Its success led to the creation of the Fresh Fruits and Vegetable Program as a permanently funded program in the 2008 Farm Bill.

The overall goal of the program is to improve the school's atmosphere so that it attracts students to healthy eating choices. The program also attempts to increase children's exposure to a variety of fruits and vegetables, increase overall consumption of fruits and vegetable and ultimately influence future health habits (United States Department of Agriculture, 2009).

The Fresh Fruits and Vegetables program operates much like the NSLP; schools purchase the necessary fruits and vegetables and are then reimbursed by the USDA. The program is fairly flexible in that it allows each school to organize and implement a program that fits the needs of the school. However, the USDA does require schools to incorporate nutrition education into the program and that fresh fruits and vegetables be offered throughout the day, not just at meal periods. The program prohibits reimbursement for fruits and vegetables provided to students in the cafeteria, thereby encouraging greater dispersal of fruits throughout the day. Schools commonly set up

kiosks or offer 35- to 40-minute presentations during class hours to discuss and distribute fruits and vegetables. Other creative ways to allocate the fruits and vegetables include filling free vending machines and keeping a supply of fresh fruits and vegetables in the nurse's office. Schools also must operate the program during the entire school year and cannot disperse fruits and vegetables before or after school, thereby reinforcing the importance of nutrition education in the classroom (United States Department of Agriculture, 2009a).

The USDA has also instituted another program – the WIC Farmer's Market Nutrition Program – in an attempt to introduce more fruits and vegetables to children in the 45 states in which the WIC program operates. The program increases the availability of locally produced fresh fruits and vegetables to mothers of children up to the age of five who otherwise would have difficulty paying retail prices for fresh fruits and vegetables in a supermarket. (United States Department of Agriculture, 2009c)

The National Cancer Institute (NCI) has also created programs designed to increase fruit and vegetable consumption in the United States. In 1991, NCI partnered with the Better Health Foundation (BHF) to implement the national "5-A Day for Better Health" Campaign. The program was implemented in nine locations, with each one being uniquely designed and adapted to target different populations: WIC participants; African American adults; Hispanic adults employed in labor/trade jobs; employees of Massachusetts Community Health Centers; fourth- and fifth-grade students in an urban school setting; fourth grade students and their parents; high school students; and employees with access to a cafeteria at work. Although very different from each other,

each “5 A Day” program featured a nutritional education component, a source of funding for fruits and vegetables, and at least one motivational activity (Havas et al, 1995).

The “5 A Day” programs have been shown to increase children’s fruit and vegetable consumption significantly (Havas et al., 1998; Perry et al., 1998). One specific evaluation of the 5-A Day program compared an intervention (receiving 5 A Day instruction) and control group both sampled from a population of WIC participants. The results of the study found a mean increase of .13 ± .17 servings in daily consumption of fruits and vegetables in the control group and an increase of .56 ± .11 in the intervention group (difference being statistically significant at p=.002). (Havas et al., 1998).

Another one of the programs – the “5 A Day Power Plus” program for fourth- and fifth-grade students in Minnesota – incorporated curriculum changes, partnership with parents, industry interaction, and foodservice changes in its design. Fruit and vegetable consumption was measured through 24 hour dietary recall reports, lunchroom observations, parent telephone surveys, and health behavior questionnaires (completed by students). Data collected from these measurements showed an increase in fruit intake for both males and females at lunch and vegetable intake for females at lunch. Interestingly, the study reported a much greater increase in the consumption of fruits rather than vegetables. One suggested reason for this was that fruits required less preparation than vegetables, thereby making them an easier, more convenient food option for children. Fruit is more typically consumed at all three meals as well, while vegetables are rarely consumed at breakfast. During the study, fruit also was served as an alternative to baked desserts at lunch, which resulted in more fruits being offered than vegetables (Perry et al.,

1998).

As previously noted, children consume far fewer fruits and vegetables than their RDA. However, as awareness of the benefits of consuming fruits and vegetables increases, and as health officials seek to stem the increasing rates of obesity, cancer and heart disease, more programs and systems are being implemented to increase the availability of fresh fruits and vegetables and motivate children to eat more of them.

This review begins to demonstrate the complex circumstances of increasing fruit and vegetable consumption among young children. Existing literature suggests that although assistance at the state and national level is beneficial, one of the biggest environments that needs to be changed is inside the home. This review also demonstrates that of the majority of aid and the primary target audience of efforts to increase fruit and vegetable consumption is school-aged children, which means that children between the ages of 2 and 3 – and age where children when children often develop food preferences -- are often excluded. This study seeks to find methods to improve children's acceptability and consumption of fruits and vegetables specifically among preschoolers in the home. Parents are significant influences in the development of their children's eating behaviors; therefore a secondary goal of this study is to make the process of serving the fruits and vegetables simple and applicable for caretakers and food providers in the home.

Chapter 3

METHODOLOGY

Samples

Motivation for Using Dips

Although little research has been done to test the effects of dips enhanced with herbs and spices on increasing the toddler aged children's consumption levels of fruit and vegetables, the affinity children have for dipping their foods is clear. Baxter and colleagues demonstrated that using dip is seen as a pleasant and trendy method of consuming vegetables amongst fourth and fifth graders (Baxter, Jack, & Schroder, 1998). Despite their appeal, pairing fruits and vegetables with dips is often frowned upon by nutritionists due to their high fat/caloric content. Additionally, children often scoop dip with their foods leading to higher consumption of the dip than the actual foods. For these reasons, the development of the dips was driven by the goal to create a dip that was preferable to children, low in calories and fat, and thin in viscosity.

Dip Development Process

The development objectives of the fruit and vegetable dips were to create neutral bases low in calories, fat, and sugar as well as smooth in texture. These bases were then flavored with various herbs and spices. The dips were developed over a span of about 11 weeks. During the base development, tastings were scheduled two or three times per week for a panel of the study's lead researchers: Dr. Leann Birch, (Penn State Center for Childhood Obesity Research) Dr. Peter Bordi, (Penn State Center for Food Innovation), and JuliePeterson (Former Penn State Food Science Department Sensory Lab Coordinator).

Vegetable Dip Development

Stage 1.0: Base Development

Table 1: Stage 1.0 Vegetable Dip Base Development

Base 1	
Ingredients	**Grams**
Reduced Fat Mayonnaise	225
Light Sour Cream	227

Base 2	
Ingredients	**Grams**
Kraft Regular Mayonnaise	192
Light Sour Cream	227

Base 3	
Ingredients	**Grams**
Kraft Regular Mayonnaise	192
Light Sour Cream	113
Red. Fat Cream Cheese	112

Base 4	
Ingredients	**Grams**
Reduced Fat Mayonnaise	225
Light Sour Cream	113
Red. Fat Cream Cheese	112

Purpose: The purpose of conducting stage 1 in the vegetable base development process was to decide on the ingredients that would form the base for the vegetable dips. The vegetable dip bases in stage 1 were composed of four different blends of regular mayonnaise, reduced fat mayonnaise, sour cream, and cream cheese.

Results: Base 1, as shown in Table 1 above, was selected as most preferred by the leading researchers' panel.

Proposed Changes: Suggestions for improvement included replacing the reduced fat mayonnaise with miracle whip. The preference of using miracle whip was suggested because its sweet aftertaste was thought to be preferable to children. This concept co-lines with Birch and Cowart's findings that children have an instinctive preference to sweet and savory foods over bitter foods (Birch, 1999; Cowart, 1981).

Stage 1.1: Base Development

Table 2: Stage 1.1 Vegetable Dip Base Development

Base 1.1			Base 2.1	
Ingredients	**Grams**		**Ingredients**	**Grams**
Kraft Miracle Whip	225		Kraft Regular Mayonnaise	192
Light Sour Cream	227		Light Sour Cream	227
Base 3.1			**Base 4.1**	
Ingredients	**Grams**		**Ingredients**	**Grams**
Kraft Regular Mayonnaise	192		Kraft Miracle Whip	225
Light Sour Cream	113		Light Sour Cream	113
Red. Fat Cream Cheese	112		Red. Fat Cream Cheese	112

Purpose: The purpose of conducting stage 1.1 in the vegetable dip base development process was to re-evaluate the taste of the vegetable dip bases having substituted Miracle Whip for the reduced fat mayonnaise that was tested in Stage 1.0.

Results: Base 1.1 as shown in Table 2 above was selected as most preferred by the panel of lead researchers.

Proposed Changes: Additional changes included reducing the viscosity of the dip. As noted earlier one of the objectives for the dip was that the children would not be able to scoop the dip. Rather that the dip would be thin enough that the children would only be able thinly coat their vegetables with the dip.

Stage 1.2 Base Development

Table 3: Stage 1.2 Vegetable Dip Base Development

Base 1.1	
Ingredients	**Grams**
Kraft Miracle Whip	225
Light Sour Cream	227

Base W:1.2	
Ingredients	**Grams**
Kraft Miracle Whip	225
Light Sour Cream	227
Water	57

Base W:1.3	
Ingredients	**Grams**
Kraft Miracle Whip	225
Light Sour Cream	227
Water	113

Base W:1.4	
Ingredients	**Grams**
Kraft Miracle Whip	225
Light Sour Cream	227
Water	227

Base W:1.5	
Ingredients	**Grams**
Kraft Miracle Whip	225
Light Sour Cream	227
Water	280

Base W:1.6	
Ingredients	**Grams**
Kraft Miracle Whip	225
Light Sour Cream	227
Water	340

Purpose: The purpose of conducting stage 1.1 in the vegetable dip base development process was to evaluate the taste and viscosity of adding various amounts of water to selected base, 1.1. This test was also conducted to determine the amount of added liquid that was required to create a dip that was thin enough in viscosity to prevent scooping.

Results: Base W1.6 was selected as the preferred base with the appropriate amount of water necessary to prevent children from scooping the dip. Adding water to the dip however diluted the taste of the dip base and was deemed unacceptable by the panel of lead researchers.

Proposed changes: Proposed changes included using 2% milk as a thinning agent to compensate for the watery taste that was produced in Stage 1.2. Additionally it was noted that the ratio of Miracle Whip to sour cream be reduced due to its strong aftertaste.

Stage 1.3: Base Development

Table 4: Stage 1.3: Vegetable Dip Base Development

Base M:1.7	
Ingredients	**Grams**
Miracle Whip	227
Light Sour Cream	227
2% Milk	113

Base M:1.8	
Ingredients	**Grams**
Miracle Whip	227
Light Sour Cream	227
2% Milk	170

Base M:1.9	
Ingredients	**Grams**
Miracle Whip	227
Light Sour Cream	227
2% Milk	227

Base M:1.10	
Ingredients	**Grams**
Miracle Whip	227
Light Sour Cream	227
2% Milk	284

Base M:1.11	
Ingredients	**Grams**
Miracle Whip	227
Light Sour Cream	227
2% Milk	340

Base M:1.12	
Ingredients	**Grams**
Miracle Whip	227
Light Sour Cream	227
2% Milk	396

Base M:1.13	
Ingredients	**Grams**
Miracle Whip	227
Light Sour Cream	227
2% Milk	454

Purpose: The purpose of conducting stage 1.3 was to evaluate the taste and texture of the vegetable dip base when thinned with 2% milk.

Results: Base M1.11 and Base M1.12 were chosen for the most acceptable level of viscosity.

Proposed Changes: As previously noted, the ratio of miracle whip to sour cream was still a concern. The Miracle Whip produced a strong and lengthy aftertaste that needed to be weakened.

Stage 1.4: Base Development

Table 5: Stage 1.4 Vegetable Dip Base Development

Base M:1.14	
Ingredients	**Grams**
Miracle Whip	170
Light Sour Cream	283.5
2% Milk	340

Base M:1.15	
Ingredients	**Grams**
Miracle Whip	170
Light Sour Cream	283.5
2% Milk	396

Base M:1. 16	
Ingredients	**Grams**
Miracle Whip	57
Light Sour Cream	170
2% Milk	340

Base M:1.17	
Ingredients	**Grams**
Miracle Whip	57
Light Sour Cream	170
2% Milk	396

Purpose: The purpose of conducting stage 1.4 was first to reduce the proportion of Miracle Whip in the Vegetable Dip Base, second to decide on a new ratio of miracle whip to sour cream, and finally to select an appropriate level of viscosity.

Results: The panel of lead researchers decided that the most acceptable ratio of Miracle Whip to sour cream and the appropriate level of viscosity was found in Base M1.15.

Proposed Changes: This base was used as the vegetable dip base for the remainder of the study.

Stage 2.0 Seasoning Development

Table 6: Stage 2.0 Vegetable Dip Seasoning Development

Trial 1				
All Purpose Blend		**Homemade**		**Vegetable**
2 T Dried Parsley		1/2 t Paprika		1/4 c Onion Powder
1 T Dried Rosemary		1/2 t Ground Coriander		1/4 c Parsley Flakes
1 T Dried Thyme		1/2 t Ground Cumin		2 T Seasoning Salt
		1/4 t Garlic Powder		2 T Garlic Powder
		1/4 t Ground Tumeric		2 T Celery Seed
French		1/8 t salt		2 t Dried Sage
1/2c Dried Tarragon				2 t Dried Marjoram
1/2c Dried Chervil		**Italian**		2 t Dried Thyme
2 T Dried Sage		4 T Dried Parsley		2 t Dried Basil
2 T Dried Rosemary		2 T Dried Basil		2 t Dried Oregano
2 T Orange Rind		2 T Dried Marjoram		2 t Pepper
2 T Ground Celery Seed		2 T Dried Oregano		2 t Dried Dill Weed
		2 T Dried Coriander		
Garlic		2 T Dried Thyme		
3 T Garlic Powder		2 T Dried Rosemary		
1 T Seasoned Salt				
1 T Pepper		**Pizza**		
		2 T Dried Oregano		
Herbed		1 T Dried Basil		
2 T Basil		1/2 T Garlic Powder		
2 T Onion Powder		1/2 T Dried Thyme		
1 t Oregano		1/2 T Dried Fennel		
1 t Celery Seed		1/2 T Paprika		
1/4 t Dried Lemon Peel		1/2 T Black Pepper		
1/8 t Pepper		1/2 T Ground Ginger		
		1/2 T Lemon Peel		
Herb				
1 T Dried Thyme		**Table**		
1 T Dried Oregano		1 T Onion Powder		
1 T Dried Parsley		1 1/2 t Dry Mustard		
2 t Rubbed Sage		1 1/2 T Basil		
1 t Dried Rosemary		1 1/2 t Celery Seed		
1 t Dried Marjoram		1/2 t Paprika		
1 t Dried Basil		1/2 t Chili Powder		

Purpose: Stage 2.0, the first stage of seasoning development, tested the initial taste of 10 seasoning mixtures. The mixtures in Table 6 were developed as a starting point for the seasoning mixtures. To evaluate the seasoning formulations, ¼ tsp. of each mixture was added to 1-1oz portion of CHD Base M1.17. The dips were held overnight so that the full flavor of the spices could be released into the dips.

Results: The spice flavoring was very high in all of the dips. Although not a pleasant taste, the strengthened taste of the herbs and spices allowed the tasting panel to specifically identify individual herbs and spices that needed to be adjusted.

Proposed Changes: Suggestions for improvement included reducing the level of the spices in the bases, as well as specifically adjusting some of the herb and spices within each mixture.

Stage 2.1 Seasoning Development

Table 7: Stage 2.1 Vegetable Dip Seasoning Development

Trial 1		Trial 2
All Purpose Blend		**All Purpose Blend**
2 T Dried Parsley		2 T Dried Parsley
1 T Dried Rosemary		**1 t Dried Rosemary**
1 T Dried Thyme		**1 t Dried Thyme**
		1 t Dried Oregano
French		**French**
1/2c Dried Tarragon		1/2c Dried Tarragon
1/2c Dried Chervil		1/2c Dried Chervil
2 T Dried Sage		2 T Dried Sage
2 T Dried Rosemary		**1/2 t Dried Rosemary**
2 T Orange Rind		2 T Orange Rind

Stage 2.1 Seasoning Development (cont.)

Table 8: Stage 2.1 Vegetable Dip Seasoning Development

Trial 1	Trial 2
Garden Herb	**Garden Herb**
1 T Dried Thyme	1 T Dried Thyme
1 T Dried Oregano	1 T Dried Oregano
1 T Dried Parsley	1 T Dried Parsley
2 t Rubbed Sage	2 t Rubbed Sage
1 t Dried Rosemary	1 t Dried Rosemary
1 t Dried Marjoram	1 t Dried Marjoram
1 t Dried Basil	1 t Dried Basil
Homemade	**Homemade**
1/2 t Paprika	1/2 t Paprika
1/2 t Ground Coriander	**1/8 t Ground Coriander**
1/2 t Ground Cumin	~~1/2 t Ground Cumin~~
1/4 t Garlic Powder	1/4 t Garlic Powder
1/4 t Ground Tumeric	1/4 t Ground Tumeric
1/8 t salt	1/8 t salt
Italian	**Italian**
4 T Dried Parsley	4 T Dried Parsley
2 T Dried Basil	2 T Dried Basil
2 T Dried Marjoram	2 T Dried Marjoram
2 T Dried Oregano	2 T Dried Oregano
2 T Dried Coriander	2 T Dried Coriander
2 T Dried Thyme	2 T Dried Thyme
2 T Dried Rosemary	**1/2 t Dried Rosemary**
	1/8 t Salt

Stage 2.1 Seasoning Development (cont.)

Table 9: Stage 2.1 Vegetable Dip Seasoning Development

Trial 1	Trial 2
Vegetable	**Vegetable**
1/4 c Onion Powder	1/4 c Onion Powder
1/4 c Parsley Flakes	1/4 c Parsley Flakes
2 T Seasoning Salt	2 T Seasoning Salt
2 T Garlic Powder	2 T Garlic Powder
2 T Celery Seed	2 T Celery Seed
2 t Dried Sage	2 t Dried Sage
2 t Dried Marjoram	2 t Dried Marjoram
2 t Dried Thyme	2 t Dried Thyme
2 t Dried Basil	2 t Dried Basil
2 t Dried Oregano	2 t Dried Oregano
2 t Pepper	2 t Pepper
2 t Dried Dill Weed	2 t Dried Dill Weed
Table	**Table**
1 T Onion Powder	1 T Onion Powder
1 1/2 t Dry Mustard	1 1/2 t Dry Mustard
1 1/2 T Basil	1 1/2 T Basil
1 1/2 t Celery Seed	1 1/2 t Celery Seed
1/2 t Paprika	1/2 t Paprika
1/2 t Chili Powder	1/2 t Chili Powder
Pizza	**Pizza**
2 T Dried Oregano	2 T Dried Oregano
1 T Dried Basil	1 T Dried Basil
1/2 T Garlic Powder	1/2 T Garlic Powder
1/2 T Dried Thyme	1/2 T Dried Thyme
1/2 T Dried Fennel	1/2 T Dried Fennel
1/2 T Paprika	1/2 T Paprika
1/2 T Black Pepper	1/2 T Black Pepper
1/2 T Ground Ginger	1/2 T Ground Ginger
1/2 T Lemon Peel	1/2 T Lemon Peel
	1/8 t Salt
	* added 1 tsp of parm cheese
	to 1oz portion of pizza dip

Stage 2.1 Seasoning Development (cont.)

Table 10: Stage 2.1 Vegetable Dip Seasoning Development

Trial 1	Trial 2
Garlic	**Garlic**
3 T Garlic Powder	3 T Garlic Powder
1 T Seasoned Salt	**1 T Salt**
1 T Pepper	1 T Pepper
Herbed	**Herbed**
2 T Basil	2 T Basil
2 T Onion Powder	2 T Onion Powder
1 t Oregano	1 t Oregano
1 t Celery Seed	1 t Celery Seed
1/4 t Dried Lemon Peel	1/4 t Dried Lemon Peel
1/8 t Pepper	1/8 t Pepper

Purpose: The purpose of Stage 2.1 in the development process of the seasoning formulations was to reduce the level of seasoning in the base samples, also to adjust some of the specific herbs and spices within each mixture. All seasoning mixtures listed under "Trial 1" on the left sides of Tables 7-10 were the same formulations as tested in Stage 2.0. The level of seasoning, and all seasoning mixtures tested in Stage 2.1 are listed on the right under "Trial 2". Changes or additions made to the herbs and spices in Trial 2 are bolded, and herbs and spices that were completely eliminated have a strike through their name (e.g. ~~Pepper~~).

Results: From the 20 herb and spice mixtures listed in Tables 7-10, seven of them were chosen to undergo further development. See Table 11 for the 7 selected seasoning formulations. From this stage, the leading researcher's panel agreed that pursuit of a pizza, garlic, and an herb dip resembling ranch would be most appealing to children. These concepts were set as development goals from this stage. Additionally, the

homemade dip, including turmeric had a unique taste and a bright yellow color, and for this reason it was also kept for further development.

Proposed Changes: Further adaptations included reformulating the selected seasoning formulations (located in table 11); focusing on creating pizza, ranch, garlic, and turmeric flavored dips.

Table 11: Stage 2.2 Selected Seasoning Formulations from Trials 1 & 2

Selected Seasonings				
Pizza 1		**Pizza 2**		**Vegetable 1**
2 T Dried Oregano		2 T Dried Oregano		1/4 c Onion Powder
1 T Dried Basil		1 T Dried Basil		1/4 c Parsley Flakes
1/2 T Garlic Powder		1/2 T Garlic Powder		2 T Seasoning Salt
1/2 T Dried Thyme		1/2 T Dried Thyme		2 T Garlic Powder
1/2 T Dried Fennel		1/2 T Dried Fennel		2 T Celery Seed
1/2 T Paprika		1/2 T Paprika		2 t Dried Sage
1/2 T Black Pepper		1/2 T Black Pepper		2 t Dried Marjoram
1/2 T Ground Ginger		1/2 T Ground Ginger		2 t Dried Thyme
1/2 T Lemon Peel		1/2 T Lemon Peel		2 t Dried Basil
		1/8 t salt		2 t Dried Oregano
				2 t Pepper
				2 t Dried Dill Weed
French 2		**All Purpose 1**		**Garlic 1**
1/2 c Dried Tarragon		2 T Dried Basil		3 T Garlic Powder
1/2 c. Dried Cherfil		1 t Dried Rosemary		1 T Seasoned Salt
2 T Dried Sage		1 t Dried Thyme		1 T Pepper
2 T Orange Rind		1 t Dried Oregano		
2 T Ground Celery Seed				
1/2 t Dried Rosemary				
Homemade 1		**Homemade 2**		**Garlic 2**
1/2 t Paprika		1/2 t Paprika		3 T Garlic Powder
1/2 t Ground Coriander		1/8 t Ground Coriander		1 T Salt
1/2 t Ground Cumin		1/4 t Garlic Powder		1 T Pepper
1/4 t Garlic Powder		1/4 t Ground Tumeric		

Stage 2.2 Seasoning Development

Table 12: Stage 2.2 Pizza Vegetable Dip Seasoning Development

Pizza Development		
Pizza 3	**Pizza 4**	**Pizza 5**
1T Basil	1T Basil	**2T Basil**
1T Oregano	1T Oregano	1T Oregano
1T Parsley	1T Parsley	1T Parsley
1t Onion Powder	1t Onion Powder	1t Onion Powder
1/2 t Garlic Powder	1/2 t Garlic Powder	1/2 t Garlic Powder
1/4t Black Pepper	1/4t Black Pepper	1/4t Black Pepper
1/2 t Romano Chz Powder	1/2 t Romano Chz Powder	1/2 t Romano Chz Powder
1/2 t Cheddar Cheese	1/2 t Cheddar Cheese	1/2 t Cheddar Cheese
1 t Tomato Powder	1 t Tomato Powder	1 t Tomato Powder
	1/8 t Thyme	1/8 t Thyme
	1/4 t Lemon Peel	1/4 t Lemon Rind
		1/2T Paprika

Table 13: Stage 2.2 Herb Vegetable Dip Seasoning Developmen

Herb Seasoning Development		
Herb I	**Herb 2**	**Herb 3**
1 T Parsley	1/2 t Garlic Powder	1 T Onion Flakes
1T Thyme	1/2 t Onion Powder	1 T Parsley Flakes
1/2T Tarragon	1 T Tarragon	1 t Dill
1/2 T Onion Flakes	1 T Basil	1 t Seasoned Salt
1t Garlic Powder	1 T Oregano	
1/2 t Salt	1 T Parsley	
1/2 t Pepper	1/16 t Lemon Rind	

Purpose: The purpose of Stage 2.2 was to further evaluate and develop the Pizza and Herb seasoning formulations. Table 12 depicts the changes that were made to the Pizza in bold. Table 13 displays three new Herb blends that were tested during this stage.

Results: Pizza 5 and Herb 1 and 3 were chosen as the preferred spices from Tables 12 and 13.

Proposed Changes: Although Herb 3 was accepted, it was suggested that the level of parsley be increased for the next phase.

Stage 2.3 Seasoning Development

Table 14: Vegetable Dip Seasoning Development

Selected Seasoning Formulations				
Pizza 1		**Pizza 5**		**Garlic 1**
1 T Dried Basil		2T Basil		3 T Garlic Powder
2 T Dried Oregano		1T Oregano		1 T Seasoned Salt
1/2 T Garlic Powder		1/2 t Garlic Powder		1 T Pepper
1t Romano Powder		1/2 t Romano Chz Powder		
1t Tomato Powder		1 t Tomato Powder		
1/2 T Dried Fennel		1/4t Black Pepper		**Homemade 1**
1/2 T Black Pepper		1/2 t Cheddar Cheese		1/2 t Paprika
1/2 T Ground Ginger		1t Onion Powder		1/2 t Ground Coriander
1/2 T Dried Thyme		1T Parsley		1/2 t Ground Cumin
1/2 T Lemon rind		1/8 t Thyme		1/4 t Garlic Powder
1/2 T Paprika		1/4 t Lemon Rind		1/4 t Ground Tumeric
		1/2T Paprika		1/8 t salt
Herb I		**Herb 3**		**Herb 3a**
1 T Parsley		1 T Onion Flakes		1 T Onion Flakes
1T Thyme		1 T Parsley Flakes		2 T Parsley Flakes
1/2T Tarragon		1 t Dill		1 t Dill
1/2 T Onion Flakes		1 t Seasoned Salt		1 t Seasoned Salt
1t Garlic Powder				
1/2 t Salt				
1/2 t Pepper				

Purpose: Stage 2.3 was conducted to evaluate the preferred seasoning mixtures that were selected in Stage 2.1 and compare them to the reformulated seasoning mixtures that were selected from Stage 2.2. Table 14 displays the seasoning formulations selected from Stage 2.1, Stage 2.2, with the addition of Herb 3a which was an improved variation of Herb 3 developed in stage 2.3.

Results: Pizza 5, Garlic 1, Homemade 1, and Herb 3a were selected as the most preferred dips from Stage 2.3.

Proposed Changes: Pizza 5 was accepted in Stage 2.3 but in order to develop a taste closer to actual pizza, it was suggested that the tomato powder, cheese powders, and oregano be increased, the basil be reduced, and the thyme be removed.

Stage 2.4 Seasoning Development

Table 15: Vegetable Dip Pizza Seasoning Development

Pizza Seasoning Development		
Pizza 5		**Pizza 6**
2T Basil		**1 T Basil**
1T Oregano		**2T Oregano**
1T Parsley		1 T Parsley
1t Onion Powder		1 t Onion Powder
1/2 t Garlic Powder		1/2 t Garlic Powder
1/4t Black Pepper		1/4 t Black Pepper
1/2 t Romano Chz Powder		**1 t Romano Cheese**
1/2 t Cheddar Cheese		**1 t Cheddar Cheese**
1 t Tomato Powder		**2 t Tomato Powder**
1/8 t Thyme		~~Thyme~~
1/4 t Lemon Peel		1/4t Lemon Peel
1/2T Paprika		1/2 T Paprika

Purpose: The purpose of conducting Stage 2.4 was to develop the Pizza 5 seasoning formulation into a dip that resembled the actual flavor of pizza more closely.

Results: The pizza 6 seasoning formulation resembled the actual flavor and color of pizza much more accurately than the previous pizza seasoning formulations.

Proposed Changes: At this point no further adaptations were suggested for the Pizza 6 formulation.

Final Selected Vegetable Dip Seasoning Formulations

Table 16: Final Vegetable Dip Seasoning Formulations

Garlic 1		**Herb 3a**
3 T Garlic Powder		1 T Onion Flakes
1 T Seasoned Salt		2 T Parsley Flakes
1 T Pepper		1 t Dill
		1 t Seasoned Salt
Pizza 6		**Homemade 1**
1 T Basil		1/2 t Paprika
2T Oregano		1/2 t Ground Coriander
1 T Parsley		1/2 t Ground Cumin
1 t Onion Powder		1/4 t Garlic Powder
1/2 t Garlic Powder		1/4 t Ground Tumeric
1/4 t Black Pepper		1/8 t salt
1 t Romano Cheese		
1 t Cheddar Cheese		
2 t Tomato Powder		
1/4t Lemon Peel		
1/2 T Paprika		

Fruit Dip Development

Stage 1.0: Hawaiian Base Development

Table 17: Stage 1.0 Hawaiian Dip Base Development

Hawaiian Base 1	
Ingredients	**Grams**
Sugar Free Fat Free Vanilla Pudding Mix	99.25
Skim Milk	283.5
Light Sour Cream	113.4

Purpose: Stage 1.0 served as the initial test of the Hawaiian fruit dip base (shown in table 17).

Results: Hawaiian Base 1 was extremely sweet and thick. The presence of the vanilla pudding mix overpowered the other ingredients.

Proposed Changes: It was suggested that the amount of milk and sour cream be increased.

Stage 1.1 Hawaiian Base Development

Table 18: Stage 1.1 Hawaiian Dip Base Development

Hawaiian Base 1.1			Hawaiian Base 2	
Ingredients	**Grams**		**Ingredients**	**Grams**
Vanilla Pudding Mix	99.23		Light Vanilla Yogurt	227
Light Sour Cream	120		Light Sour Cream	120
2% Milk	565		2% Milk	100

Purpose: Stage 1.1 was conducted to evaluate Hawaiian bases 1.1 and 2. Hawaiian base 1.1 consisted of Hawaiian Base 1 with an increased level of 2% milk. Hawaiian base 2 was developed using light vanilla yogurt in replacement of the vanilla

pudding mix.

Results: Hawaiian base 2 was preferred. Hawaiian base 1 and 1.1 tasted too similar to vanilla pudding. It was thought that the strong taste of vanilla pudding would entice the children to consume the dip as a dessert item.

Proposed Changes: The light vanilla yogurt used in Hawaiian Base 2 included artificial sweeteners which produced an unpleasant aftertaste. Possible corrections for this included using a low fat yogurt without artificial sweeteners.

Stage 1.2 Hawaiian Base Development

Table 19: Stage 1.2 Hawaiian Dip Base Development

Hawaiian Base 2.1		
Ingredients		**Grams**
Low Fat Vanilla Yogurt		227
Light Sour Cream		120
2% Milk		100
*** NO ARTIFICIAL SWEETENERS**		
	1.5% milk fat	

Purpose: Stage 1.2 was conducted to evaluate the taste of Hawaiian Base 2 consisting of a low fat yogurt that did not include any artificial sweeteners.

Results: Hawaiian Base 2.1, (depicted in Table 19) was approved, but the introduction to a yogurt without any artificial sweeteners generated the concept of using low fat vanilla yogurt alone as the base for the fruit dips.

Future Adaptations: Test Hawaiian Base 2.1 and Hawaiian Base 3 (100% low

fat vanilla yogurt) with seasoning mixtures.

Stage 2.0 Hawaiian Base Development + Seasoning Formulations

Table 20: Stage 1.3 Hawaiian Dip Base Development

Hawaiian Base 2.1		Hawaiian Base 3	
Ingredients	**Grams**	**Ingredients**	**Grams**
Low Fat Vanilla Yogurt	227	Low Fat Vanilla Yogurt	56.7
Light Sour Cream	120		
2% Milk	100		
*** NO ARTIFICIAL SWEETENERS**		*** NO ARTIFICIAL SWEETENERS**	
	1.5% milk fat		1.5% milk fat

Table 21: Fruit Dip Base & Seasoning Development

Hawaiian Base 2.1	
Coconut	
Ingredients	**Grams**
Hawaiian Base 2.1	86
Pineapple Juice	8
Ground Cinnamon	0.7
Shredded Coconut	4
Cinnamon - Allspice	
Ingredients	**Grams**
Hawaiian Base 2.1	86
Skim Milk	25
Ground Cinnamon	0.7
Allspice	0.35
Hawaiian Citrus	
Ingredients	**Grams**
Hawaiian Base 2.1	86
Pineapple Juice	5
Dried Orange Zest	0.9
Dried Lemon Zest	0.9
Hawaiian Spice	
Ingredients	**Grams**
Hawaiian Base 2.1	86
Pineapple Juice	5
Dried Orange Zest	0.9
Dried Lemon Zest	0.9
Ground Cinnamon	0.14

Hawaiian Base 3	
Coconut	
Ingredients	**Grams**
Hawaiian Base 3	86
Pineapple Juice	8
Ground Cinnamon	0.7
Shredded Coconut	4
Cinnamon - Allspice	
Ingredients	**Grams**
Hawaiian Base 3	86
Skim Milk	25
Ground Cinnamon	0.7
Allspice	0.35
Hawaiian Citrus	
Ingredients	**Grams**
Hawaiian Base 3	86
Pineapple Juice	5
Dried Orange Zest	0.9
Dried Lemon Zest	0.9
Hawaiian Spice	
Ingredients	**Grams**
Hawaiian Base 3	86
Pineapple Juice	5
Dried Orange Zest	0.9
Dried Lemon Zest	0.9
Ground Cinnamon	0.14

Purpose: Stage 2.0 was conducted to compare the taste and texture of Hawaiian Base 2.1 and Hawaiian Base 3 when seasoning mixtures were added to them.

Results: Hawaiian Base 3 was preferred over Hawaiian Base 2 with each seasoning mixture.

Proposed Changes: Several changes to the seasoning mixtures were proposed. Suggestions included removing shredded coconut and the allspice. The flavor of the orange and lemon zests were liked, however both zests produced an unfavorable texture and bitterness.

Stage 2.1 Hawaiian Dip Seasoning Development

Table 22: Fruit Dip Seasoning Formulations

Coconut	
Ingredients	**Grams**
Hawaiian Base 3	86
Pineapple Juice	8
Ground Cinnamon	0.7
Shredded Coconut	4

Coconut	
Ingredients	**Grams**
Hawaiian Base 3	86
Pineapple Juice	8
Ground Cinnamon	0.7
~~Shredded Coconut~~	~~4~~

Cinnamon/Allspice	
Ingredients	**Grams**
Hawaiian Base 3	86
Skim Milk	25
Ground Cinnamon	0.7
Allspice	0.175

Cinnamon/Allspice	
Ingredients	**Grams**
Hawaiian Base 3	86
Skim Milk	**15**
Ground Cinnamon	0.7
~~Allspice~~	

Hawaiian Citrus	
Ingredients	**Grams**
Hawaiian Base 3	86
Pineapple Juice	5
Dried Orange Zest	0.9
Dried Lemon Zest	0.9

Hawaiian Citrus	
Ingredients	**Grams**
Hawaiian Base 3	86
Pineapple Juice	5
Dried Orange Zest	**0.45**
Dried Lemon Zest	**0.45**
Honey	**11**

Hawaiian Spice	
Ingredients	**Grams**
Hawaiian Base 3	86
Pineapple Juice	5
Dried Orange Zest	0.18
Dried Lemon Zest	0.9
Ground Cinnamon	0.14

Hawaiian Spice	
Ingredients	**Grams**
Hawaiian Base 3	86
Pineapple Juice	5
Dried Orange Zest	**0.9**
Dried Lemon Zest	**0.18**
Ground Cinnamon	0.14
Honey	**11**

Purpose: Table 22 displays the changes made to the seasoning mixtures that were added to Hawaiian Bases 2.1 and 3 in Stage 2.0. The seasoning formulations listed under Trial 1 in Table 2 are the seasoning mixtures that were used in Stage 2.0. The seasoning formulations listed under Trial 2 are the adapted seasoning formulations from Stage 2.0.

Results: The flavors of the citrus zests were highly preferred but further development is necessary to remove the bitterness and the bumpy texture the zests created.

Proposed Changes: Suggested changes included developing a plain cinnamon dip, grinding the citrus zests through a spice grinder to decrease their size, and adding vanilla to soften the bitterness produced by the citrus zests.

Stage 2.2 Hawaiian Dip Seasoning Formulations

Table 23: Hawaiian Dip Seasoning Formulations

H:3.1	
Ingredients	**Grams**
Hawaiian Base 3	56.7
Ground Cinnamon	0.7
H:3.2	
Ingredients	**Grams**
Hawaiian Base 3	56.7
Ground Cinnamon	0.35
H:3.3	
Ingredients	**Grams**
Hawaiian Base 3	56.7
Ground Cinnamon	0.35
Dried Orange Zest	0.35
Dried Lemon Zest	0.35
Honey	1.18

H:3.4	
Ingredients	**Grams**
Hawaiian Base 3	56.7
Pineapple Juice	10
Dried Orange Zest	0.45
Dried Lemon Zest	0.45
Ground Cinnamon	0.35
Honey	1.18
H:3.5	
Ingredients	**Grams**
Hawaiian Base 3	56.7
Pineapple Juice	10
Dried Orange Zest	0.35
Dried Lemon Zest	0.35
Ground Cinnamon	0.35
Vanilla Extract	0.59

Purpose: The purpose of conducting Stage 2.2 was to evaluate the taste of a plain cinnamon dip, and determine the appropriate level of spice for a cinnamon dip. Stage 2.2 also served to test the effect of grinding the zests through a spice grinder, and adding vanilla to minimize the bitterness and bumpy texture caused by the citrus zests.

Results: The taste and level of cinnamon dip H:3.1 was preferred. The bitterness and bumpy texture produced by the citrus zests was not removed by the addition of the vanilla or by grinding it through the spice grinder.

Future Adaptations: The bitterness and bumpy texture may be reduced in seasoning formulation H:3.5 by increasing the ratio of base to the seasoning mixture.

Stage 2.3 Hawaiian Dip Seasoning Formulations

Table 24: Hawaiian Dip Seasoning Formulations

H:3.6	
Ingredients	**Grams**
Base 3	85
Pineapple Juice	10
Dried Orange Zest	0.45
Dried Lemon Zest	0.45
Ground Cinnamon	0.35
Vanilla Extract	0.59

Purpose: Stage 2.3 was conducted to evaluate the taste and texture of seasoning formulation H:3.5 when added to a greater proportion of dip base.

Results: Seasoning formulation H:3.6, as shown in Table 24, was deemed acceptable by the panel of lead researchers.

Future Adaptations: No further adaptations to H:3.6 were suggested at this time.

Stage 2.4 Hawaiian Dip Seasoning Formulations

Table 25: Hawaiian Dip Seasoning Formulations: Cardamom

H:3.7	
Ingredients	**Grams**
Hawaiian Base 3	56.7
Ground Cardamom	0.35
H:3.8	
Ingredients	**Grams**
Hawaiian Base 3	56.7
Ground Cardamom	0.53
H:3.9	
Ingredients	**Grams**
Hawaiian Base 3	56.7
Ground Cardamom	0-Jan

Table 26: Hawaiian Dip Seasoning Formulations: Mint

H:3.10			H:3.13	
Ingredients	**Grams**		**Ingredients**	**Grams**
Hawaiian Base 3	113.4		Hawaiian Base 3	113.4
Ground Mint	0.5		Ground Mint	0.5
			Vanilla Extract	1.81
H:3.11			**H:3.14**	
Ingredients	**Grams**		**Ingredients**	**Grams**
Hawaiian Base 3	113.4		Hawaiian Base 3	113.4
Ground Mint	0.25		Ground Mint	0.25
			Vanilla Extract	1.81
H:3.12			**H:3.15**	
Ingredients	**Grams**		**Ingredients**	**Grams**
Hawaiian Base 3	113.4		Hawaiian Base 3	113.4
Ground Mint	0.125		Ground Mint	0.125
			Vanilla Extract	1.81

Purpose: The purpose of conducting Stage 2.4 was to evaluate mint and

cardamom, and their taste when added to Hawaiian Base 3.

Results: Dips, H:3.8 and H:3.11, as displayed in Tables 25 and 26 were chosen as acceptable in taste and texture by the lead researcher's panel.

Proposed Changes: No further adaptations were made to the seasoning formulations at this time.

Final Selected Hawaiian Dip Seasoning Formulations

Table 27: Final Hawaiian Dip Seasoning Formulations

Cinnamon H:3.1	
Ingredients	**Grams**
Hawaiian Base 3	56.7
Ground Cinnamon	0.7

Hawaiian Spice H:3.6	
Ingredients	**Grams**
Hawaiian Base 3	85
Pineapple Juice	10
Dried Orange Zest	0.45
Dried Lemon Zest	0.45
Ground Cinnamon	0.35
Vanilla Extract	0.59

Cardamom H:3.8	
Ingredients	**Grams**
Hawaiian Base 3	56.7
Ground Cardamom	0.53

Mint H:3.11	
Ingredients	**Grams**
Hawaiian Base 3	113.4
Ground Mint	0.25

Pumpkin Dip Development

Stage 1.0 Pumpkin Base Development

Table 28: Pumpkin Base Development

Pumpkin Dip Base 1		
Ingredients		**Grams**
1/3 Reduced Fat Cream Cheese (softened)		227
Powdered Sugar		78
Canned Pumpkin		425

Table 29: Pumpkin Seasoning Formulations

Pumpkin Seasoning Formulations				
Ingredients		**Grams**		
Ground Cinnamon		3		
Ground Ginger		2		

Purpose: The pumpkin dip base was first tasted in Stage 1.0, base development. A simple seasoning formulation was developed and added to the entire dip base recipe.

Results: Pumpkin dip base 1 was very thick and sweet. Secondly, the level of spices in the dip was very low.

Proposed Changes: Suggestions for the improvement of base 1 included thinning the dip with water or milk. Subsequently, the level of seasoning should be increased.

Stage 1.1 Pumpkin Base Development

Table 30: Pumpkin Dip Base Development

Base W:1		Base W:1.5		
Ingredients	**Grams**	**Ingredients**	**Grams**	
Pumpkin Base 1	113	Pumpkin Base 1	113	
Water	28	Water	43	
Base W:2		**Base W:2.5**		
Ingredients	**Grams**	**Ingredients**	**Grams**	
Pumpkin Base 1	113	Pumpkin Base 1	113	
Water	58	Water	71	
Base W:3		**Base W:3.5**		
Ingredients	**Grams**	**Ingredients**	**Grams**	
Pumpkin Base 1	113	Pumpkin Base 1	113	
Water	85	Water	99	

Purpose: Stage 1.1 was conducted to determine an acceptable viscosity for the pumpkin dip. Additionally, the use of water as a thinning agent was tested for taste, texture and appearance.

Results: Water was identified as an unacceptable thinning agent for the pumpkin dip in stage 1.1.

Proposed Changes: Suggestions to improve the quality of the dip while decreasing its viscosity included testing 2% milk as a thinning agent.

Stage 1.2 Pumpkin Base Development

Table 31: Pumpkin Dip Base Development

Base M:1		Base M:1.1.5		
Ingredients	**Grams**	**Ingredients**	**Grams**	
Pumpkin Base 1	113	Pumpkin Base 1	113	
2% Milk	28	2% Milk	43	
Base M:1.2		**Base M:1.2.5**		
Ingredients	**Grams**	**Ingredients**	**Grams**	
Pumpkin Base 1	113	Pumpkin Base 1	113	
2% Milk	58	2% Milk	71	
Base M:1.3		**Base M:1.3.5**		
Ingredients	**Grams**	**Ingredients**	**Grams**	
Pumpkin Base 1	113	Pumpkin Base 1	113	
2% Milk	85	2% Milk	99	

Purpose: Stage 1.2 was conducted to test the possibility of using 2% milk as a thinning agent in the pumpkin dip.

Results: Even at the greatest level of liquid displayed, 3.5oz of 2% milk per 2 oz of base, the pumpkin base seemed overly thick and rich.

Proposed Changes: Suggestions for change included reducing the level of cream cheese, and further increasing the level of 2% milk.

Stage 1.3 Pumpkin Base Development

Table 32: Pumpkin Dip Base Development

Pumpkin Base 1		Pumpkin Base 2		
Ingredients	**Grams**	**Ingredients**	**Grams**	
Red Fat Cream Cheese	224	Powdered Sugar	40	
Powdered Sugar	78	Canned Pumpkin	416	
Canned Pumpkin	416	Plain Non-fat yogurt	90	
Pumpkin Base 3		**Pumpkin Base 4**		
Ingredients	**Grams**	**Ingredients**	**Grams**	
Powdered Sugar	40	Powdered Sugar	40	
Canned Pumpkin	416	Canned Pumpkin	416	
Vanilla Low-fat Yogurt	130	Vanilla Low-Fat Yogurt	45	
		Red. Fat Cream Cheese	113.4	

Purpose: The purpose of conducting Stage 1.3 was to reduce the richness of the dip prior to thinning it with 2% milk. Table 32 represents the various formulations that were tested to increase the taste preference of the dip.

Results: Bases 3 and 4 shown in Table 32 were chosen as the most preferred combination of ingredients for the pumpkin base.

Proposed Changes: Future adaptations include thinning the dip bases with 2% milk.

Stage 1.4 Pumpkin Base Development

Table 33: Pumpkin Dip Base Development

Pumpkin Base 5	
Ingredients	**Grams**
Powdered Sugar	40
Canned Pumpkin	416
Vanilla Low-fat Yogurt	130
2% Milk	567

Pumpkin Base 6	
Ingredients	**Grams**
Powdered Sugar	40
Canned Pumpkin	416
Vanilla Low-fat Yogurt	45
Red. Fat Cream Cheese	113.4
2% Milk	595

Purpose: Stage 1.4 allowed the panel of lead researchers to evaluate the differences between Base 5, which included vanilla low-fat yogurt, and Base 6 which included both vanilla low-fat yogurt and reduced fat cream cheese.

Results: Base 5 was selected as the preferred pumpkin base.

Proposed Changes: Suggestions for improvement included increasing the amount of vanilla yogurt and 2% milk in proportion to the canned pumpkin.

Stage 1.5 Base Development

Table 34: Pumpkin Base Development

Pumpkin Base 7		
Ingredients		**Grams**
Powdered Sugar		40
Canned Pumpkin		416
Vanilla Low-fat Yogurt		230
2% Milk		450

Pumpkin Base 8		
Ingredients		**Grams**
Powdered Sugar		60
Canned Pumpkin		416
Vanilla Low-fat Yogurt		300
2% Milk		408

Pumpkin Base 9		
Ingredients		**Grams**
Powdered Sugar		60
Canned Pumpkin		416
Vanilla Low-fat Yogurt		230
2% Milk		450

Purpose: The purpose of Stage 1.5 Pumpkin Base Development, was to increase the percentage of vanilla yogurt and 2% milk in proportion to the pumpkin puree included in the recipe.

Results: The percentage of vanilla yogurt and 2% milk were not high enough to produce a dip that was fairly neutral in flavor and thin enough in viscosity that children would not be able to scoop the dip.

Proposed Changes: Improvements included further increasing the amount of vanilla yogurt and 2% milk.

Stage 1.6 Pumpkin Base Development

Table 35: Pumpkin Base Development

Pumpkin Base 10					
Ingredients		**Grams**	%		
Powdered Sugar		60	4.70%		
Canned Pumpkin		416	32.60%	% Pumpkin & Yogurt	
Vanilla Low-fat Yogurt		350	27.43%		
2% Milk		450	35.27%	62.70%	
Total		**1276**	**100.00%**		
Pumpkin Base 11					
Ingredients		**Grams**	%		
Powdered Sugar		60	4.36%		
Canned Pumpkin		416	30.23%	% Pumpkin & Yogurt	
Vanilla Low-fat Yogurt		400	29.07%		
2% Milk		500	36.34%	65.41%	
Total		**1376**	**100.00%**		
Pumpkin Base 12					
Ingredients		**Grams**	%		
Powdered Sugar		60	3.91%		
Canned Pumpkin		416	27.08%	% Pumpkin & Yogurt	
Vanilla Low-fat Yogurt		475	30.92%		
2% Milk		585	38.09%	69.01%	
Total		**1536**	**100.00%**		

Purpose: Stage 1.6 was conducted to further increase the ratio of vanilla yogurt and 2% milk in proportion to the pumpkin puree in the pumpkin dip base.

Results: None of the bases designed for Stage 1.6, shown in table 35, were accepted. The level of vanilla yogurt and 2% milk was too high.

Proposed Changes: Improvements included creating a base where the total percentage of vanilla yogurt and 2% milk is between 55% and 63%. Additionally, the percentage of vanilla yogurt should be greater than the percentage of 2% milk (Up to this

point, 2% milk had always been formulated at a greater amount than the vanilla yogurt).

Stage 1.7 Pumpkin Base Development

Table 36 : Pumpkin Dip Base Development

		Pumpkin Base 13				
Ingredients		**Grams**	**%**			
Powdered Sugar		60	5.38%			
Canned Pumpkin		416	37.28%	% Pumpkin & Yogurt		
Vanilla Low-fat Yogurt		400	35.84%			
2% Milk		240	21.51%	57.35%		
Total		**1116**	**100.00%**			
		Pumpkin Base 14				
Ingredients		**Grams**	**%**			
Powdered Sugar		60	4.66%			
Canned Pumpkin		416	32.32%	% Pumpkin & Yogurt		
Vanilla Low-fat Yogurt		475	36.91%			
2% Milk		336	26.11%	63.01%		
Total		**1287**	**100.00%**			

Purpose: The purpose of conducting Stage 1.7 was to evaluate the taste and texture of Pumpkin Base 13 and Pumpkin Base 14 as displayed in table 36.

Results: Pumpkin Base 13 was selected as preferred and acceptable for testing with added herbs and spices as a fruit dip (primarily for apples).

Proposed Changes: No changes to the base were suggested at this time.

Stage 2.0 Pumpkin Dip Seasoning Development

Table 37: Pumpkin Dip Seasoning Development

P:13.1			P:13.2	
Ingredients	**Grams**		**Ingredients**	**Grams**
Pumpkin Base 13	250		Pumpkin Base 13	250
Ground Cinnamon	0.7		Ground Cinnamon	0.14
P:13.3			**P:13.4**	
Ingredients	**Grams**		**Ingredients**	**Grams**
Pumpkin Base 13	250		Pumpkin Base 13	250
Ground Cinnamon	0.14		Ground Cinnamon	0.14
Ground Nutmeg	0-Jan		Ground Ginger	0.175

Purpose: Stage 2.0 Seasoning Development was conducted to determine which spices and at what level of the spices would create an acceptable flavor in Pumpkin Base 13.

Results: Samples P:13.1 and P:13.2 as displayed in table 37, were deemed acceptable however, the seasoning levels were slightly weak. Sample P:13.3 was approved by the lead researchers panel. Sample P:13.4 produced a very bitter aftertaste thought to be caused by the ginger.

Proposed Changes: Suggestions were made to either eliminate or reduce the amount of ginger located in P:13.4.

Stage 2.1 Pumpkin Dip Seasoning Development

Table 38: Pumpkin Dip Seasoning Development

P:13.2	
Ingredients	**Grams**
Pumpkin Base 13	250
Ground Cinnamon	0.14
P:13.3	
Ingredients	**Grams**
Pumpkin Base 13	250
Ground Cinnamon	0.14

P:13.5	
Ingredients	Grams
Pumpkin Base 13	250
Ground Cinnamon	0.14
Ground Ginger	0.1
Ground Cloves	0.1

Purpose: Stage 2.1 Pumpkin Dip Seasoning Development was conducted to re-evaluate seasoning mixtures P:13.2 and P:13.3 against a new seasoning mixture P:13.5. As shown in Table 38, P:13.5 introduced a minimal amount of ground ginger and ground cloves.

Results: P:13.5 was selected as the most preferred seasoning formulation displayed above in Table 38. The reduction of the ginger greatly reduced the bitter aftertaste that was reported in Stage 2.0.

Proposed Changes: Suggestions for improvement included testing the addition of nutmeg to seasoning formulation P:13.5.

Stage 2.3 Pumpkin Seasoning Development

Table 39: Pumpkin Base Seasoning Development

P:13.5			P:13.6	
Ingredients	Grams		Ingredients	Grams
Pumpkin Base 13	250		Pumpkin Base 13	250
Ground Cinnamon	1.1		Ground Cinnamon	1.1
Ground Ginger	0.1		Ground Ginger	0.1
Ground Cloves	0.1		Ground Cloves	0.1
			Ground Nutmeg	0.15

Purpose: The purpose of conducting Stage 2.3 was to evaluate the addition of nutmeg to seasoning formulation P:13.5.

Results: Seasoning formulation P:13.6 was selected as the final formulation for the Pumpkin Dip.

Proposed Changes: No further recommendations were made to the Pumpkin Dip at this time.

Final Fruit and Vegetable Dips Presented to McCormick Science Institute

Stage 3.0 Propose Vegetable and Fruit Dips to McCormick Science Institute

Table 40: Vegetable Dips Proposed to MSI

Ranch Dip Recipe:			**Herb 3a**
Ingredients	**Grams**		1 T Onion Flakes
CHD Base M:1.15	227		2 T Parsley Flakes
Herb 3a Seasoning	5		1 t Dill
			1 t Seasoned Salt
Pizza Dip Recipe:			**Pizza 6**
Ingredients	**Grams**		1 T Basil
CHD Base M:1.15	227		2T Oregano
Pizza 6 Seasoning	2.6		1 T Parsley
			1 t Onion Powder
			1/2 t Garlic Powder
			1/4 t Black Pepper
			1 t Romano Cheese
			1 t Cheddar Cheese
			2 t Tomato Powder
			1/4t Lemon Peel
			1/2 T Paprika
Homemade Dip Recipe:			**Homemade 1**
Ingredients	**Grams**		1/2 t Paprika
CHD Base M:1.15	227		1/2 t Ground Coriander
Homemade Seasoning 1	4.3		1/2 t Ground Cumin
			1/4 t Garlic Powder
			1/4 t Ground Tumeric
			1/8 t salt
Garlic Dip Recipe:			**Garlic 1**
Ingredients	**Grams**		3 T Garlic Powder
CHD Base M:1.15	227		1 T Seasoned Salt
Garlic 1 Seasoning	1.5		1 T Pepper

Table 41: Final Fruit Dips Proposed to McCormick Science Institute

Cinnamon H:3.1	
Ingredients	**Grams**
Hawaiian Base 3	56.7
Ground Cinnamon	0.7

Hawaiian Spice	
Ingredients	**Grams**
Hawaiian Base 3	85
Pineapple Juice	10
Dried Orange Zest	0.45
Dried Lemon Zest	0.45
Ground Cinnamon	0.35
Vanilla Extract	0.59

Gardamom	
Ingredients	**Grams**
Hawaiian Base 3	56.7
Ground Cardamom	0.53

Mint	
Ingredients	**Grams**
Hawaiian Base 3	113.4
Ground Mint	0.35

Pumpkin Spice	
Ingredients	**Grams**
Pumpkin Base 13	250
Ground Cinnamon	1.1
Ground Ginger	0.1
Ground Cloves	0.1

Purpose: The purpose of the proposal to MSI was to gain their feedback and approval of the dips before testing the dips' contribution to children's acceptance and consumption of fruits and vegetables.

Results: MSI was pleased overall with the fruit and vegetable dip concepts, however, the Hawaiian Spice dip was not accepted. Additionally, MSI did not approve of the seasoned salt that was an element of the Garlic 1 and Herb 3a vegetable dip seasoning formulations.

Proposed Changes: Reformulate the Herb 3a and Garlic 1 seasoning formulations to exclude seasoned salt.

Stage 3.1 Reformulated Dips Based on Feedback from MSI

Table 42: Reformulated Vegetable Dip Seasoning Formulations

Ranch Dip Recipe:			**Herb 3a**
Ingredients	**Grams**		1 T Onion Flakes
CHD Base M:1.15	227		2 T Parsley Flakes
Herb 3a Seasoning	5		1 t Dill
			1 t Salt
Pizza Dip Recipe:			**Pizza 6**
Ingredients	**Grams**		1 T Basil
CHD Base M:1.15	227		2T Oregano
Pizza 6 Seasoning	2.6		1 T Parsley
			1 t Onion Powder
			1/2 t Garlic Powder
			1/4 t Black Pepper
			1 t Romano Cheese
			1 t Cheddar Cheese
			2 t Tomato Powder
			1/4t Lemon Peel
			1/2 T Paprika
Homemade Dip Recipe:			**Homemade 1**
Ingredients	**Grams**		1/2 t Paprika
CHD Base M:1.15	227		1/2 t Ground Coriander
Homemade Seasoning 1	4.3		1/2 t Ground Cumin
			1/4 t Garlic Powder
			1/4 t Ground Tumeric
			1/8 t salt
Garlic Dip Recipe:			**Garlic 1**
Ingredients	**Grams**		3 T Garlic Powder
CHD Base M:1.15	227		1 T Salt
Garlic 1 Seasoning	1.5		1 T Pepper

Purpose: The purpose of conducting Stage 3.1 was to replace the seasoned salt used in the dips proposed to MSI (Table 40) with iodized table salt.

Results: The taste of the dips reformulated with salt (shown in Table 42) were

evaluated and approved by the lead researchers' panel.

Proposed Changes: No further adaptations were made at this time.

Vegetable and Fruit Dip Scaling Process

Stage 4.0 Phase 1: Acceptance-Vegetable Dips Alone (Round 1)

Table 43: Scaled Vegetable Dips : Phase 1 Acceptance- Vegetable Dips Alone

Ounces Needed for Base	300
Ounces Needed per Sample	60
One oz =	28.35 g

Vegetable Base M:1.15					
Ingredients	**Amount Sm Scale**	**Unit**	**Conversion Factor**	**Amount for 300 oz**	**Unit**
Miracle Whip	85	g	20.01	1701.0	g
Light Sour Cream	142	g	20.01	2841.7	g
2% Milk	198	g	20.01	3962.3	g
Total	425	g		8505.0	g
Yield	14.99	oz		300	oz

Ranch Dip Recipe:					
Ingredients	**Amount Sm Scale**	**Unit**	**Conversion Factor**	**Amount for 60 oz**	**Unit**
Vegetable Base M:1.15	227	g	7.33	1664.3	g
Herb 3a Seasoning	5	g	7.33	36.7	g
Total	232	g		1701.0	g
Yield	8.18	oz		60	oz

Pizza Dip Recipe:					
Ingredients	**Amount Sm Scale**	**Unit**	**Conversion Factor**	**Amount for 60 oz**	**Unit**
Vegetable Base M:1.15	227	g	7.41	1681.7	g
Pizza 6 Seasoning	2.6	g	7.41	19.3	g
Total	229.6	g		1701.0	g
Yield	8.10	oz		60	oz

Homemade Dip Recipe:					
Ingredients	**Amount Sm Scale**	**Unit**	**Conversion Factor**	**Amount for 60 oz**	**Unit**
Vegetable Base M:1.15	227	g	7.35	1669.4	g
Homemade Seasoning 1	4.3	g	7.35	31.6	g
Total	231.3	g		1701.0	g
Yield	8.16	oz		60	oz

Garlic Dip Recipe:					
Ingredients	**Amount Sm Scale**	**Unit**	**Conversion Factor**	**Amount for 60 oz**	**Unit**
Vegetable Base M:1.15	227	g	7.44	1689.8	g
Garlic 1 Seasoning	1.5	g	7.44	11.2	g
Total	228.50	g		1701.0	g
Yield	8.06	ox		60	oz

Table 44: Scaled Vegetable Dip Seasoning Formulations: Phase 1: Acceptance-Vegetable Dips Alone

			Seasoning Mixtures with a 2T cushion		
Grams Needed for Pizza		19.3	25.3		
Grams Needed for Homemade		31.6	37.6		
Grams Needed for Garlic 1		11.2	17.2		
Grams Needed for Herb 3a		36.7	42.7		
Pizza 6 Seasoning Recipe					
Ingredients	**Amount Small Scale**	**Unit**	**Conversion Factor**	**Amount for 25.3 g**	**Unit**
Basil	2.9	g	0.78	2.3	g
Oregano	6	g	0.78	4.7	g
Parlsey	1.3	g	0.78	1.0	g
Onion Powder	3.2	g	0.78	2.5	g
Garlic Powder	1.3	g	0.78	1.0	g
Black Pepper	0.7	g	0.78	0.5	g
Romano Cheese Pow	2.2	g	0.78	1.7	g
Cheddar Cheese Pow	2	g	0.78	1.6	g
Tomato Pow	8.2	g	0.78	6.4	g
Lemon Peel	0.8	g	0.78	0.6	g
Paprika	3.7	g	0.78	2.9	g
Total	32.3	g		25.3	
Homemade 1 Seasoning Recipe					
Ingredients	**Amount Small Scale**	**Unit**	**Conversion Factor**	**Amount for 37.6 g**	**Unit**
Paprika	3.7	g	2.87	10.6	g
Ground Coriander	2.4	g	2.87	6.9	g
Cumin	2.6	g	2.87	7.5	g
Garlic Powder	**1.3**	g	2.87	3.7	g
Ground Tumeric	1.2	g	2.87	3.4	g
Salt	1.9	g	2.87	5.5	g
Total	13.1	g		37.6	
Garlic 1 Seasoning Recipe					
Ingredients	**Amount Small Scale**	**Unit**	**Conversion Factor**	**Amount for 17.2 g**	**Unit**
Garlic Powder	29	g	0.37	10.8	g
Salt	9	g	0.37	3.4	g
Pepper	8	g	0.37	3.0	g
Total	46	g		17.2	g
Herb 3a (Ranch) Seasoning Recipe					
Ingredients	**Amount Small Scale**	**Unit**	**Conversion Factor**	**Amount for 42.7 g**	**Unit**
Onion Flakes	10	g	2.37	23.7	g
Parsley Flakes	4	g	2.37	9.5	g
Dill	1	g	2.37	2.4	g
Salt	3	g	2.37	7.1	g
Total	18	g		42.7	g

Table 45: Scaled Hawaiian Dip Formulations: Phase 1: Acceptance-Vegetable Dips Alone

Ounces Needed for Base	240
Ounces Needed per Sample	60
One oz =	28.35 g

Hawaiian Base 3					
Ingredients	**Amount Sm Scale**	**Unit**	**Conversion Factor**	**Amount for 300 oz**	**Unit**
Low Fat Vanilla Yogurt	56.8	g	120.00	6816.0	g
Total	56.8	g		6816.0	g
Yield	2.00	oz		240.42	oz

Cinnamon Dip Recipe					
Ingredients	**Amount Sm Scale**	**Unit**	**Conversion Factor**	**Amount for 60 oz**	**Unit**
Hawaiian Base 3	56.8	g	29.58	1680.3	g
Ground Cinnamon	0.7	g	29.58	20.7	g
Total	57.5	g		1701.0	g
Yield	2.03	oz		60	oz

Mint Dip Recipe					
Ingredients	**Amount Sm Scale**	**Unit**	**Conversion Factor**	**Amount for 60 oz**	**Unit**
Hawaiian Base 3	113.6	g	14.95	1698.0	g
Ground Mint Flakes	0.2	g	14.95	3.0	g
Total	113.8	g		1701.0	g
Yield	4.01	oz		60	oz

Cardamom Dip Recipe					
Ingredients	**Amount Sm Scale**	**Unit**	**Conversion Factor**	**Amount for 60 oz**	**Unit**
Hawaiian Base 3	56.8	g	29.89	1698.0	g
Cardamom	0.1	g	29.89	3.0	g
Total	56.9	g		1701.0	g
Yield	2.01	oz		60	oz

Table 46: Scaled Pumpkin Dip : Phase 1 Acceptance- Fruit Dips Alone

Ounces Needed for Base	240
Ounces Needed per Sample	60
One oz =	28.35 g

Pumpkin Base 13					
Ingredients	**Amount Sm Scale**	**Unit**	**Conversion Factor**	**Amount for 300 oz**	**Unit**
Powdered Sugar	60	g	3.05	183.0	g
Canned Pumpkin	416		3.05	1268.8	
Low-Fat Vanilla Yogurt	400		3.05	1220.0	
2% Milk	240		3.05	732.0	
Total	1116	g		3403.8	g
Yield	39.37	oz		120.06	oz

Pumpkin Dip Recipe					
Ingredients	**Amount Sm Scale**	**Unit**	**Conversion Factor**	**Amount for 60 oz**	**Unit**
Pumpkin Base 13	250	g	6.76	1690.0	g
Ground Cinnamon	1.1	g	6.76	7.4	
Ground Nutmeg	0.15		6.76	1.0	
Ground Cloves	0.1		6.76	0.7	
Ground Ginger	0.1	g	6.76	0.7	g
Total	251.45	g		1699.8	g
Yield	8.87	oz		59.96	oz

Purpose: The purpose of Stage 4.0 was to increase the scale of the vegetable and fruit dip recipes in order to prepare enough dip for 46-1oz servings. These portions would be used to conduct Phase: 1 Acceptance - Vegetable and Fruit Dips Alone at the ABC daycare center.

Result: Conducting Phase 1: Acceptance – Vegetable Dips Alone at the ABC daycare center revealed that the seasoning in the dips needed adjustments. The scaled dips tasted much stronger than when they were previously tested by the lead researcher's panel. Due to the strong taste, the dips were not well received by the children.

Proposed Changes: It was suggested that the seasoning formulations of the Pizza

and Ranch (Herb 3a) from the vegetable dips and the Cinnamon and Pumpkin Spice from the fruit dips be modified in the large scaled recipes. Additionally, at this time the Homemade 1, Garlic 1, Mint, and Cardamom dips were eliminated from testing.

Stage 4.1 Revised Pizza 6 and Herb 3a Dips

Table 47: Revised Pizza Dip Seasonings

Pizza 6.1 Dip Scaled for Phase 1: Acceptance - Veg Dip Alone	
Ingredients	**Grams**
Base M:1.15	1681.8
Pizza 6.1 Seasoning	19.3
Total Grams	1701.1
Total Ounces	60.00

Pizza 6.1	
Ingredients	**Grams**
Basil	1.5
Oregano	3.0
Parlsey	1.0
Onion Powder	2.3
Garlic Powder	1.0
Black Pepper	0.5
Romano Cheese Pow	1.5
Cheddar Cheese Pow	1.5
Tomato Pow	5.8
Paprika	2.5
Total	20.5

Pizza 6.2 Dip Scaled for Phase 1: Acceptance - Veg Dip Alone	
Ingredients	**Grams**
Base M:1.15	1681.8
Pizza 6.2 Seasoning	19.3
Total Grams	1701.1
Total Ounces	60.00

Pizza 6.2	
Ingredients	**Grams**
Basil	1.0
Oregano	2.0
Parlsey	1.0
Onion Powder	2.3
Garlic Powder	1.0
Black Pepper	0.5
Romano Cheese Pow	1.5
Cheddar Cheese Pow	1.5
Tomato Pow	5.8
Paprika	2.5
Total	19.1

Table 48: Revised Herb 3a (Ranch) Dip Seasonings

Herb 3a.1 Dip Scaled for Phase 1: Acceptance - Veg Dip Alone	
Ingredients	**Grams**
Base M:1.15	1664.35
Herb 3a.1 Seasoning	25.5
Total Grams	1689.85
Total Ounces	59.61

Herb 3a.1	
Ingredients	**Grams**
Onion Flakes	30
Parsley Flakes	12
Dill	1
Salt	8
Total	51.0

Herb 3a.2Dip Scaled for Phase 1: Acceptance - Veg Dip Alone	
Ingredients	**Grams**
Base M:1.15	1664.35
Herb 3a.2 Seasoning	26
Total Grams	1690.35
Total Ounces	59.62

Herb 3a.2	
Ingredients	**Grams**
Onion Flakes	30
Parsley Flakes	12
Dill	2
Salt	8
Total	52.0

Herb 3a.3 Dip Scaled for Phase 1: Acceptance - Veg Dip Alone	
Ingredients	**Grams**
Base M:1.15	1664.35
Herb 3a.3 Seasoning	26.5
Total Grams	1690.85
Total Ounces	59.64

Herb 3a.3	
Ingredients	**Grams**
Onion Flakes	30
Parsley Flakes	12
Dill	3
Salt	8
Total	53.0

Purpose: The purpose of this phase was to evaluate the reformulated Pizza and Ranch dips.

Results: As shown in table 49 below, Herb 3a.1 and Pizza 6.2 were selected to be tested along with Base M:1.15 in Phase 1: Acceptance – Vegetable Dips Alone (Round 2)

as the most preferred dips from this stage.

Proposed Changes: No further changes were made to the Vegetable dips.

Table 49: Final Vegetable Dips Scaled for Phase 1: Acceptance - Vegetable Dips Alone (Round 2)

Pizza 6.2 Dip Scaled for Phase 1: Acceptance - Veg Dip Alone	
Ingredients	**Grams**
Base M:1.15	1681.8
Pizza 6.2 Seasoning	19.3
Total Grams	1701.1
Total Ounces	60.00

Herb 3a.1 Dip Scaled for Phase 1: Acceptance - Veg Dip Alone	
Ingredients	**Grams**
Base M:1.15	1664.35
Herb 3a.1 Seasoning	25.5
Total Grams	1689.85
Total Ounces	59.61

Stage 4.2 Revised Cinnamon and Pumpkin Dips

Table 50: Revised Cinnamon Dips

Cinnamon H:3.12 Dip Scaled for Phase 1: Acceptance - Fruit Dip Alone	
Ingredients	**Grams**
Hawaiian Base 3	1680.3
Ground Cinnamon	5
Total Grams	1685.3
Total Ounces	59.45

Pumpkin P:13.7 Dip Scaled for Phase 1: Acceptance - Veg Dip Alone	
Ingredients	**Grams**
Base P:13	1664.35
Ground Cinnamon	7.5
Ground Nutmeg	0.15
Ground Cloves	0.1
Ground Ginger	0.1
Total Grams	1672.2
Total Ounces	58.98

Cinnamon H:3.13 Dip Scaled for Phase 1: Acceptance - Fruit Dip Alone	
Ingredients	**Grams**
Hawaiian Base 3	1680.3
Ground Cinnamon	10
Total Grams	1690.3
Total Ounces	59.62

Pumpkin P:13.8 Dip Scaled for Phase 1: Acceptance - Veg Dip Alone	
Ingredients	**Grams**
Base P:13	1664.35
Ground Cinnamon	7.5
Ground Nutmeg	0.3
Ground Cloves	0.2
Ground Ginger	0.2
Total Grams	1672.55
Total Ounces	59.00

Cinnamon H:3.14 Dip Scaled for Phase 1: Acceptance - Fruit Dip Alone	
Ingredients	**Grams**
Hawaiian Base 3	1680.3
Ground Cinnamon	12.5
Total Grams	1692.8
Total Ounces	59.71

Pumpkin P:13.9 Dip Scaled for Phase 1: Acceptance - Veg Dip Alone	
Ingredients	**Grams**
Base P:13	1664.35
Ground Cinnamon	7.5
Ground Nutmeg	0.6
Ground Cloves	0.4
Ground Ginger	0.4
Total Grams	1673.25
Total Ounces	59.02

Purpose: The purpose of phase 4.1 was to evaluate the reformulated Cinnamon and Pumpkin dips.

Results: As shown in table 51 below, Cinnamon H:3.14 and Pumpkin P:13.8 were selected to be tested along with Hawaiian Base 3 and Pumpkin Base 13 in Phase 1: Acceptance – Fruit Dips Alone (Round 2) as the most preferred dips from this stage.

Proposed Changes: No further changes were made to the Fruit dips.

Table 51: Final Fruit Dips Scaled for Phase 1: Acceptance - Vegetable Dips Alone (Round 2)

Cinnamon H:3.14 Dip Scaled for Phase 1: Acceptance - Fruit Dip Alone			**Pumpkin P:13.8 Dip Scaled for Phase 1: Acceptance - Veg Dip Alone**	
Ingredients	**Grams**		**Ingredients**	**Grams**
Hawaiian Base 3	1680.3		Base P:13	1664.35
Ground Cinnamon	12.5		Ground Cinnamon	7.5
			Ground Nutmeg	0.3
Total Grams	1692.8		Ground Cloves	0.2
Total Ounces	59.71		Ground Ginger	0.2
			Total Grams	1672.55
			Total Ounces	59.00

Stage 4.3 Scaled Vegetable Dips for Phase 1: Acceptance – Vegetable dips + Vegetables

Table 52: Vegetable Dips – Phase 1 Acceptance – Vegetables + Vegetable Dips

Pizza 6.2 Dip Scaled for Phase 1: Acceptance - Vegetables + Dip			Herb 3a.1 Dip Scaled for Phase 1: Acceptance - Vegetables + Dip	
Ingredients	**Grams**		**Ingredients**	**Grams**
Base M:1.15	3364		Base M:1.15	3329
Pizza 6.2 Seasoning	38.6		Herb 3a.1 Seasoning	52
Total Grams	3402.6		Total Grams	3381
Total Ounces	120.02		Total Ounces	119.26

Purpose: The purpose of Stage 4.3 was to increase the scale of the Pizza 6.2 and Herb 3a.1 recipe in order to prepare 120 oz. of dip for Phase 1: Acceptance testing vegetables with dip. From this120 oz of dip each child received ~1.5 oz (43g).

Results: The dips were successfully scaled with no issues regarding the strength of the seasonings.

Proposed Changes: No further changes were made to the Vegetable dips.

*****Dips prepared for Phase 2: Consumption – Squash & Celery + Vegetable Dip were identical to the dips prepared for Phase 1: Acceptance – Vegetables + Vegetable Dip

Stage 4.4 Scaled Fruit Dips for Phase 1: Acceptance – Fruit dips + Fruit

Table 53: Vegetable Dips - Phase 1 Acceptance - Fruit + Fruit Dips

Cinnamon H:3.14 Dip Scaled for Phase 1: Acceptance - Fruit Dip Alone			Pumpkin P:13.8 Dip Scaled for Phase 1: Acceptance - Veg Dip Alone	
Ingredients	**Grams**		**Ingredients**	**Grams**
Hawaiian Base 3	3360.6		Base P:13	3329
Ground Cinnamon	25		Ground Cinnamon	15
			Ground Nutmeg	0.6
Total Grams	3385.6		Ground Cloves	0.4
Total Ounces	119.42		Ground Ginger	0.4
			Total Grams	3345.4
			Total Ounces	118.00

Purpose: The purpose of this phase was to increase the scale of the Cinnamon H:3.14 and Pumpkin P:13.8 recipe in order to prepare 120 oz. of dip for Phase 1: Acceptance testing fruit with dip.

Results: The dips were successfully scaled with no issues regarding the strength of the seasonings.

Proposed Changes: No further changes were made to the fruit dips.

*Fruit Dips prepared for Phase 1: Acceptance – Fruit Dips + Fruit were not tested at the ABC daycare center. Results from Phase 1: Acceptance of Fruit Alone demonstrated that the children readily accepted the fruit without the presence of a dip. Therefore the impact of the dip was not a meaningful measure. All testing of fruits and the fruit dip ceased at this time.

Fruit Preparation

Table 54: Fruit Sample Prep – Phase 1: Acceptance

	Prep Location	Serving Size	Type	Prep Notes
Blue Berries	CFI Kitchen	3 each	Fresh	Washed
Cantaloupe	CFI Kitchen	3- 1"x 1/4" cubes	Fresh	Removed rind and pulp, sliced, cut into cubes
Kiwi	CFI Kitchen	3-1/4" slices	Fresh	Peeled, sliced into coins, sliced coins in half
Lychee	CFI Kitchen	2 segments	Canned	Drained, rinsed
Mandarine Oranges	CFI Kitchen	3 segments	Dole -Jar	Drained
Strawberries	CFI Kitchen	½ strawberry	Fresh	Washed, cut off top, sliced berry in half
Grapes	CFI Kitchen	3 each	Red-Seedless	Washed, removed from stem
Apples	Daycare Center	2 slices	Red-Delicious	Washed, skin on, sliced with apple slicer

Table 55: Vegetable Sample Prep – Phase 1: Acceptance

	Prep Location	Serving Size	Variety	Prep Notes
Carrots	CFI Kitchen	2 each	Baby	Washed
Green Beans	CFI Kitchen	2 each	Fresh	Washed, trimmed, blanched, cut to 1.5" length
Baby Potatoes	CFI Kitchen	3 slices	Baby, Red	Washed, sliced, into coins, boiled, cooled
Celery	CFI Kitchen	3-2" batons	Fresh	Wash, removed ends, sliced into batons
Broccoli	CFI Kitchen	2 florets	Fresh	Wash, cut into florets
Yellow Squash	CFI Kitchen	2-half coins	Fresh	Wash, sliced into coins, sliced coins in half
Red Bell Pepper	CFI Kitchen	2-1/4" strips	Fresh	Washed, removed stem and seeds, julienned
Cucumber	CFI Kitchen	2 coins	Fresh	Peeled, sliced on mandoline

Subjects

The study was conducted at ABC daycare center in State College, P.A. Participants included 46 daycare students between the ages of 3-5 from 6 classrooms in the daycare center. An informative letter describing the study was sent home with the students with a parental consent form. Parents that permitted their children to participate in the study confirmed returned a signed consent form to the ABC daycare center. Due to a number of absences and children not preferring the spice dips the sample size was reduced to 34 for the final analysis of Phase 1: Acceptance. Increased absence and missing data reduced the sample to 27 in Phase 2: Consumption.

Procedure

Practice Session

In order to familiarize the students with the study procedure and to reduce any unnecessary commotion in the class room, a practice session was conducted with all of the participants. The practice session was administered by Julie Peterson, (Former Food Science Sensory Coordinator, Penn State) and a team of research assistants. Foods used for the practice session were familiar to the students consisting of goldfish crackers, raisins, mini shredded wheat, raspberry yogurt covered pretzels, and unsalted saltine crackers. During this session, research assistants (mostly made up of trained undergraduate food science students) demonstrated the scale to the students and showed them the procedure, fondly naming the test the “Tasting Game”.

Scale

The scale used consisted of three yellow faces printed on plain white paper (See Appendix). The first face was a smiley face signifying the participant's preference or likeness, operationalized as "yummy", for the food in question. The second face was a straight face signifying a participant's moderate attitude, operationalized as " just okay", for the food in question. The third and final face was a frown face signifying a participant's dislike for the food in question conveyed to the participant as "yucky".

Phase 1: Acceptance of Vegetables and Fruits

Phase 1: Acceptance was scheduled into six sessions, conducted on 6 separate days: fruit alone, vegetables alone, fruit dip alone, vegetable dip alone, fruit with dip, vegetables with dip. Prior to commencing the administration of the test, the fruit and vegetables were prepped at the CFI kitchen. The fruit and vegetable samples were not weighed but portioned according to the approximate serving sizes listed in Tables 53 & 54 (pg 81). The prepped fruit and vegetable portions were placed in 4oz cups fitted with lids. The prepped, portioned fruit was delivered to the ABC daycare center in coolers. The samples were removed from the coolers and kept on ice throughout the administration of the study. The sensory evaluation took place between 9:30 and 10:30 A.M. One research assistant was assigned to each of 6 class rooms.

<u>Phase 1: Acceptance - Fruit Alone</u>

On the morning of the test, the research assistants arrived and set up trays complete with one of each of the prepped fruit samples on it (8 total samples). The research assistants took the tray of fruit, data collection sheets, and a set of smiley face scales to their assigned classrooms. The research assistant set up a small station at a table

off to one side of each room. The research assistants would individually call over a selected participant and have them participate in the “Tasting Game”. The remainder of the class was participating in projects or other activities throughout the room.

Prior to tasting the fruits, the participant was asked if they could identify what each of the faces stood for (ie. yummy, yucky, or just okay). If the children were unsure, the research assistant explained the scale again until it was comprehended. Secondly, the research assistant told the participant the name of each fruit. The order in which the child sampled the fruit was left to their discretion but was recorded. The children were then asked to try each of the 8 fruit samples and to set the cup in front of whichever face they felt demonstrated their opinion about the food. The attitude of the research assistants toward the game was positive but they were instructed not to influence the participant’s reactions to any of the foods. Additionally, if the children were reluctant to try the fruits, the research assistants would ask one time, “Would you like to try the _____?” If the children declined, the research assistants refrained from further prompting and simply recorded any activity. In addition to labeling each fruit sample with “yummy”, “yucky”, or “just okay”, the participants were also asked if they had ever tried the sample before and to rank the samples of from their most favorite (8) to their least favorite (1).

Phase 1: Acceptance - Vegetables Alone

The vegetables were administered on the second day of testing and were evaluated by the children in the exact same format as the fruit alone test.

Phase 1: Acceptance - Dips Alone

Similarly to the testing of the fruits and vegetables alone, the dips were prepared in the CFI kitchen and transported to the ABC daycare center via iced coolers. The dips were portioned (at the CFI) into ~1.5oz portions into a 2oz soufflé cup fitted with a lid. The research assistants again organized the trays at the ABC daycare center and attended their assigned classrooms with the scale, data sheet, and trayed samples. The fruit dips and vegetable dips were tested on two separate days. The sensory evaluation of the dips modeled the fruit and vegetable evaluations except the dips were tasted with miniature plastic spoons rather than by hand. Again the children were asked to rate the dips using the "yummy", "yucky", "just okay" faces and rank them according to their preference.

Phase 1: Acceptance - Fruit Dips Alone (Round 1)

The fruit dips initially tested were Hawaiian Dip Base H:3 (plain vanilla low-fat yogurt base), H:3.1 (cinnamon), H:3.11 (mint), and H:3.8 (cardamom), P:13 (plain pumpkin base), and P:13.6 (pumpkin spice).

Phase 1: Acceptance – Fruit Dips Alone (Round 2)

After the dips were tested, it was noticed that only a few of the dips were well received. After tasting the dips, it was noted that the cinnamon dip was too strong. The level of seasoning in the dips was reduced and the following dips were tested on a subsequent day: H:3 (plain vanilla yogurt base), H:3.14 (cinnamon), P:13 (plain pumpkin base), and P:13.8 (pumpkin spice).

Phase 1: Acceptance - Vegetable Dips Alone (Round 1)

The vegetable dips that were primarily tested were Garlic 1, Herb 3a (ranch), Pizza 6, Homemade 1 (turmeric), and the Plain Vegetable Dip Base M:1.15.

Phase 1: Acceptance – Vegetable Dips Alone (Round 2)

Similar to the testing of the fruit dip, the herb/spice flavor in the vegetable dips were not received very well in round 1 of testing Phase 1: Acceptance. In order to alleviate the issue, the dips were reformulated and re-evaluated by the participants. For the second round of sensory evaluation on the vegetable dips, Vegetable Dips Pizza 6.2 dip, Herb 3a.1 (ranch) were tested along with the Plain Vegetable Dip Base M:1.15.

Phase 1: Acceptance - Fruit with Fruit Dips

The results from the sensory evaluation on the fruits alone, and fruit dips alone, were categorized by ranking, familiarity, and preference of item. From this data it was noted that almost all of the fruits were readily accepted by most children and that it wasn't advantageous to continue testing the impact of the dips on the fruit.

Phase 1: Acceptance - Vegetables with Vegetable Dip

The results from the sensory evaluation on vegetables alone, and vegetable dips alone, were categorized by ranking, familiarity, and preference of item. The data was separated per participant. From this data one vegetable that was labeled under each of the categories ("yummy", "yucky", and "just okay") were selected for testing with the child's most preferred spice dip (Pizza 6.2 or Herb 3a.1) and the plain vegetable base (M:1.15). Children that did not have vegetables ranked in one of each of the above listed categories were given one vegetable that they categorized as "yummy" and two vegetables placed in

the “yucky”, “just okay”, or “refused to try” categories. Children who did not initially prefer a spice dip were randomly assigned a spice dip.

On the day prior to the test the ~1.5oz of dip was portioned into 2oz soufflé cups fitted with a lid and labeled with the participant’s number. Similarly, the vegetables were portioned into a 4oz cup fitted with a lid and also labeled with participant number. On the day the sensory evaluation was to be administered the research assistance assembled the trays with the three selected vegetable samples, selected spice dip sample, and plain dip base sample. The researcher’s took their respective trays to their assigned classrooms along with their data collection sheets and a set of the scales.

The participating children were called over from the activities going on in the class room and asked to evaluate the dips and the vegetables. The participants were allowed to choose the order of tasting both the dips and the vegetables. Research assistants were asked to have the children try and evaluate both dips and all three vegetable samples. Additionally, the children were asked to rank the vegetables with the dips and choose a preferred dip.

Phase 2: Consumption of Vegetables

Phase 2: Consumption took place over the span of 4 testing days at the ABC daycare center. Due to absenteeism in both phases, the number of participants that turned in parental consent forms in phase 1 dropped from 46 to 33 participants. The dip samples used for Phase 2: Consumption were Pizza 6.2, Herb 3a.1, and the plain vegetable dip base, M:1.15. The only two vegetables tested were yellow squash and celery. These two

vegetables were chosen because they were the most disliked vegetables rated in Phase 1: Acceptance.

Below is a description of how the vegetables were prepped.

Table 56. Vegetable Sample Prep – Phase 2: Consumption

	Prep Location	Serving Size	Variety	Prep Notes
Yellow Squash	CFI Kitchen	½ c sliced coins ~55g	Fresh	Wash, sliced into coins, sliced coins in half
Celery	CFI Kitchen	½ c batons ~52	Fresh	Wash, removed ends, sliced into batons

The target portion size of each cup of vegetables was 1/2c. This was determined in order to comply with the USDA serving size for fresh vegetables. The target weight for the squash was 55g and the target weight for the celery was 52g. The exact weight of each cup was recorded prior to testing. Each cup was also labeled with participant number. The test was to be administered during snack time so enough samples for the entire class (including non-participating students) were prepped and labeled with dummy numbers.

The target weight for the dip was 1.5oz or 43g. Each participant was assigned his or her preferred spice dip. Children with no preference and children not participating in the study received a randomly assigned spice dip. No plain dip was used in phase 2 of the study.

Celery vs. Celery and Dip

On the first day of testing, 3 of the participating 6 classrooms received celery

alone while the remaining 3 classrooms received celery and dip. On the second test day, the order was reversed (classrooms that received celery alone on day 1 received both celery and dip while the remaining classrooms received celery alone). The morning of testing, the research assistants (1/classroom + and overseer and 2 kitchen prep people) assembled the labeled celery and dip cups corresponding to each participant number. One research assistant was assigned to each classroom. The assembled trays were taken to each classroom. The scales were not used for phase two of the study.

The entire class sat down at 2 adjacent tables for snack. The children were allowed to choose their seats. The children all wore stickers that were labeled with their participant number for identification. The celery or celery and dip samples were passed out to the corresponding participants. The children were free to begin and end their snack time at their own discretion. After the children had consumed the amount of snack that they desired, they were instructed to place the lid on their cup and leave the table. Research assistants recorded notes such as spilled dip, refusal to eat, etc.

Once all of the participants were finished with their snack, the research assistant collected all of the trays and cups and returned to the prep kitchen (located in the ABC daycare center). In the kitchen all of the cups were re-weighed to measure the consumption levels of the celery and the dip. The post-weights were recorded on a data sheet.

Yellow Squash vs. Yellow Squash and Dip

Yellow squash and yellow squash with dip were tested on 2 days following the celery testing. The yellow squash was tested in an identical format as the celery. On the

first day of testing the yellow squash 3 classrooms received samples consisting of yellow squash alone while the three remaining classes received both yellow squash and their most preferred spice dip from phase 1. Like the celery testing, the order was reversed on the second day. This resulted in each class sampling the plain vegetable and the plain vegetable with dip.

The yellow squash and dips were weighed prior to testing and after the children had consumed their snack. The weights were recorded and the research assistants noted any unusual activities or behaviors that took place (e.g. spilled dip).

Chapter 4

RESULTS

Dip Development Process

Research Hypothesis 1:

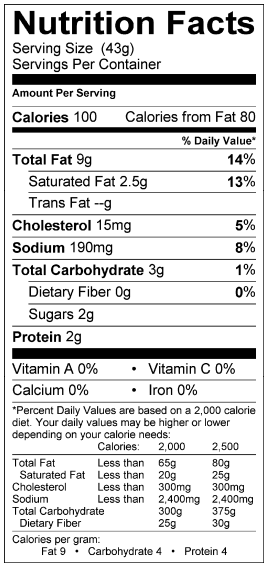
1. Developing a flavorful dip with less than 70 calories, and 5g of fat can be achieved through the addition of herbs and spices.

    1.a A low calorie, low fat dip enhanced with herbs and spices can contribute to children's acceptability of fruits and vegetables.

Vegetable Dip Development

Table 57: Vegetable Base 1 vs. Vegetable Base M:1.15

Vegetable Dip Base 1			Vegetable Dip Base M1.15	
Ingredients	**Grams**		**Ingredients**	**Grams**
Reduced Fat Mayonnaise	225		Miracle Whip	170
Light Sour Cream	227		Light Sour Cream	283.5
			2% Milk	396



Nutrition Facts
Serving Size (43g)
Servings Per Container

Amount Per Serving

Calories 100 Calories from Fat 80

	% Daily Value*
Total Fat 9g	**14%**
Saturated Fat 2.5g	**13%**
Trans Fat --g	
Cholesterol 15mg	**5%**
Sodium 190mg	**8%**
Total Carbohydrate 3g	**1%**
Dietary Fiber 0g	**0%**
Sugars 2g	
Protein 2g	

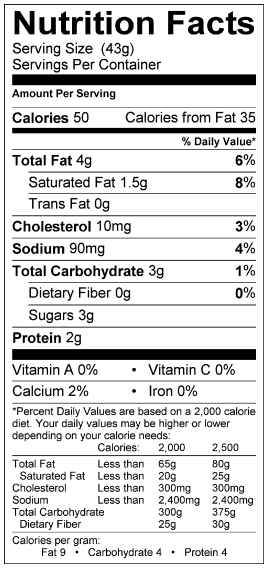
Vitamin A 0% • Vitamin C 0%
Calcium 0% • Iron 0%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Figure 1: Vegetable Dip Base 1



Nutrition Facts
Serving Size (43g)
Servings Per Container

Amount Per Serving

Calories 50 Calories from Fat 35

	% Daily Value*
Total Fat 4g	**6%**
Saturated Fat 1.5g	**8%**
Trans Fat 0g	
Cholesterol 10mg	**3%**
Sodium 90mg	**4%**
Total Carbohydrate 3g	**1%**
Dietary Fiber 0g	**0%**
Sugars 3g	
Protein 2g	

Vitamin A 0% • Vitamin C 0%
Calcium 2% • Iron 0%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Figure 2: Vegetable Dip Base M:1.15

***Unrounded calorie/serving = 54.9kcal**

Tables 57 represents the final formulation for the Vegetable Dip Base M:1.15 in comparison to the original base, Vegetable Base 1. Figures 1 and 2 represent the nutritional content of the Vegetable Base 1 in comparison to the developed base, Vegetable Base M:1.15. Through the development of the vegetable dip base, a dip was produced that contains 50 kcal and 4g of fat per 1.5oz serving.

Final Vegetable Dips Enhanced with Herbs and Spices

Table 58: Final Vegetable Dip Recipes: Pizza 6.2 & Herb 3a.1

Pizza 6.2 Dip			Herb 3a.1 Dip	
Ingredients	**Grams**		**Ingredients**	**Grams**
Base M:1.15	3364		Base M:1.15	3329
Pizza 6.2 Seasoning	38.6		Herb 3a.1 Seasoning	52

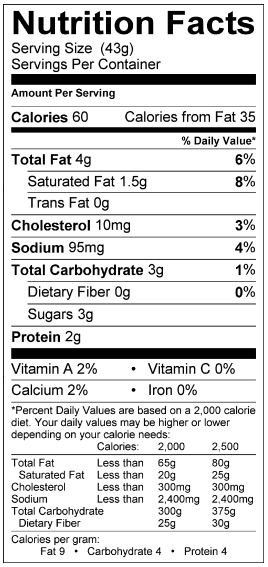


Figure 3: Pizza 6.2
***Unrounded calorie/serving = 55.9kcal**

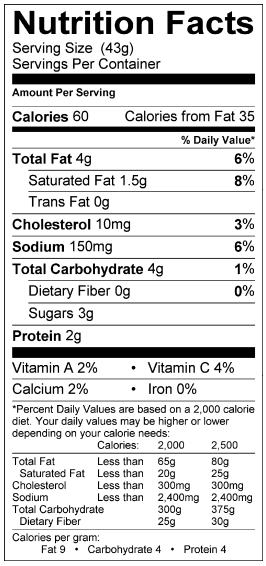


Figure 4: Herb 3a.1 Ranch
***Unrounded calorie/serving = 56.3kcal**

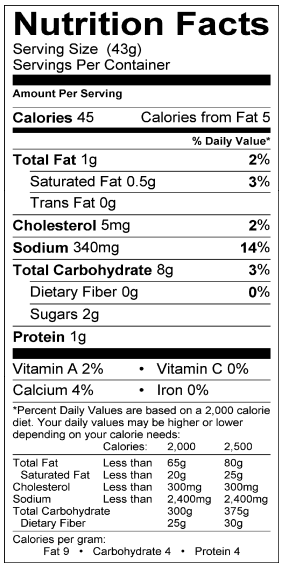
Figures 3 and 4 demonstrate the nutritional content of the final vegetable dip developments. These figures demonstrate that by flavoring vegetable dips with herbs and

spices, vegetable dips can be flavorful in addition to being low in calories and fat.

Final Hawaiian Fruit Dips Enhanced with Herbs and Spices

Table 56: Hawaiian Base 1 vs. Hawaiian Base 3

Hawaiian Base 1			Hawaiian Base 3	
Ingredients	**Grams**		**Ingredients**	**Grams**
Sugar Free Fat Free Vanilla Pudding Mix	99.25		Low Fat Vanilla Yogurt	56.7
Skim Milk	283.5			
Light Sour Cream	113.4			



Nutrition Facts
Serving Size (43g)
Servings Per Container

Amount Per Serving

Calories 45 Calories from Fat 5

% Daily Value*

Total Fat 1g **2%**
Saturated Fat 0.5g **3%**
Trans Fat 0g
Cholesterol 5mg **2%**
Sodium 340mg **14%**
Total Carbohydrate 8g **3%**
Dietary Fiber 0g **0%**
Sugars 2g
Protein 1g

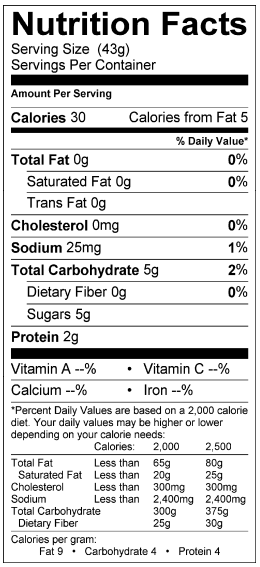
Vitamin A 2% • Vitamin C 0%
Calcium 4% • Iron 0%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Figure 5: Hawaiian Base 1



Nutrition Facts
Serving Size (43g)
Servings Per Container

Amount Per Serving

Calories 30 Calories from Fat 5

% Daily Value*

Total Fat 0g **0%**
Saturated Fat 0g **0%**
Trans Fat 0g
Cholesterol 0mg **0%**
Sodium 25mg **1%**
Total Carbohydrate 5g **2%**
Dietary Fiber 0g **0%**
Sugars 5g
Protein 2g

Vitamin A --% • Vitamin C --%
Calcium --% • Iron --%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

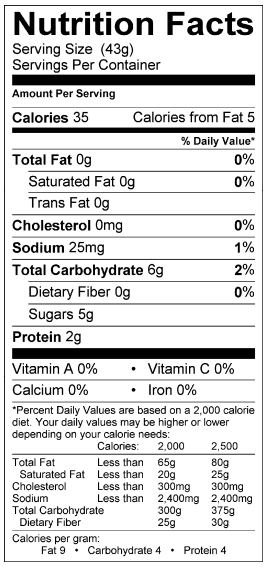
Figure 6: Hawaiian Base 5

Table 59 displays the initial formulation for the Hawaiian Fruit Dip base (Hawaiian Base 1) in comparison to the final formulation of the Hawaiian Fruit Dip Base (Hawaiian Base 3). Through the development process, Hawaiian Base 5's caloric value was reduced by 33%. Additionally, Hawaiian Base 5 includes 0g of fat per serving.

Final Hawaiian Fruit Dip Enhanced with Spices

Table 57: Cinnamon H:3.14

Cinnamon H:3.14	
Ingredients	**Grams**
Hawaiian Base 3	3360.6
Ground Cinnamon	25



Nutrition Facts

Serving Size (43g)
Servings Per Container

Amount Per Serving

Calories 35 — Calories from Fat 5

% Daily Value*

Total Fat 0g — **0**%
- Saturated Fat 0g — **0**%
- Trans Fat 0g

Cholesterol 0mg — **0**%

Sodium 25mg — **1**%

Total Carbohydrate 6g — **2**%
- Dietary Fiber 0g — **0**%
- Sugars 5g

Protein 2g

Vitamin A 0% • Vitamin C 0%

Calcium 0% • Iron 0%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Figure 7: H:3.14 Cinnamon

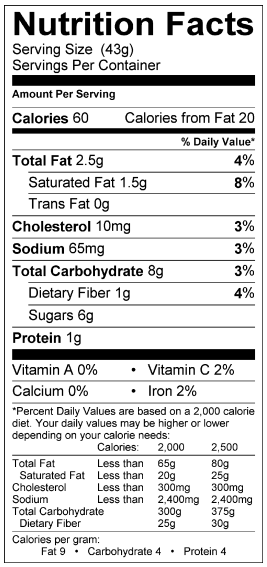
***Unrounded calorie/serving = 32.75 kcal**

Table 60 displays the final formulations for the Hawaiian Fruit Dip: H:3.14 Cinnamon. Figure 7 demonstrates that the caloric content of the dip has remained the same as the base with the addition of the selected herbs and spices. This nutrition label demonstrates that the objective to maintain a caloric profile similar to the base, as described in hypothesis 1 was achieved. As noted in Chapter 1, all fruit and fruit dip testing was removed from the study due to the high acceptance of fruits prior to the addition of a dip. Due to this, hypothesis 1a was unable to be tested for the Hawaiian and Pumpkin Fruit Dips.

Fruit Dip Bases: Pumpkin Dip

Table 61: Pumpkin Dip Base 1 vs. Pumpkin Dip Base P:13

Pumpkin Dip Base 1			Pumpkin Dip Base P:13	
Ingredients	**Grams**		**Ingredients**	**Grams**
Reduced Fat Cream Cheese	227		Powdered Sugar	60
Powdered Sugar	78		Canned Pumpkin	416
Canned Pumpkin	425		Low Fat Vanilla Yogurt	400
			2% Milk	240



Nutrition Facts
Serving Size (43g)
Servings Per Container

Amount Per Serving

Calories 60 Calories from Fat 20

	% Daily Value*
Total Fat 2.5g	**4%**
Saturated Fat 1.5g	**8%**
Trans Fat 0g	
Cholesterol 10mg	**3%**
Sodium 65mg	**3%**
Total Carbohydrate 8g	**3%**
Dietary Fiber 1g	**4%**
Sugars 6g	
Protein 1g	

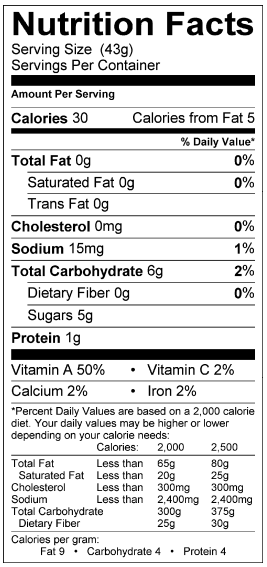
Vitamin A 0% • Vitamin C 2%
Calcium 0% • Iron 2%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Figure 8: Pumpkin Base 1



Nutrition Facts
Serving Size (43g)
Servings Per Container

Amount Per Serving

Calories 30 Calories from Fat 5

	% Daily Value*
Total Fat 0g	**0%**
Saturated Fat 0g	**0%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 15mg	**1%**
Total Carbohydrate 6g	**2%**
Dietary Fiber 0g	**0%**
Sugars 5g	
Protein 1g	

Vitamin A 50% • Vitamin C 2%
Calcium 2% • Iron 2%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Figure 9: Pumpkin Base 13

Figures 7 and 8 represent the nutritional content of the original Pumpkin Base 1 in comparison to the final formulation, Pumpkin Base 13. The caloric content of the original base was cut in half during the development of Pumpkin Base P:13. Additionally, the grams of fat per serving were completely eliminated in the final formulation of the Pumpkin Base. These results demonstrate the potential using vegetables such as pumpkin as bases for fruit and vegetable dips with little added calories or fat.

Final Pumpkin Dip Enhanced with Spices

Table: 62: Pumpkin P:13.8

Pumpkin P:13.8	
Ingredients	**Grams**
Pumpkin Base P:13	3329
Ground Cinnamon	15
Ground Nutmeg	0.6
Ground Cloves	0.4
Ground Ginger	0.4

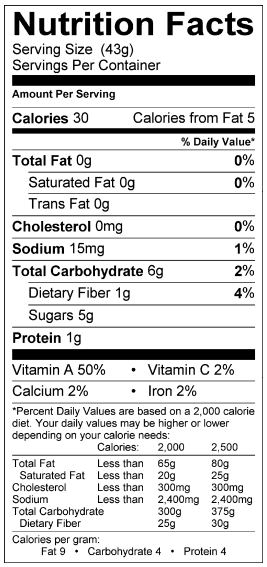


Figure 10: Pumpkin P:13.8

Table 62 displays the final formulations for the Pumpkin Fruit Dip: Pumpkin P:13.8. Figure 10 demonstrates that the caloric content of the dip has remained the same as the base with the addition of the selected herbs and spices. This nutrition label demonstrates that the objective to maintain a caloric profile similar to the base, as described in hypothesis 1 was achieved. As noted in Chapter 1, all fruit and fruit dip testing was removed from the study due to the high acceptance of fruits prior to the addition of a dip. Due to this, hypothesis 1a was unable to be tested for the Hawaiian and Pumpkin Fruit Dips.

Phase 1: Acceptability of Vegetables

The following information demonstrates the impact that the additions of dips have on 34 preschool aged children's level of acceptance and 27 preschool aged children's consumption of selected fruits and vegetables.

Research Hypothesis 2

2. The addition of dip (plain or spice) improves the acceptability of selected vegetables alone.

To evaluate the impact of adding a dip (plain or spice) to a plain vegetable, a repeated measures analysis was performed. Three groups were formed by separating the participant's rating of vegetables alone into three categories (yucky=1, just okay =2, yucky=3). The means within these groups were then compared as follows: the rating of the vegetable alone vs. the rating of the vegetable with plain dip and the rating of a vegetable alone vs. the rating of the vegetable with spice dip. Not all participants ranked a vegetable in all three groups so the total number of responses varies between the categories. Also, some participants ranked two vegetables within the same category (eg. Participant 3 ranked 2 vegetables in the yucky category). To determine one rating for children who ranked two vegetables in the same category, the mean of the two responses with dip values was taken.

Hypothesis 2.a: Vegetables established as "yummy" alone will maintain a rating of "yummy" with the addition of a dip.

Table 63, 64, and Figure 11 below demonstrate that with the addition of a dip (plain or spice) to a plain vegetable previously established as liked or "yummy", the level of acceptance is not maintained. In fact, the addition of a plain dip to an already preferred vegetable actually lowered the mean rating from 3 to 2.4 ($p<.001$). The addition of a spice dip to a vegetable previously rated as "yummy" did not reveal a significant difference in rating.

Table 63. Descriptive Statistics: Vegetables Liked Alone

	Mean	Std. Deviation	N
Vegetable Alone	3.0000	.00000	30
Vegetable + Plain	2.4167	.76658	30
Vegetable + Spice	2.8333	.53067	30

Table 64. Pairwise Comparison: Vegetables Liked Alone

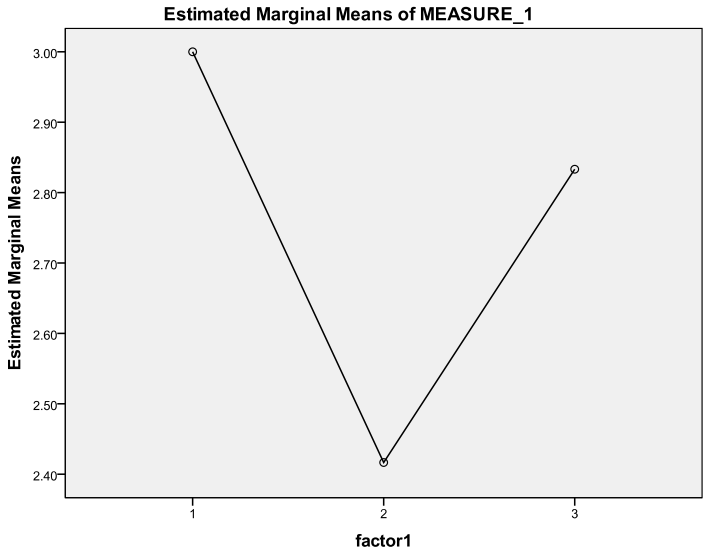
Measure:MEASURE_1

(I) factor1	(J) factor1	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	.583*	.140	.000	.297	.870
	3	.167	.097	.096	-.031	.365
2	1	-.583*	.140	.000	-.870	-.297
	3	-.417*	.156	.012	-.735	-.099
3	1	-.167	.097	.096	-.365	.031
	2	.417*	.156	.012	.099	.735

Based on estimated marginal means

*. The mean difference is significant at the .05 level.
a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

(1=Vegetable Alone, 2=Vegetable + Plain Dip, 3= Vegetable + Spice Dip)



(1=Vegetable Alone, 2=Vegetable + Plain Dip, 3= Vegetable + Spice Dip)

Figure 11. Plot of Vegetables Liked Alone with the Addition of Dip

Hypothesis 2.b: Vegetables rated "just okay" alone have a higher rating when paired with a dip.

As shown below in Tables 65, 66, and Figure 12, the addition of a dip (plain or spice) to a vegetable previously rated as "just okay" or liked, did not significantly improve the rating of the vegetable. Although the addition of a dip demonstrated an increase in the acceptability of the vegetable, the variance is not statistically significant at p=.05.

Table 65. Descriptive Statistics: Vegetables Rated "just okay" Alone

	Mean	Std. Deviation	N
Vegetable Alone	2.0000	.00000	11
Vegetable Plain	2.1364	.67420	11
Vegetable Spice	2.4545	.68755	11

Table 66. Pairwise Comparison: Vegetables Rated "just okay" Alone

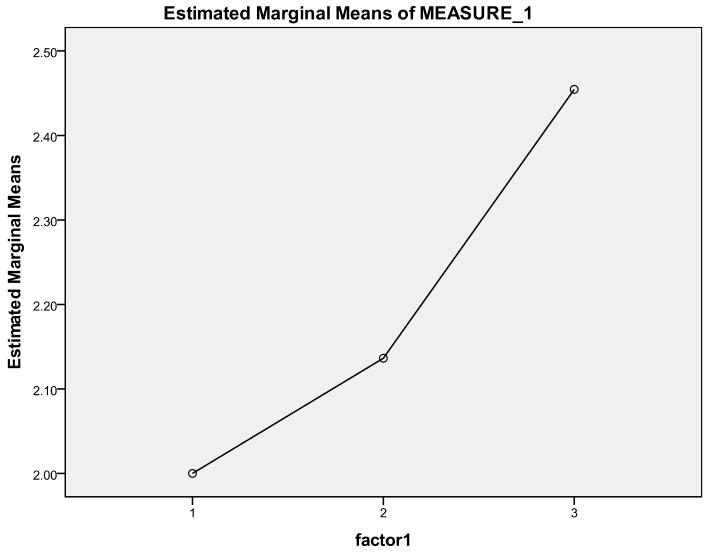
Measure:MEASURE_1

(I) factor1	(J) factor1	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	-.136	.203	.518	-.589	.317
	3	-.455	.207	.053	-.916	.007
2	1	.136	.203	.518	-.317	.589
	3	-.318	.236	.208	-.844	.208
3	1	.455	.207	.053	-.007	.916
	2	.318	.236	.208	-.208	.844

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

(1=Vegetable Alone, 2=Vegetable + Plain Dip, 3= Vegetable + Spice Dip)



(1=Vegetable Alone, 2=Vegetable + Plain Dip, 3= Vegetable + Spice Dip)

Figure 12. Plot of Vegetables Rated "just okay" Alone with the Addition of Dip

Hypothesis 2.c: Fruits and vegetables rated as "yucky" alone will have a higher rating when paired with a dip.

The impact of the addition of a dip to a vegetable that was previously established by the participants as "yucky" or disliked is demonstrated in Tables 67, 68, and Figure 13 below. The addition of a dip (plain or spice) to a vegetable previously disliked, increased children's acceptance of the vegetable significantly ($p<.001$). The addition of a spice dip increased the average liking from a value of 1 ("yucky") to a value of 2.58 (between "just okay" and "yummy").

Table 67. Descriptive Statistics: Vegetables Rated "yucky" Alone

	Mean	Std. Deviation	N
Vegetable Alone	1.0000	.00000	24
Vegetable Plain	2.0000	1.06322	24
Vegetable Spice	2.5833	.71728	24

Table 68. Pairwise Comparison: Vegetables Rated "yucky" Alone

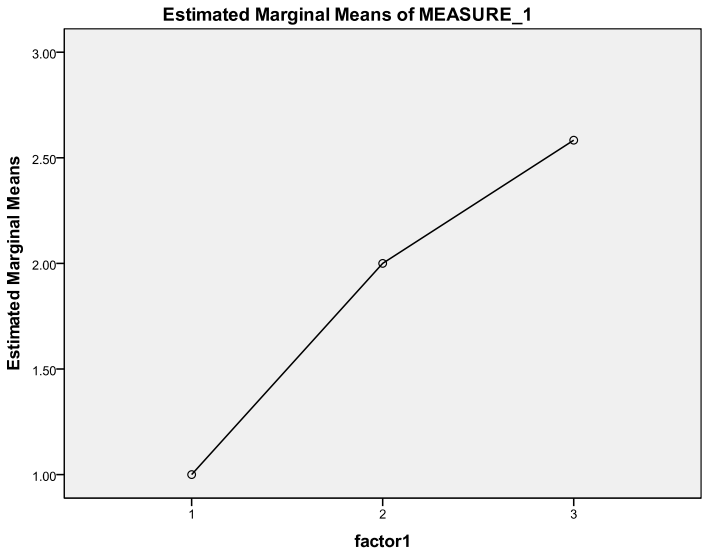
(I) factor1	(J) factor1	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	-1.000*	.217	.000	-1.449	-.551
	3	-1.583*	.146	.000	-1.886	-1.280
2	1	1.000*	.217	.000	.551	1.449
	3	-.583*	.208	.010	-1.013	-.153
3	1	1.583*	.146	.000	1.280	1.886
	2	.583*	.208	.010	.153	1.013

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

(1=Vegetable Alone, 2=Vegetable + Plain Dip, 3= Vegetable + Spice Dip)



(1=Vegetable Alone, 2=Vegetable + Plain Dip, 3= Vegetable + Spice Dip)

Figure 13. Plot of Vegetables Rated "yucky" Alone with the Addition of Dip

Research Hypothesis 3

3. Ha: The addition of a preferred spice dip improves the acceptability of the selected vegetables more than a plain dip.

To test the difference between the impact of a spice dip and a plain dip on children's level of acceptability of vegetables, three within group t-tests were performed. The independent variables for the test consisted of the ratings given to the vegetables plain, the ratings given to the vegetables with plain dip, and the ratings given to the vegetables with spice dip. The dependent variable was established by performing a difference score between the ratings of the vegetable with plain dip and the ratings given to the vegetable with spice dip. A separate within groups t-test was performed for each level of acceptability.

Hypothesis 3a.: Fruits and vegetables rated as liked alone maintain their rating with the addition of a spice dip

The t-test displayed in Table 69 revealed that the level of acceptability of vegetables rated as liked alone was greater with the addition of a preferred spice dip than with a plain dip. This average increase in acceptability of .42 was significant at $p<.05$.

Table 58. Difference in Acceptability of Liked Vegetables Spice vs. Plain Dip

	N	Mean	Std. Deviation	Std. Error Mean
spice3minusplain3	30	.4167	.85181	.15552

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
spice3minusplain3	2.679	29	.012	.41667	.0986	.7347

Hypothesis 3b.: Fruits and vegetables rated "just okay" alone have a higher rating when paired with a spice dip than with a plain dip.

The t-test displayed in Table 70 reveals that the difference in improvement between adding a spice dip to vegetables rated as "just okay" alone, and adding a plain dip to vegetables rated as "just okay" alone, was not statistically significant.

Table 70. Difference in Acceptability of "Just Okay" Vegetables Spice vs. Plain Dip

	N	Mean	Std. Deviation	Std. Error Mean
spice2minusplain2	11	.3182	.78335	.23619

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
spice2minusplain2	1.347	10	.208	.31818	-.2081	.8444

Test of Hypothesis 3.c: Vegetables rated disliked alone have a higher rating when paired with a spice dip than paired with a plain dip.

The t-test displayed in Table 71 demonstrates the significant increase in children's acceptability of vegetables rated as disliked alone when paired with a spice dip rather than the addition of a plain dip. The average increase in acceptability of vegetables established as yucky when paired with a spice dip rather than a plain dip is .58g, p=.01.

Table 71. Difference in Acceptability of Disliked Vegetables: Spice vs. Plain Dip

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
spic1minusplain1	24	.5833	1.01795	.20779

One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
spic1minusplain1	2.807	23	.010	.58333	.1535	1.0132

Phase 2: Consumption of Vegetables

Hypothesis 4: Consumption levels of fruits and vegetables are greater when paired with an herb and spice flavored dip, than when served alone.

To determine if the consumption levels of vegetables with a spice dip were greater than consumption levels of vegetables alone amongst 3-5 year old children, 2 within groups t-tests were performed.

Table 72 presents a t-test, testing the significance of the difference in consumption of celery with and without spice dip. The t-test below concludes that the average increase in consumption of celery of 9.7g consumed with a spice dip is significant at $p<.05$.

Table 59. Difference in Consumption between Celery with Dip and Celery without Dip

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Celdipminuscelnodip	27	9.7063	17.04536	3.28038

One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
celdipminuscelnodip	2.959	26	.007	9.70630	2.9634	16.4492

Table 73. Descriptive Statistics for Celery Consumed Alone and with Dip

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Celnodip	27	.25	52.51	15.6278	15.28835
Celwithdip	27	1.84	52.90	25.3341	18.17275
Celdipminuscelnodip	27	-19.01	51.82	9.7063	17.04536
Valid N (listwise)	27				

The test of the variance in consumption when presented with a preferred spice dip was replicated using yellow squash. Tables 74 and 75 below demonstrate that the increase in consumption of squash when paired with a spice dip is statistically significant at p=.001. The average increase in consumption was 8.78g when the squash was served with a preferred spice dip.

Table 74 Difference in Consumption between Squash with Dip and Squash without Dip

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Squash no dip – Squash dip	25	8.7748	12.13561	2.42712

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Squash no dip – Squash dip	3.615	24	.001	8.77480	3.7655	13.7841

Table 75. Descriptive Statistics for Squash Consumed Alone and with Dip

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Squashnodip	25	.00	54.24	6.3496	11.25256
Squashdip	25	.18	54.67	15.1244	14.67723
squashnodipminussquashdip	25	-7.85	52.78	8.7748	12.13561
Valid N (listwise)	25				

Chapter 5

DISCUSSION & CONCLUSIONS

Study Summary

This study, funded by the McCormick Science Institute explored the possibility of developing a series of good tasting vegetable and fruit dips low in fat, and calories, by flavoring the dips with herbs and spices. The McCormick Science Institute's research focuses include further evaluating the impact that herbs and spices have on dietary health. More specific to this project, the McCormick Science Institute is also interested in how herbs and spices can be used to benefit human health (McCormick Science Institute, 2009). These goals, in addition to the widespread evidence supporting that children between the ages of 2 and 5 are not consuming the USDA's recommended amount of fruits and vegetables, this study sought to develop of herb-and spice-enhanced dips that helped increase fruit and vegetable consumption among children.

The development of the fruit and vegetable dips began with the creation of a creamy neutral base. Features important to the base included a fairly neutral taste, low fat and caloric density, little or no viscosity (to prevent scooping), and the absence of artificial sweeteners. Dip varieties were then created by adding herbs and spices to the bases. The flavors created by the herb and spice combinations were refined and eventually led to the creation of four uniquely flavored vegetable dips (pizza, ranch, homemade, and garlic) and three uniquely flavored fruit dips (cinnamon, mint, and cardamom). Researchers then conducted a sensory analysis of four vegetable dips and three fruit dips; participants in the evaluation were 34 children between the ages of 3 and

5 attending the ABC Daycare Center in State College, Pennsylvania.

The children initially had a negative response to all of the dips; as a result, the recipes were reformulated to scale down the amount of seasoning in each dip. The Pizza and Ranch vegetable dips and the Cinnamon fruit dip were then reintroduced to the participants, who indicated their acceptability of vegetables and fruits alone followed by their acceptability of vegetables when paired with their preferred spice dip.

A second phase of the sensory analysis then evaluated the impact that the herbs and spices had on the children's consumption of fruits and vegetables. Pre- and post-consumption weights of samples (squash and celery) were taken in order to compare the amounts of vegetables children consumed both with and without their preferred spice dip.

Discussion of the Findings

Dip Development Process

Results of the dip development process demonstrated that it is possible to develop low-calorie, low-fat fruit and vegetable dips that consumers enjoy. Final formulations of the vegetable dips demonstrate that fat and calorie content can be reduced significantly by thinning dips with natural products such as milk. Reactions to the Ranch and Pizza vegetable dips also indicate that adding herbs and spices can enhance the flavor without adding calories. Using herbs and spices in the final formulations also enhanced the color of the fruit and vegetable dips.

The final formulations of the Pizza and Ranch vegetable dips and the Cinnamon fruit dip can serve as a model for easily preparing healthy, flavorful dips in the home,

thereby enhancing the possibility that children will consume more fruits and vegetables at home. It is important to note, however, that these dips could easily be offered in school cafeterias, daycare centers, restaurants and other public food outlets.

Phase 1: Acceptance of Vegetables

As discussed in Chapter 4, the effect of adding a dip (spice or plain) to a vegetable that is already accepted as liked or "yummy" by preschool-aged children does not significantly improve the rating of the dip. In fact, the addition of a plain dip significantly reduced the children's acceptance of a previously established "yummy" vegetable ($p<.001$). This suggests that when attempting to increase the likeability of vegetables that are rated high among preschool-aged children, serving them alone results in a greater level of acceptability.

Adding a dip to a vegetable previously established by preschool-aged children as being "just okay" without dip, increased the average rating of the vegetable preference. Vegetables rated a 2 (on a 1-3 scale) increased to an average rating of 2.14 with the addition of a plain dip and increased to 2.45 with the addition of a preferred spice dip. However, the increase was not found to be statistically significant ($p=.518$, $p=.053$). This again demonstrates that serving vegetables that are moderately liked by preschool aged children alone may not be significantly improved by adding a dip.

Vegetables rated "yucky" by preschool aged children when served alone showed a significant increase in acceptability when served with a preferred spice dip ($p<.001$).

Overall, comparing the addition of a dip (spice or plain) to a vegetable served without dip demonstrated that the greatest impact of a dip occurs when introducing a dip

to a vegetable for which children previously expressed distaste. Birch and Marlin express the importance of repeated exposure of foods to children in the development of food preferences (1982). If the use of a healthy dip can be used to increase children's acceptability and willingness to taste vegetables, the addition of a dip could aid parents and food providers in practicing repeated exposures of disliked vegetables to develop children's food preferences toward vegetables.

As the t-test scores in Chapter 4 indicate, the addition of a spice dip to a vegetable previously established as liked without a dip upholds the liked rating better than a plain dip ($p<.05$). The results also indicate that the addition of a spice dip to a vegetable rated "just okay" does not increase acceptance better than a plain dip at a statistically significant level. The difference between adding a spice dip and a plain dip to a plain vegetable rated as disliked alone revealed that the spice dip increased children's level of acceptance of the vegetable more than a plain dip ($p<.05$). These findings suggest that the addition of a spice dip has a greater influence on increasing consumption than does the addition a plain dip.

Phase 2: Consumption of Vegetables

The t-test in Tables 72 and 74 indicate that the improvement in consumption of both vegetables with the addition of a spice dip is statistically significant ($p=.001$). Table 72 shows that the average increase in consumption of celery with a spice dip was 9.7g; Table 74 reveals that the average increase in consumption of the squash when paired with a spice dip was approximately 8.4g. Although the addition of the spice dip did not increase consumption of either vegetable by a full serving (1/2 cup or about 55g), it is

important to recognize the magnitude of the increase compared to vegetable consumption without the dip. As shown in table 72, the average consumption of celery without dip was 15.6g. The average consumption of celery with the spice dip was 25.3g, showing a 62% increase in consumption. Similar results were found with the squash. The average consumption of squash alone was 6.35g while the consumption of squash with the addition of a spice dip was 15.12g, indicating that consumption more than doubled by adding the spice dip.

Conclusions

Low-calorie, low-fat vegetable and fruit dips that were also acceptable to children were successfully developed by adding herbs and spices to the dips. Using these flavor-enhanced dips to increase levels of acceptability and consumption of plain vegetables among children shows great potential. Adding dips to plain vegetables showed statistically significant increases in acceptability of disliked vegetables ($p<.001$). With the addition of providing a low energy method of increasing flavor and color to the vegetable dips, the herb and spice flavored dips improved acceptability of both liked and disliked vegetables better than the plain dips ($p<.05$). Pairing disliked vegetables with a spice dip resulted in increased consumption levels of the vegetables ($p<.05$). As a result of this study, a series of fruit and vegetable dips capable of increasing the acceptability and consumption levels of disliked fruits and vegetables now exists. These low-fat, low-calorie dips were made of ingredients and methods easily applicable to home food providers.

Recommendations for Future Research

This study reveals the potential that exists for using herbs and spices to increase the acceptability and consumption of fruits and vegetables. The development of additional dip formulations and experimentation with dry herbs and spices are two areas that could be explored in order to expound upon the work that was completed for this study. The development and evaluation of additional dip formulations would be valuable in determining whether other dip flavors would further improve the acceptability of fruits and vegetables among children.

Another possible improvement would be to eliminate particulates from the dips. Although all of the herb and spice mixtures were ground through a grinder prior to their addition to the dip bases, the particulates in mixtures containing herb leaves were not ground to a dust. Additionally, using children as panelists rather than adults during the development phase would be extremely informative and useful in creating dips that are more acceptable to children.

Other potential options include the creation of a legume-based spread flavored with herbs and spices. In addition to pairing well with herbs and spices, the nutritional composition of legumes (high in protein and low in saturated fat) makes them an advantageous alternative. Using a legume base for the dips would prevent a need to thin the dip drastically because consuming both the dip and the vegetables would provide significant health benefits.

Using herbs and spices as a sprinkling seasoning is also a possibility worth exploring. This alternative would add little or no calories to the vegetable being

consumed and would be virtually prep free. Having herb and spice seasoning mixtures that kids could themselves control also introduces and element of play to the equation. Packaging the herb and spice mixtures in hand-operated grinders could be another idea worth exploring. Consumption levels of vegetables and fruits of children using the spice grinder as opposed to the consumption levels of children not using the grinders could be compared To determine the impact that children controlling some or all of their entire snack has on consumption levels.

The positive results of this study not only have ramifications on the primary food providers in the family setting, but may also have ramifications for public foodservice settings as well. If herb- and spice-enhanced dips can increase children's consumption of vegetables, then restaurants may want to consider adding these dips to their children's menus. As the proportion of vegetables increase, the proportion of the meal derived from animal protein and starchy sides decrease, thereby creating a more balanced meal for children.

Although this study focused primarily on the fruit and vegetable intake of children between the ages of 2 and 5, research suggests that fruit and vegetable consumption amongst adolescents falls below the USDA's recommendations (USDA & ARS, 1999). Conducting food acceptance testing of the formulated dips on adolescents in school cafeterias could lead to increased vegetable consumption. Specifically, testing the impact of preferred spice dips on vegetables chosen by adolescents at salad bars would be of interest, as dressings offered at salad bars often are high in calories and fat.

This study shows that vegetable consumption can be increased among children

between the ages of 2 and 5 by pairing vegetables with herb- and spice-enhanced dips. The work completed in this study serves as a foundation for many applications in which the impact of herbs and spices on vegetable and fruit consumption can be evaluated.

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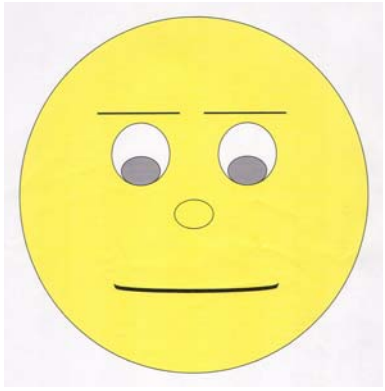
APPENDIX

Smiley Face Scale

Yummy = 3



Just Okay = 2

Yucky = 1