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The Preference of Protein Powders Among Adult Males and Females: A Protein Powder Taste Study

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A Protein Powder Taste Study

by

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Table of Contents

List of Tables

List of Figures

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ABSTRACT

Protein is essential in one's diet because it is an important component in many organs and tissues throughout the body. Athletes ingest protein in order to stimulate protein synthesis and increase lean muscle mass. In order to assist with obtaining adequate amounts of protein, athletes and bodybuilders purchase supplemental protein in the form of protein powders. Protein metabolism and digestion play key roles in this because if the protein is not metabolized or digested effectively, then those who are wishing to gain fat free mass will not be successful. A high quality protein will be digested, metabolized, and directed towards lean tissue accretion more efficiently than a lower quality protein. In order to be a high quality protein, it must contain the essential amino acids. Fortunately, whey protein is a high quality protein because it contains an abundant supply of the essential amino acids.

Whey protein is a high quality protein; hence, many athletes and physically active individuals purchase whey protein supplements. Some individuals do not care about taste and overcome awful protein powder taste, while others value a good tasting whey protein. After extensive research, it appears that scientific taste tests on protein supplements are lacking. The purpose of this study was to test some of the most popular protein supplements (Muscle Milk, BSN, Nesquik Vanilla Milk and Optimum Nutrition) and discover which one tasted the best.

In this study, there were 94 males and 68 females. The results showed that there was a difference in initial taste and after taste in protein supplements among a male and female population. The difference among the drinks was statistically significant. The findings showed that both genders thought BSN and Muscle Milk were close to “neither good nor bad” while Nesquick Milk was rated as “good” and Optimum was “bad.” The initial taste ratings were BSN (mean=4.05; SD=1.7), Muscle Milk (mean=4.6; SD=1.8), Nesquick Milk (mean=5.4; SD=1.2), and Optimum Nutrition (mean=3.1; SD=1.6).

This research study showed that there was a statistically significant difference in taste among protein drinks, but the results do not answer as to why that is. Future research would need to be conducted in order to find the answer as to why there is a difference in initial and after taste.

Chapter One

Introduction

Protein is essential in one’s diet because it is found in many organs and tissues throughout the body. Athletes ingest protein in order to stimulate protein synthesis and increase lean muscle mass. Research suggests that people should consume around 1 gram per kg of body weight (Pasquale 2009). In order to assist with obtaining adequate amounts of protein, athletes and bodybuilders purchase supplemental protein in the form of protein powders.

Protein metabolism and digestion play key roles in this because if the protein is not metabolized or digested effectively, then those who are wishing to gain fat free mass will not be successful. Protein digestion is essentially how the protein gets from the mouth to the blood stream, and metabolism is how the protein gets from the blood stream to its many endpoints. In order for protein to be digested, metabolized, and directed towards lean tissue accretion, it must be a high quality protein. Therefore it must contain the essential amino acids. Whey protein is a high quality protein because it contains an abundant supply of the essential amino acids. Unfortunately, many whey proteins are known as having a poor taste yet individuals continue to drink whey protein.

In regards to taste, the tongue has many taste buds which are made up of epithelial cells. Small hairs known as microvilli protrude from the taste buds, and these hairs essentially provide the sense of taste. According to Guyton (2000), taste preference is a result from a mechanism in the central nervous system. Guyton fails to explain what the mechanism exactly is or how to find it. Research does not show one “thing” which solely determines taste preferences. One can infer then that taste preference will in large part be subjective. Taste could also be due to previous experiences that could have been related to emotional issues. There have been taste test studies done on water, milk, iced tea, and donuts; however, it appears that there has yet to be a taste study on protein powders.

Purpose of the Study

Whey protein is a high quality protein; hence, many athletes and physically active individuals purchase whey protein supplements. However, is it possible some whey proteins taste better than others? After extensive research, it appears that scientific taste tests on protein supplements are lacking. The purpose of this study is to test the some popular protein supplements (Muscle Milk, BSN, and Optimum Nutrition), and Nesquik vanilla milk and discover which one tastes the best.

Independent and Dependent Variables

The independent variable for this study will be the protein drink with the four different types. Dependent variables will be the initial taste and the after taste measured on a 1-7 point scale.

Null Hypotheses

Ho_1: There will be no difference in the initial taste of the protein supplements.

Ho_2: There will be no difference in the aftertaste of the protein supplements.

Chapter Two

Review of Literature

Fundamentals of Protein

Protein is found in tissues, muscles, organs, bones, hormones, antibodies, and many other parts in the body. Because protein is a structural component of so many areas, it is impossible for the body to possess functional integrity without it. In addition, there are eight amino acids (isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine) that are categorized as "essential" in the adult. The following sections will present a discussion of protein's function, what it is comprised of, and what types of proteins are the most beneficial for health.

Protein is an organic compound that is found in almost every cell of the human body. The building blocks of protein are amino acids. For amino acids to make protein, their peptide linkage must bond together to create a chain. These chains are what make proteins and what gives them different characteristics. There are several different types of protein with many different functions.

Simple proteins are made up of only amino acids, and some of them include albuminoids, glutelins, and prolamines (Pasquale, 2009). Conjugated proteins are bound together with several different non protein substances. Some of these include chromoproteins, lipoproteins, and nucleoproteins (Pasquale 2009). In addition, a protein's structure can determine where they will be assigned in the body. Some are round while many are simply long chains which are bound together.

Functions of Protein

Even though there are several different types of proteins, all of them are limited to four specific functions. The first is growth because protein can help create many different types of tissues in the body. Maintenance is another function. Since the body is breaking down, it needs to try and restore itself so protein turnover helps that process. Proteins also help regulate functions throughout the body; it could be in tissues, the blood, or hormones. The last function is energy; the breakdown of amino acids help create energy within the body. These four functions are vital to sustaining muscles and life. If protein did not perform these functions, muscles would not work therefore one's body would not be able to function properly, or even worse, life would not be possible.

Protein Requirements

It is very apparent that protein is necessary for life, yet it seems that there are several different opinions as to how much protein one should consume. Everyone has a different protein requirement because their bodies have a different turnover rate of amino acids and nitrogen requirements. Some nitrogen is not retained in the body and is excreted in various ways (i.e., urine); therefore one must consume enough protein to maintain this balance.

Therefore, protein requirements are more of estimations unless extensive tests are done on each individual person. In reference to the recommended daily allowance of protein Pasquale states the normal amount of protein recommended for sedentary people is .8 g of protein per kilogram of body weight per day. As for athletes, they need to consume more protein; RDA's for strength and endurance athletes varies from 1.2-1.8 g/kg/day (Pasquale 2009). In 1990, Gattas performed a nitrogen balance study on prepubertal school age boys and discovered that 1.2 g/kg/day of protein should be enough to maintain protein balance. Rand conducted a meta analysis in 2003 of nitrogen balance studies for protein requirements. His results stated that for healthy adults, they need between .63 and .85 g/kg/day of good quality protein. Lastly, Layman wrote a review article in 2004 which stated that people can take up to 1.5 g/kg/day or more and doing so it is very helpful with weight loss. Therefore, the previous research shows that one can consume anywhere between .63 and 1.5 g/kg/day. These requirements vary quite a bit since everyone's bodies are different. Since most research states around 1 g/kg/day is enough that is most likely a safe estimate for an adult who is moderately active to use.

Amino Acids

Amino acids are the building blocks of protein, which makes them vastly important. Of the 22 amino acids, the body can produce 14, which means the other eight must be ingested by food or supplements. These eight amino acids (isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine) are called essential amino acids. Three of the essential amino acids (isoleucine, leucine, and valine) are known as branched chain amino acids (BCAAs) because they have a carbon chain which extends from the central carbon backbone. Also, the BCAAs are important with protein synthesis.

In 2003, Rieu et al. conducted a leucine supplementation study on rats to see its effects on protein metabolism. It was reported that leucine supplements after a meal aided protein metabolism in adult and old rats. Another study done on the essential amino acids (EAA) showed positive results as well such as Borsheim et al. in 2000. They performed a study on humans, and discovered that ingesting 6 g of EAAs post exercise increased net protein balance, thus displaying that supplemental EAAs have a positive effect on protein metabolism. Now that one has an understanding of protein and amino acids, they can build upon that foundation and move on to more difficult concepts such as protein digestibility and metabolism.

Protein Digestion

The digestion of protein could simply be described as the process of how the protein goes from the mouth and eventually ends up in the blood. Pasquale (2009) defines protein digestion as:

> "the mechanical, chemical and enzymatic breakdown of the protein in food into smaller units. Digestion involves several stages including the mechanical extraction of the protein from the food, denaturation of the protein, and hydrolysis of the peptide bonds. Protein is mechanically extracted from the food in the process of mastication and by the action of the stomach."

Summarizing Pasquale, digestion breaks down the proteins into amino acids by breaking apart the peptide bonds, which allows them to either be absorbed in the body or broken down more and eventually excreted through the urine. The way protein is digested and how much the body absorbs is mainly dependent upon the quality of the protein.

Protein Quality

Giliani et al. states, "the quality of a dietary protein is determined by the pattern and concentration of indispendable or essential amino acids, the protein digestibility, and the bioavailability of its amino acids" (Giliani et al. 2008). Currently, there are several different measures of protein quality. The five most often used methods of assessing protein quality are the Protein Digestibility Corrected Amino Acid Score (PDCAAS), the

Amino Acid Score (AAS), the Protein Efficiency Ratio (PER), the Biological Value (BV), and the Nitrogen Protein Utilization method. The PDCAAS is used the most of these five methods because it is simple, and it asses protein digestibility in humans very well (Pasquale 2009). The PER is not very reliable because it is a test which is used on rats. The BV measures the input and output of nitrogen, but it is difficult to account for every loss and gain of nitrogen in the body therefore scientists do not have a lot of confidence in it. The PDCAAS has essentially been adopted has the primary means of measuring protein quality. (Schaafsma et al. 2000).

The PDCAAS is based upon a score of 0.0 to 1.0. A protein with a score of 1.0 is considered to be a complete protein, which contains the essential amino acids. The formula used for finding the PDCAAS score is limiting amino acid in 1 g of test protein divided by same amino acid in 1 g of reference protein times true fecal digestibility (Schaafama et al. 2000). Proteins such as whey, whole egg, casein, and soy protein concentrate have a score of 1.0 (Pasin & Miller 2000). In 2003, a protein quality study was conducted on rats to see if the quality scores would be the same as for humans (Giliani et al. 2003). The results showed that the PDCAAS scores were higher compared to human subjects. Therefore using rats for measuring protein quality cannot be compared to humans, unfortunately.

Even though the PDCAAS is the most common used method to measure protein quality, there are several research studies stating that the method needs to be improved because it has its limitations (Darragh et al. 2000; Schaafsma 2000; Gilani et al. 2008; Sarwar 1997). One of the main complaints is that if any protein has a score greater than 1.0, it is rounded back down to 1.0 (Giliani et al. 2008). It appears that many are ignoring these limitations because the PDCAAS is still used often for measuring protein quality and will continue to be unless someone creates something better.

The digestion of protein relies heavily on the quality of the protein. Once protein is digested, it will go to the blood and from there travel to many different end points, which is determined by metabolic needs. Protein is broken down to amino acids by the time it reaches the various end points. The amino acids can either be absorbed by the body in skeletal muscle, the amino acid pool, different tissues, etc. or it will be excreted through the urine.

Protein Metabolism

Nitrogen retention is often used to measure protein metabolism because if the protein is not absorbed in the body, the amino acids are catabolized and the nitrogen is excreted through the urine. Nitrogen is a main component of amino acids thus protein as well. Therefore if nitrogen is in the urine, then the amino acids and proteins are not staying in the body. "The primary site for degradation of most amino acids is the liver. The liver is unique because of its capacity to degrade amino acids and to synthesize urea for elimination of the amino nitrogen" (Pasquale 2009). One apparent problem however is that there is a wide array of opinions as to what exactly determines protein absorption; it seems as if no one knows the exact answer. One study believes that the pattern and kinetics of amino acids play a major role in absorption (Fouillet et al. 2002). There have been many studies done on protein absorption which used nitrogen retention to test it, but no one appears to have a definite answer as to why some protein is absorbed and some is not.

Garlick et al. wrote a review article in 1999 on protein metabolism and nitrogen retention. Their findings were vague but provided some useful information. They concluded that people can go from a low protein intake to a high protein intake, and their body will adapt by retaining more protein, which was shown through urine tests. However, they did state that they were not sure how long this retention period lasts, and if it will continue at this higher level. Therefore, they advocate a higher protein intake because it will result in greater retention, but they are not sure if this retention is a permanent change or not. Previous studies also agree with Garlick et al. that nitrogen balance will remain positive when protein intake is increased. (Pannemanns et al. 1993, Todd et al. 1984).

According to Dangin et al. (2001), the digestion rate of protein is a factor in retention. In their study, they compared whey and casein protein by administering these types of protein in liquid form to their subjects. They discovered that casein had a better retention rate, which was measured through leucine balance which in turn measured the nitrogen balance. They believed the casein absorbed better because it has a slower digestion rate. In their conclusion, they state that age can also have an effect on nitrogen retention, and other tests need to be done on different age groups and populations to see if the results will be the same.

Two older studies provide interesting views on what causes nitrogen retention. Kies et al. (1964) makes a strong case that essential amino acids play a huge role in nitrogen retention. Their study showed that when individuals took a supplement of essential amino acids, their nitrogen retention was better than those who did not take the supplement. Leverton et al. (1949) did a preliminary study on how time of ingestion may affect nitrogen retention. Their results were astounding. One group of subjects was required to eat protein at every meal while another group was required to skip protein at breakfast. They discovered that there was greater nitrogen retention when subjects would eat animal protein at every meal compared to those who did not. In the end, one can see that nitrogen retention is a good method to measure protein balance in the body, unfortunately there does not seem to be a consensus as to why some protein is absorbed and some is not.

The processes of protein metabolism and digestibility are important to those who take protein supplements because customers will want proteins that digest quickly and efficiently. This creates a question however as to why some people enjoy the taste of certain brands of protein while they dislike other brands. Is it possible to determine what causes one to like a certain name brand of protein yet dislike another commercial brand? Everyone experiences taste, and everyone has taste preferences, which is why some people enjoy certain protein brands compared to others.

The Tongue

The taste buds on the tongue determine whether one perceives something to taste sour, salty, sweet, or bitter. Taste buds are made up of about 50 epithelial cells, and these cells are essentially what cause taste. These cells have small taste hairs, also called microvilli that protrude from the cells and provide the surface for taste. According to Guyton (2000), taste preference results from a mechanism located in the central nervous system and not from the taste receptors themselves. There does not seem to be any scientific facts that there is one certain “thing” that causes one to enjoy a certain taste. Therefore, taste preference is subjective and will be different for every person.

Taste Studies

There has been several research studies conducted on taste and taste preference; studies have measured taste preference with milk, iced tea, water, and donuts. These studies provide excellent guidelines and a framework to follow for future taste studies. Bordi et al. (2008) performed a study with a repeated measures design on donuts to compare the taste of trans-fat and trans-fat free donuts. Participants ate donuts that were cooked in trans-fat shortening and trans-fat free shortening. The participants were students and faculty from a northeastern university, and they agreed to participate after receiving an email in regards to the study. The participants sat in individual booths and were given three different donut samples to evaluate the taste. The donuts were created with three different types of shortenings to see if trans-fat free shortenings had a different taste. Taste was rated on a 7 point hedonic scale (1= dislike very much; 7= like very much). The results showed that there was not a statistical difference between the different donuts' taste. Therefore, the study showed that donuts with trans-fat free shortening can be used instead, which has significant health implications.

Vickers et al. in 1998 carried out a taste study on a beverage instead. They wished to discover if a laboratory or foodservice setting would influence the taste ratings of milk. Students from a local university drank the milk in a foodservice setting, while a group of participants drank the milk in a laboratory setting, and the results were compared to one another. The students who were in the food service setting were not aware a taste study was occurring. The researchers measured the amount of milk in the machine before dinner and after dinner, and their results were based off of how much milk was consumed. They placed 2% milk in the machine on certain evenings, and on the other nights, they used an off-flavored milk. After 16 days, they compared how much milk was consumed on the different nights. They stated approximately 300 students owned meal contracts and roughly 35 to 75 students consumed milk at dinner.

In the laboratory, 39 participants drank the 2% milk and the off-flavored milk. The taste of the milk was rated on a 9 point hedonic scale (1= dislike extremely; 9= like extremely). The researchers used ANOVAs to determine if the amount of milk consumed or the likings ratings were related to the type of milk. It was not stated how much milk they were told or allowed to consume. The results showed that roughly the same amount of milk (20 Kg) was consumed in the lab and food service setting.

In 2004, Koseki et al. conducted a taste study on water which had various concentrations of hardness. The participants were 108 female junior college students who ages ranged from 19-20. They were not given any instructions in regards to breakfast, lunch, dinner, or tooth brushing before the test. Ten samples of bottled water were given to the participants and the water was evaluated in terms of 5 grades- very good tasting, good tasting, neither, bad tasting, very bad tasting (+2, +1, 0, -1, -2). The participants were told to drink the different waters in any order they choose; the room and sample temperatures were both 75.2 degrees Fahrenheit. In addition, participants judged the water on aftertaste, bitterness, sweetness, and overall impression of the water using the same scale. The results were how each water concentration was rated for taste, and with that rating, it was compared to the other concentrations. This study would be good for future studies to follow because of the 5 point rating scale they used for taste and because they tested aftertaste as well.

Purpose of the Present Study

After searching the literature on this topic, it appears evident there is no published research conducted on taste testing and protein supplements. Therefore, there is a need to perform a taste test study on popular protein supplements. The previous taste test studies will be used as a guide for this study in order to ensure this study is designed adequately and carried out in an effective manner. The goal of the proposed study is to see which brands (BSN, Muscle Milk, Nesquick Vanilla Milk, and Optimum Nutrition) have the best taste.

Chapter Three

Methods

Study Design

The study design was a quantitative, non-experimental design.

Participants

In this study, there were 162 participants (94 males, 68 females). The average age of the males was 21.9 (*SD*=3.3) and the average age of the females was 21.4 (*SD*=2.8). The average weight and height of the males was 177 pounds (*SD*=33.2) and 70 inches (*SD*=3.0), respectively. The average weight height and height of the females was 136 pounds (*SD*=25.5) and 64 inches (*SD*=2.7). In order to participate in this study, participants had to be physically active individuals, not allergic to milk or wheat, and between the ages of 18-25. Physically active was defined by either being active at least 3 hours per week or active 2 days per week. Participants were students from the University of South Florida, and out of convenience, most were recruited in the campus recreation center. They were personally asked in the recreation center to participate or they responded to the posted flyers in the recreation center about the study. Participants initially signed a consent form to be a part of the study. Participants were blinded to the protein supplements that were used during the study.

Screening

Participants were screened before they participated. They were asked the initial screening questions (appendix #1) in person to make sure they qualified for the study. The only questions on the initial screening form that made one eligible for the study was if they were physically active, not allergic to milk or wheat, and between the ages of 18-25. They were also asked on the screening form if they had purchased protein powders in the past. The researcher was interested in determining if familiarization might play a role in affecting one's taste.

Materials

The necessary materials were 3 oz cups, three blenders, and the four different types of protein drinks (™Nesquik, Muscle Milk, Optimum Nutrition, and BSN- see appendix #3 for nutritional info). Dish soap was used along with a scrub brush to clean out the blenders after they had been used.

Testing Protocol

Participants were required to come to the lab on the lower floor of the recreation center 2 times within approximately one week, and they were asked to not to ingest any food an hour before testing. Out of 162 participants, 115 students returned for a second visit (70% return rate).

<u>Testing Session #1</u>: After signing the informed consent form, participants were given the four protein supplements in a randomized order. The website psychicscience.org was used to generate the randomized order for the drinks. The drinks were made with bottled water, which was kept refrigerated, and the blenders were used to create the drinks. The participant was blinded to the preparation of the protein supplements. The blenders were turned on at the lowest setting for 30 seconds. The drinks were put in a small 3 oz cup. The participants drank each supplement and answered a questionnaire (see appendix C) on the initial taste and the aftertaste after each individual drink. The rating for each drink was "very bad", "bad", "slightly bad", "neither

good nor bad", "slightly good", "good", "very good", which was recorded as 1 "very bad" to 7 "very good" for data analysis (See appendix C for example of rating form). The participants were given 15 seconds after their taste of each drink to rate the initial taste. After another 15 seconds the participants were asked to rate the aftertaste. Therefore, within 30-45 seconds, the participant rated the initial and aftertaste of each drink. The participants either took several sips or drank all 3 oz before providing their opinion of the taste. During the pilot study, the participants found the 7 point scale and the instructions easy to understand. Participants were provided water if they wished to rinse their mouth in between drinks. Once the participants had tasted each protein drink and filled out the questionnaire for each drink, they were free to go until the next time they returned to the lab.

Testing Session #2: This session was identical to testing session #1, except the randomization of the drinks was different.

Data Analysis

Data were analyzed via a 2x4 repeated measures design with gender as a between-subjects factor and protein as a within-subjects factor utilizing SPSS 15.0. Criterion for significance for all tests was set at $p < .05$.

Chapter Four

Results

Familiarization

Out of the 94 male participants, 54 purchased protein on a regular basis (57%). Only 8 of the 68 females purchased protein on a regular basis (12%).

Initial Taste Data

Mean scores for the initial tastes of the protein beverages are as follows: the mean score for drink #1 (BSN Syntha-6) was 4.05 (*SD*=1.7), the mean score for drink #2 (Muscle Milk) was 4.6 (*SD*=1.8), the mean score for drink #3 (Nesquik Vanilla milk) was 5.36 (*SD*=1.2), and the mean score of drink #4 (Optimum Nitro Core) was 3.13 (*SD*=1.5). The amount of variability in the ratings, as measured by the standard deviation, was similar across the four drinks, and the range for each drink was 6. The mean rating for drink 1 was at the "neither good nor bad" point on the rating scale, rating for drink 2 was approaching "slightly good" good point, drink 3 was right on the "slightly good" point, and drink 4 was closest to "slightly bad" on the rating scale. There was an overall significant difference ($p < .05$) between the four protein supplement beverages (the p-level for each was 0.00). Post hoc paired *t*-tests corrected for alpha inflation (Bonferroni correction) were utilized for identifying the specific differences. Figure one highlights these significant differences. Nesquik Vanilla milk was rated the most positive in taste followed by MM, BSN and Optimum. H_{o1} stated that there would be no difference in the initial tastes of the protein supplements. Due to the observed statistical differences between the protein supplements, we reject H_{01}. (see appendix D for more data on visit one initial taste)

Aftertaste Data

The results of the After Taste Visit 1 had similar results. Mean scores for the protein are as follows: the mean score for drink #1 (BSN Syntha-6) was 4.06 (*SD*=1.4), the mean score for drink #2 (Muscle Milk) was 4.28 (*SD*=1.7), the mean score for drink #3 (Nesquik Vanilla Milk) was 5.08 (*SD*=1.3), and the mean score for drink #4 (Optimum Nitro Core) was 3.07 (*SD*=1.6). There was an overall significant difference ($p < .05$) between the four protein supplement beverages, and the score for each was 0.00. Post hoc paired *t*-tests corrected for alpha inflation (Bonferroni correction) were utilized for identifying the specific differences. Figure two highlights these significant differences. Again, Nesquik Vanilla milk was rated the most positive in taste followed by MM, BSN and Optimum. H_{o2} stated that there would be no difference in the aftertastes of the protein supplements. Due to the observed statistical differences between the protein supplements, we reject H_{02}. (see appendix E for more data on visit one aftertaste)

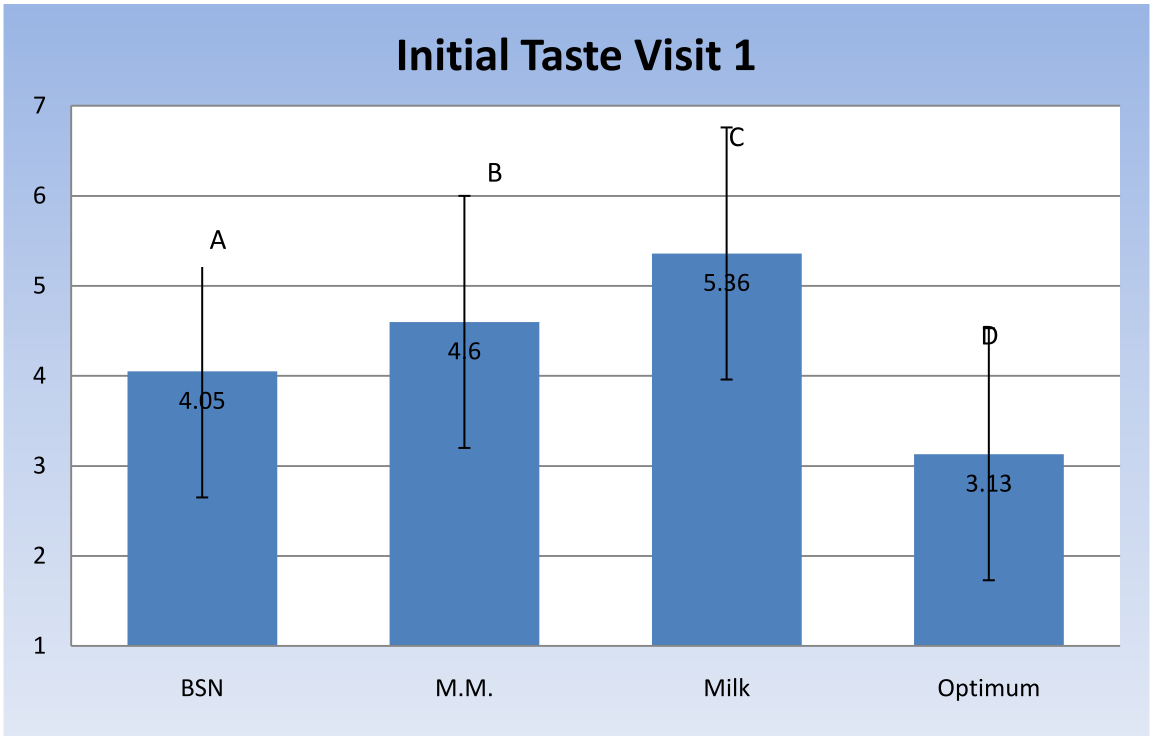

Figure 1 – Mean taste scores for each of the protein supplements. Differences between values with uncommon letters (e.g., A,B, C) are statistically significant at p < .05. *SD* for BSN =1.7, *SD* for M.M.= 1.8, *SD* for Milk= 1.2, and *SD* for Optimum= 1.5.

Correlation and Reliability between First and Second Visits

Unfortunately during the data collection, not all of the participants came back for a second visit. Out of the 162 participants, 115 came back a second time (representing a 71% return rate). 60 of the 94 males returned for a second visit (64% return rate), and 55 of the 68 females returned (81% return rate). The reason for the second visit was to be sure the rating scores correlated from the first to second visit. There was a highly significant correlation ($p < .05$) for the four protein supplement beverages when comparing the first and second visits. This was true for the initial tastes and after tastes. The correlations (i.e., reliability) were not very strong, however. For initial taste visit one to visit two, the correlation between the ratings for the first and second visits for BSN was .37, for Muscle milk .50, for Nesquik Milk .34, and for Optimum .40. For aftertaste visit one to visit two, the correlation between the ratings for the first and second visits for BSN was .36, Muscle Milk .51, Nesquik Milk .35, and Optimum .49. (see appendix F for graph of data)

The correlations between initial taste and aftertaste were much stronger compared to visit one to visit two. For initial to aftertaste of visit one, BSN's correlation was .75, Muscle Milk .82, Nesquik Milk .78, and Optimum .83. For initial to aftertaste at visit two the correlation between the two ratings for BSN was .74, Muscle Milk .75, Nesquik Milk .77, and Optimum .81 (see appendix G for table of correlations).

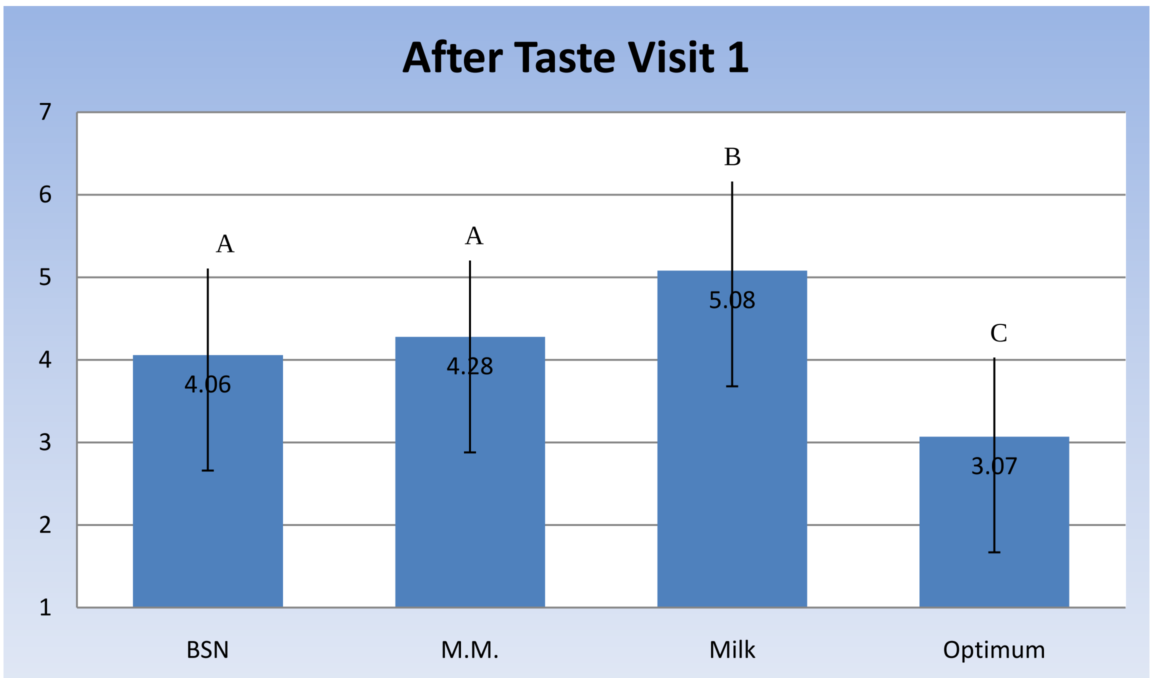

Figure 2 – Mean taste scores for each of the protein. Differences between values with uncommon letters (e.g., A,B,C) are statistically significant at $p < .05$.

Males vs. Females

In regards to initial taste ratings at visit one, the males rated BSN at 4.14 (*SD*=1.6) while the females rated it 3.93 (*SD*= 1.8). The males rated Muscle Milk at 4.9 (*SD*=1.8) and the females at 4.19 (*SD*=1.8). The males rated Nesquik milk at 5.33

(*SD*=1.3) and the females gave it 5.41 (*SD*=1.2). The males gave Optimum a 3.37 (*SD*=1.5) rating and the females gave it at 2.79 (*SD*=1.7) rating. For males and females the order of taste preference was the same. Nesquik Vanilla milk was rated the most positive in taste followed by M.M., BSN and Optimum. Figure 3 highlights these data.

As for the aftertaste, the males gave BSN a rating of 4.11 (*SD*=1.4), and the females a rating of 4.0 (*SD*=1.6). For Muscle Milk, the males gave it a rating of 4.54 (*SD*=1.6) and the females a rating of 3.93 (*SD*=1.7). For Nesquik milk, the males gave it a rating of 5.07 (*SD*=1.4) and the females a rating of 5.09 (*SD*=1.1). For Optimum, the males gave it a 3.21 (*SD*=1.6) and the females a 2.88 (*SD*=1.6). The order of preferences was nearly the same. Nesquik was rated the most positively in taste for males and females and Optimum was rated the least positively, BSN was rated slightly higher than Muscle Milk for the females. Figure 4 highlights these data.

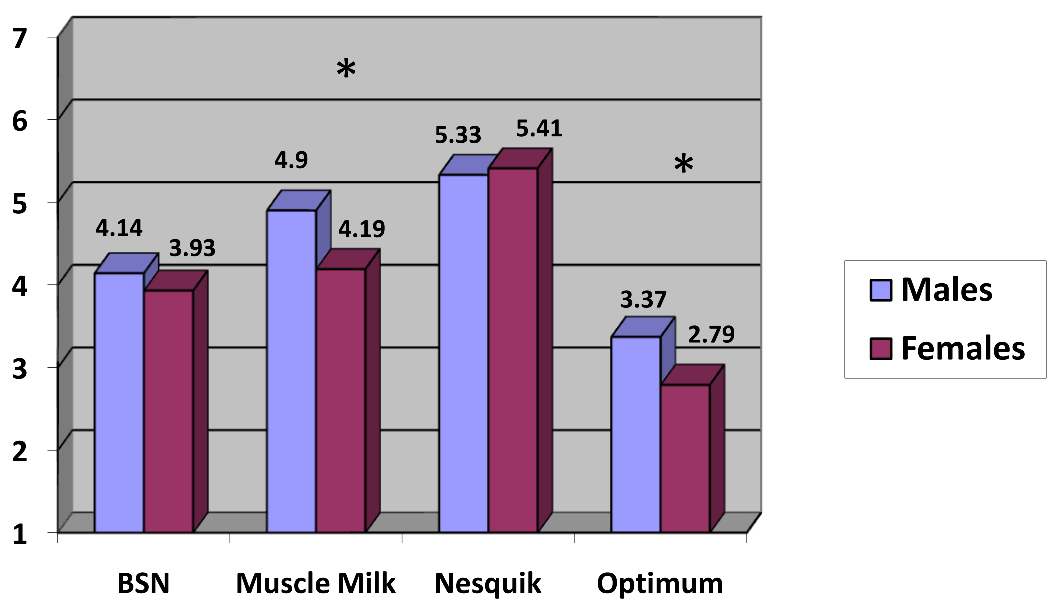

Figure 3. Males vs. Females Initial Tastes. * - denotes a significant statistical difference from Independent sample t test.

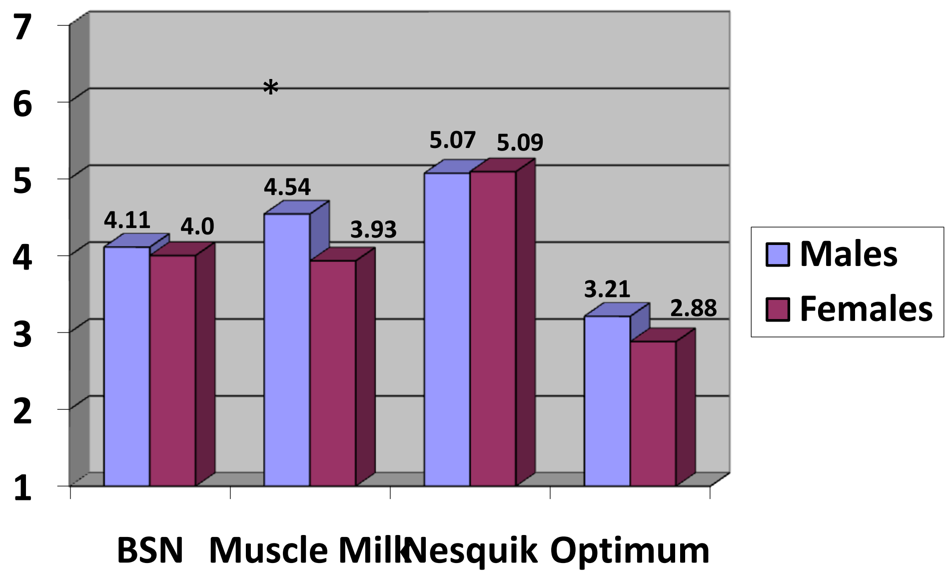

Figure 4. Males vs Females Aftertaste. * - denotes a significant statistical difference from Independent sample t test.

As for the ratings of the second visit, the males rated the initial taste of BSN at 4.44 (*SD*=1.7) while the females rated it 4.27 (*SD*= 1.6). The males rated Muscle Milk at 4.42 (*SD*=1.5) and the females at 4.15 (*SD*=1.6). The males rated Nesquik milk at 5.06 (*SD*=1.3) and the females rated it 5.46 (*SD*=1.4). The males gave Optimum a 2.84 (*SD*=1.6) rating and the females gave it a 2.52 (*SD*=1.3) rating. For males and females the order of taste preference was the same. Nesquik Vanilla milk was rated the most positive in taste followed by M.M., BSN and Optimum.

As for the aftertaste of the second visit, the males gave BSN a rating of 4.52 (*SD*=1.4), and the females a rating of 4.2 (*SD*=1.4). For Muscle Milk, the males gave it a rating of 4.15 (*SD*=1.4) and the females a rating of 3.83 (*SD*=1.6). For Nesquik milk, the males gave it a rating of 4.84 (*SD*=1.2) and the females a rating of 5.00 (*SD*=1.3). For Optimum, the males gave it a 2.95 (*SD*=1.5) and the females a 2.58 (*SD*=1.2). The order of preferences was nearly the same again. Nesquik was rated the most positively in taste for males and females and Optimum was rated the least positively, BSN was rated slightly higher than Muscle Milk for the females.

Chapter 5

Discussion

The results of the study showed that Nesquik Vanilla milk was the most favored among the four drinks. Muscle Milk was a close second, followed by BSN, and Optimum was at a distant fourth. These results were consistent with the initial taste and aftertaste of visit one and visit two. As for the comparison of males vs. females, both genders preferred Nesquik the most then Muscle Milk and BSN, while Optimum was the least favored.

Comparison of the Present Study to Other Taste Test Studies

Due to this study being the first of its kind, the goal of the researchers was to determine if there were differences in the tastes of protein supplements. As stated in the review of literature, taste is based upon the working of the Central Nervous System; therefore each person's CNS could perceive taste differently (Guyton, 2000)

The methodology from this study was very similar compared to other taste studies previously done (Koseki et al., 2000; Bordi et al., 2008). The main difference was that Koseki et al. (2000) used a five point scale for rating the test compared to this study and Bordi et al. (2008) used a 7 point scale. The 7 point scale allowed for the scores to be spread apart more which in turn showed which drinks were rated more highly (refer to Appendix C). The present study utilized some of the strong points of the previous taste studies and added a second trial to confirm the reliability of the taste test scores.

One of the methods that was followed was testing for aftertaste, and Koseki et al. (2005) tested aftertaste in their study on hard water. They used a 5 point scale for rating the taste compared to Vickers et al. (1999) who used a 9 point scale or Bordi et al.'s (2005) 7 point scale. In addition, Koseki et al. (2005) and Bordi et al. (2009) used different foods and beverages in their study. Koseki et al. (2005) tested different types of water and Bordi et al. (2005) tested different types of donuts. None of the studies had their subjects return to repeat the trials to discover if there was any correlation between the results of the first and second visit. Following these methods and adding a second visit to the testing gives strength to the methods of the present study.

Explanation of Taste Differences

It is not exactly known as to why there are differences in taste; there could be a variety of reasons for the differences. One explanation that may have been responsible is the differing amounts of sugar and fat that were unique to each protein supplement. Sugar could have been the main factor in making Nesquik milk the best tasting because it has 29 grams of sugar per 8 ounces. Twenty-nine grams per 8 ounces is a large amount when compared to the other protein supplements for such a small serving; it is easy to conclude that all the sugar will help the taste. Also, it only contains 8 grams of protein per serving. The other proteins had much more reasonable amounts of sugar in the servings. Future research may wish to control the amount of sugar in each supplement and perhaps that will have an effect on the results.

Muscle Milk is well known for having a high fat content, which most likely causes it to be one of the best tasting. It only contains 3 grams of sugar per 8 ounces, but it has 9 grams of fat and 4.5 grams of saturated fat. However, Muscle Milk writes in large print on their product that 80% of the saturated fat is Medium Chain Triglycerides (MCT's), which are mostly burned as energy and not stored as fat (Bach and Babayan, 1982). This claim about MCT's most likely helps convince the consumers to purchase Muscle Milk even though it has a high fat content, and it has 24 grams of protein per serving.

BSN Syntha-6 and Optimum Nutrition Nitro Core both have very similar contents. BSN has 2 grams of sugar, 6 grams of fat, 2 grams of saturated fat, and 22 grams of protein. Optimum has 2 grams of sugar, 5 grams of fat, 1.5 grams of saturated fat, and 24 grams of protein. It was interesting to note that even though they have similar contents, Optimum scored significantly lower in taste as compared to BSN.

The nutrition labels identify what sugars are used in each supplement, but they do not distinguish how much of each type of sugar is used. The Nesquik Vanilla Milk just contains sugar, while Muscle Milk has maltodextrin, fructose, and sucralose. Optimum's Nitro Core only contains fructose, and BSN only contains sucralose. Perhaps the different types of sugar were responsible for the taste scores of the various protein supplements. A future study could manipulate the types or amount of sugar in each protein supplement. Optimum might taste just as good as Muscle Milk if it contained maltodextrin, fructose, and sucralose as well.

As for the types of protein in each supplement, Nesquik's milk did not list any but it can be assumed that they would be milk proteins. Muscle Milk contained milk protein isolate, whey protein isolate, whey protein concentrate, whey peptides, calcium caseinate, and sodium caseinate. Optimum's Nitro Core also had whey protein isolate, whey protein concentrate, and whey peptides. BSN contained whey protein concentrate (milk and soy), whey protein isolate (whey and soy), calcium caseinate casein, micellar casein (milk and soy), milk protein isolate (milk and soy), egg albumen, and sodium caseinate (milk). Table 1 below summarizes the macronutrient content of each protein supplement utilized in the present study. The order of the drinks was likely not a factor on the taste scores due to the randomization. The drinks could have been placed in the same order each time, but the researchers felt the randomization would help strengthen the study.

Table 1. Fat, Sugar, and Protein Content of the Protein Supplements

Name Brand	**Fat (g)**	**Saturated Fat (g)**	**Sugar (g)**	**Protein (g)**
BSN Syntha-6	6	2	2	22
Muscle Milk	9	4.5	3	24
Nesquik Milk	4	8	29	8
Optimum Nitro	5	1.5	2	24

Male vs. Female Taste Scores

According to the data collected in the present study, it was revealed that the male participants purchased protein more often than the female participants. Out of 94 men, 54 of them purchased protein on a regular basis. As for women, out of 68 females, 8 of them purchased protein powders on a consistent basis. Roughly 50% of men and 10% of women purchased protein supplements. This could have a huge impact on one's taste because the men may be more accustomed to protein powder and its unique taste, while the women may likely not be as familiar with the protein supplements. The familiarization could be the difference in the taste between genders.

Perception and previous experience could be another answer. When men were asked to participate in the study, they were eager to participate. Conversely, when females were asked to volunteer, their first response was something of disgust. Most likely their experience with protein supplements was minimal and negative. These experiences may have biased their perceptions about the tastes of the protein supplements utilized in the present study.

The marketing of protein supplements may also partly explain how they are perceived. Muscle Milk is known for marketing that its protein is based off of “mother’s milk” thus making it the best quality protein supplement. Muscle Milk also states on their labels that their protein is the best tasting protein. This marketing could influence men’s perception of Muscle Milk, thus causing men to have a positive perception of the protein before they even try it. Subconsciously men believe that Muscle Milk is the best protein and best tasting therefore they will enjoy it when they try it. The researchers believe this marketing works because whenever men were asked to be participants, the men brought up Muscle Milk immediately. Muscle Milk’s marketing has obviously helped its popularity and help position it, at least perceptually, as a great tasting protein supplement.

One possible weakness in this study’s methods was that a cup of water was provided for each participant to sip in between the protein drinks. Some chose to drink it while some did not. The researchers did not record how many did and did not use the water. The researchers did notice that the vast majority did not drink the water in between the protein drinks.

While it is difficult to definitely state why one protein supplement was rated differently than others in terms of taste, any of the aforementioned reasons may be contributing factors. It clear from the present study that some of the more popular protein supplements are significantly different in taste. Future studies may wish to control the amount and types of sugar in the protein supplements, and the fat content as well. Future research on this topic could also investigate potential mechanisms of taste preferences in relation to protein supplements.

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Appendices

Appendix A- Initial Screening Form

Personal Information

Name:

Address:

City: ______________ State: _____ Zip Code_________

Cellular (___) _________________

Email address: _______________________

Birth date:___ /___ /____ Age: ____ Height: _____ Weight: ______

Exercise History/Activity Questionnaire

1. Do you have any food allergies? Protein powders, milk, eggs, nuts?

2. Describe your typical recreational activities

3. Describe any exercise training that you routinely participate.

4. How many days per week do you exercise/participate in these activities?

5. How many hours per week do you train?

6. Do you ingest protein supplements?

7. How often?

8. Name the brands you have had in the last 3 months?

9. Name the brands you have had in the last month?

<u>Appendix B – Protein Supplements Nutrition Information</u>

Nesquik Vanilla Milk

Nutrition Facts

Serving Size 1 bottle

Amount Per Serving	
Calories 130 Calories from Fat 25	
	% Daily Value (DV)*
Total Fat 2.5 g	4%
Saturated Fat 1.5 g	8%
Trans Fat 0 g	
Cholesterol 10 mg	4%
Sodium 160 mg	7%
Total Carbohydrate 15 g	5%
Dietary Fiber 0g	0%
Sugars 15 g	
Protein 10 g	

Vitamin A 10% * Vitamin C 2%

Calcium 40% *Iron 0% *Vitamin D 25%

*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	65 g	80 g
Sat Fat	Less than	20 g	25 g
Cholesterol	Less than	300 mg	300 mg
Sodium	Less than	2,400 mg	2,400 mg
Total Carbohydrate		300 g	375 g
Dietary Fiber		25 g	30 g

Muscle Milk

Supplement Facts

Serving Size 2 scoops (70g)
Servings Per Container 16

Amount Per Serving	% Daily Value*
Calories 300	
Calories from Fat 110	
Total Fat 12 g	19%
Saturated Fat 6 g†	31%
Cholesterol 15 mg	5%
Total Carbohydrate 16 g	5%
Dietary Fiber 5 g	20%
Soluble Fiber 3 g	**
Insoluble Fiber 2 g	**
Sugars 4 g	**
Protein 32 g	64%
Vitamin A (as vitamin A palmitate) 1750 IU	35%
Vitamin C (as ascorbic acid) 21 mg	35%
Vitamin D (as cholecalciferol) 140 IU	35%
Vitamin E (as d-alpha tocopheryl acetate) 11 IU	35%
Thiamin (as thiamin mononitrate) 0.5 mg	35%
Riboflavin 0.6 mg	35%
Niacin (as niacinamide) 7 mg	35%
Vitamin B6 (as pyridoxine hydrochloride) 0.7 mg	35%
Folate (as folic acid) 140 mcg	35%
Vitamin B12 (as cyanocobalamin) 2.1 mcg	35%
Biotin 105 mcg	35%
Pantothenic Acid (as calcium pantothenate) 4 mg	35%
Calcium (as di-calcium phosphate) 350 mg	35%
Iron (as ferrous fumarate) 6 mg	35%
Phosphorus (as di-calcium phosphate) 450 mg	45%
Iodine (as potassium iodide) 53 mcg	35%
Magnesium (as magnesium oxide) 140 mg	35%
Zinc (as zinc oxide) 5 mg	35%
Copper (as copper gluconate) 0.7 mg	35%
Chromium (as chromium nicotinate) 96 mcg	80%
Sodium 230 mg	10%
Potassium 790 mg	23%

* Percent Daily Values are based on a 2,000 calorie diet.
** Daily Value not established.

† 80% of saturated fats are in the form of medium chain triglycerides (MCT's). MCT's are typically burned as energy and show little or no propensity for storage as body fat or as a contributor to arteriosclerosis.

INGREDIENTS: EVOPRO™ (CALCIUM AND SODIUM CASEINATE, MILK PROTEIN ISOLATE, WHEY PROTEIN ISOLATE, WHEY PROTEIN CONCENTRATE, WHEY PEPTIDES, LACTOFERRIN, L-GLUTAMINE, TAURINE), LEAN-LIPIDS™ (MEDIUM-CHAIN TRIGLYCERIDES, SUNFLOWER AND/OR SAFFLOWER OIL, CANOLA OIL, L-CARNITINE), COCOA POWDER, MALTODEXTRIN, RESISTANT MALTODEXTRIN, FRUCTOSE, NATURAL AND ARTIFICAL FLAVOR, CYTOVITE I™ VITAMIN MINERAL BLEND, FRUCTO-OLIGOSACCHARIDE, POTASSIUM CHLORIDE, ACESULFAME POTASSIUM, SUCRALOSE, SOY LECITHIN.

ALLERGEN STATEMENT: THIS PRODUCT CONTAINS INGREDIENTS DERIVED FROM MILK AND SOY.

THIS PRODUCT IS MANUFACTURED IN A PLANT THAT PROCESSES MILK, SOY, WHEAT & EGGS.

Optimum Nutrition

100% NATURAL WHEY

Serving Size 1 Rounded Scoop (32.4 g)
Servings per Container 72

Amount Per Serving		% Daily Value
Calories	130	
Calories from Fat	15	
Total Fat	1.5 g	2%*
Saturated Fat	0.5 g	3%*
Cholesterol	30 mg	10%
Total Carbohydrate	5 g	2%*
Sugars	3 g	†
Protein	24 g	48%*
Calcium	150 mg	15%
Sodium	60 mg	3%
Potassium	240 mg	7%
Stevia Extract (*Stevia rebaudiana*) (leaf) (standardized to 90% steviosides)	70 mg	†
Enzyme Blend	25 mg	
Aminogen®		†
Lactase (standardized to 100,000 FCC units/g)		†

* Percent Daily Values are based on a 2,000 calorie diet.
† Daily Value not established.

OTHER INGREDIENTS: Protein Blend (Whey Protein Isolate, Whey Protein Concentrate, Whey Peptides), Cocoa (Processed with Alkali), Fructose, Lecithin, Natural Flavor.

ALLERGEN INFORMATION: CONTAINS MILK AND SOY (LECITHIN) INGREDIENTS.

Aminogen® is a registered trademark of Triarco Industries, Inc.

BSN

NUTRITION FACTS

Serving Size: 1 Rounded Scoop (44g) ‡

Servings Per Container : 30

Amount Per Serving	
Calories 200	Calories From Fat 50
	% Daily Value†
Total Fat 6g	9%
Saturated Fat 2g	10%
Trans Fat 0g	
Cholesterol 55mg	18%
Sodium 220mg	8%
Potassium 170mg	4%
Total Carbohydrate 15g	5%
Dietary Fiber 5g	20%
Sugars 2g	
Protein 22g	44%

Vitamin A 0% • Vitamin C 0% • Calcium 10% • Iron 1% • Phosphorus 10% • Magnesium 4%

†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
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg

Potassium	Less than	3,500mg	3,500mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g
Protein		50g	65g

Ingredients:

Protein & Amino Acid Matrix Comprised of (Whey Protein Concentrate [Milk & Soy], Whey Protein Isolate [Milk & Soy], Calcium Caseinate Casein [Milk & Soy], Micellar Casein [Milk & Soy], Milk Protein Isolate [Milk & Soy], Egg Albumen [Egg], and Glutamine Peptides [Wheat]), Sunflower Powder Consisting of (Sunflower Oil, Corn Syrup Solids, Sodium Caseinate [Milk], Mono- & Di-Glycerides, Dipotassium Phosphate, Tricalcium Phosphate, Lecithin [Soy], and Tocopherols), Dutch Processed Cocoa Powder, Polydextrose, Natural & Artificial Flavors [Milk & Soy], MCT Powder Consisting of (Medium Chain Triglycerides, Non-Fat Dry Milk, Disodium Phosphate, and Silicon Dioxide), Cellulose Gum, Sucralose, Acesulfame Potassium, Papain, and Bromelain.

‡ Due to settling, a natural occurrence with powders, variations in the powder height level may vary from bottle to bottle. Additionally, powder density may be affected as a result of the settling which may cause slight variations in the scoop serving size.

Allergen Warning:

Manufactured on equipment, which processes products containing milk, egg, soybeans, wheat, shellfish, fish oil, tree nuts, and peanut flavor.

Appendix C- Data Collection Form

Please drink the protein supplements, you can take a few sips or drink all 3 oz, and rate its initial taste within 15 seconds and after taste within another 15 seconds, a total of 30 seconds.

Protein Drink #1- initial taste (Code______)

☐	☐	☐	☐	☐	☐	☐
Very Bad	Bad	Slightly Bad	Neither good nor bad	Slightly Good	Good	Very Good

Protein Drink #1 after taste (Code _____)

☐	☐	☐	☐	☐	☐	☐
Very Bad	Bad	Slightly Bad	Neither good nor bad	Slightly Good	Good	Very Good

Protein Drink #2 initial taste (Code _____)

☐	☐	☐	☐	☐	☐	☐
Very Bad	Bad	Slightly Bad	Neither good nor bad	Slightly Good	Good	Very Good

Protein Drink #2 after taste (Code _____)

☐	☐	☐	☐	☐	☐	☐
Very Bad	Bad	Slightly Bad	Neither good nor bad	Slightly Good	Good	Very Good

Appendix D- Visit 1 Initial Taste Data

Statistics

		V1.D1.Init	V1.D2.Init	V1.D3.Init	V1.D4.Init
N	Valid	162	162	162	162
	Missing	27	27	27	27
Mean		4.05	4.60	5.36	3.13
Std. Error of Mean		.134	.144	.098	.125
Median		4.00	5.00	6.00	3.00
Mode		3	6	6	2
Std. Deviation		1.701	1.833	1.245	1.585
Variance		2.892	3.358	1.550	2.511
Skewness		-.086	-.541	-.546	.420
Std. Error of Skewness		.191	.191	.191	.191
Kurtosis		-1.018	-.773	-.121	-.774
Std. Error of Kurtosis		.379	.379	.379	.379
Range		6	6	6	6
Minimum		1	1	1	1
Maximum		7	7	7	7
Sum		656	746	869	507

V1.D1.Init. = Visit 1, Drink 1 (BSN) Initial Taste; V1.D2.Init= Visit 1, Drink 2 (Muscle Milk) Initial Taste; V1.D3.Init= Visit 1, Drink 3 (Nesquik Milk) Initial Taste; V1.D4.Init= Visit 1, Drink 4 (Optimum) Initial Taste.

Appendix E- Visit 1 Aftertaste Data

Statistics

		V1.D1.After	V1.D2.After	V1.D3.After	V1.D4.After
N	Valid	162	162	162	162
	Missing	27	27	27	27
Mean		4.06	4.28	5.08	3.07
Std. Error of Mean		.116	.130	.099	.125
Median		4.00	4.00	5.00	3.00
Mode		4	6	6	3
Std. Deviation		1.473	1.659	1.256	1.594
Variance		2.170	2.751	1.577	2.541
Skewness		-.155	-.247	-.477	.436
Std. Error of Skewness		.191	.191	.191	.191
Kurtosis		-.098	-.818	-.213	-.539
Std. Error of Kurtosis		.379	.379	.379	.379
Range		6	6	5	6
Minimum		1	1	2	1
Maximum		7	7	7	7
Sum		658	694	823	498

V1.D1.After. = Visit 1, Drink 1 (BSN) aftertaste; V1.D2.After= Visit 1, Drink 2 (Muscle Milk) aftertaste; V1.D3.After= Visit 1, Drink 3 (Nesquik Milk) aftertaste; V1.D4.After= Visit 1, Drink 4 (Optimum) aftertaste.

Appendix F- Reliability Scores of First Visit to Second Visit

		V2.D1.Init	V2.D2.Init	V2.D3.Init	V2.D4.Init
V1.D1.Init	Pearson Correlation	.372	.089	-.054	.158
	Sig. (2-tailed)	.000	.344	.566	.093
	N	116	115	115	114
V1.D2.Init	Pearson Correlation	.228	.498	-.090	.163
	Sig. (2-tailed)	.014	.000	.336	.083
	N	116	115	115	114
V1.D3.Init	Pearson Correlation	-.037	.059	.340	.066
	Sig. (2-tailed)	.694	.533	.000	.485
	N	116	115	115	114
V1.D4.Init	Pearson Correlation	.205	-.039	-.088	.403
	Sig. (2-tailed)	.027	.679	.348	.000
	N	116	115	115	114

V1.D1.Init. = Visit 1, Drink 1 (BSN) Initial Taste; V1.D2.Init= Visit 1, Drink 2 (Muscle Milk) Initial Taste; V1.D3.Init= Visit 1, Drink 3 (Nesquik Milk) Initial Taste; V1.D4.Init= Visit 1, Drink 4 (Optimum) Initial Taste.

		V2.D1.After	V2.D2.After	V2.D3.After	V2.D4.After
V1.D1.After	Pearson Correlation	.361	.153	-.258	.152
	Sig. (2-tailed)	.000	.102	.005	.106
	N	116	115	115	114
V1.D2.After	Pearson Correlation	.117	.505	-.054	.210
	Sig. (2-tailed)	.210	.000	.570	.025
	N	116	115	115	114
V1.D3.After	Pearson Correlation	.145	.029	.352	.061
	Sig. (2-tailed)	.122	.757	.000	.516
	N	116	115	115	114
V1.D4.After	Pearson Correlation	.149	.119	-.131	.486
	Sig. (2-tailed)	.110	.205	.162	.000
	N	116	115	115	114

V1.D1.After. = Visit 1, Drink 1 (BSN) aftertaste; V1.D2.After= Visit 1, Drink 2 (Muscle Milk) aftertaste; V1.D3.After= Visit 1, Drink 3 (Nesquik Milk) aftertaste; V1.D4.After= Visit 1, Drink 4 (Optimum) aftertaste.

Appendix G- Reliability Scores of Initial to Aftertaste

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	V1.D1.Init & V1.D1.After	162	.745	.000
Pair 2	V1.D2.Init & V1.D2.After	162	.824	.000
Pair 3	V1.D3.Init & V1.D3.After	162	.776	.000
Pair 4	V1.D4.Init & V1.D4.After	162	.825	.000

V1.D1.Init. = Visit 1, Drink 1 (BSN) Initial Taste; V1.D2.Init= Visit 1, Drink 2 (Muscle Milk) Initial Taste; V1.D3.Init= Visit 1, Drink 3 (Nesquik Milk) Initial Taste; V1.D4.Init= Visit 1, Drink 4 (Optimum) Initial Taste.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	V2.D1.Init & V2.D1.After	116	.737	.000
Pair 2	V2.D2.Init & V2.D2.After	115	.747	.000
Pair 3	V2.D3.Init & V2.D3.After	115	.773	.000
Pair 4	V2.D4.Init & V2.D4.After	114	.806	.000

V1.D1.After. = Visit 1, Drink 1 (BSN) aftertaste; V1.D2.After= Visit 1, Drink 2 (Muscle Milk) aftertaste; V1.D3.After= Visit 1, Drink 3 (Nesquik Milk) aftertaste; V1.D4.After= Visit 1, Drink 4 (Optimum) aftertaste.