The Health Benefits of Substituting Whole Milk with Hemp Milk in Chocolate Pudding and the Effects on the Final Product

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Abstract

Background: As the population of vegetarians and vegans is rising, we designed this experiment to improve the intake of omega-3 fatty acid for this population by substituting whole milk with hemp milk in chocolate pudding.

Objective: This experiment was to test if hemp milk pudding is acceptable in a general population.

Design: Three different chocolate puddings were made in this experiment, whole milk (control), half amount of hemp milk and half amount of whole milk (half and half) , and hemp milk (extreme) chocolate pudding. We randomly asked 25 people who do not know the substituted ingredient to come and do the subjective evaluations on the chocolate puddings. After the tasters finished tasting the samples, they were asked to complete a scorecard and rate the characteristics of the samples.

Results: The average scores of the characteristics of the three products were very similar. The appearance and aroma scores between the samples were the closest. The average scores of the appearance and aroma for the whole milk and hemp milk chocolate pudding were 85%. The half and half chocolate pudding was 86% for appearance and 80% for aroma. On the other hand, the scores of flavor had the greatest difference. The average score of the control was 84%; half and half was 73%; the extreme was 66%. Overall, 64% of the tasters claimed that they would buy the whole milk chocolate pudding. 56% of the participants voted yes on the half and half chocolate pudding, and 48% stated that they would choose to buy the hemp milk chocolate pudding.

Conclusions: Even though the flavor of the hemp milk chocolate pudding was not as acceptable as the other puddings, the averages score was 4.64 which is 66% of the maximum score. Also,

almost half of the participants claimed that they would buy the extreme. Thus, the result showed a general acceptance in our new product.

Introduction

Vegetarian and vegan diets are getting very popular nowadays due to the health benefits that they have promoted to the human body. Based on a nationwide poll in 2006, approximately 2.3% of the adult population in the United States reported that they were vegetarians and about 1.4% of the population was vegans (American Dietetic Association, 2009). However, vegetarian and vegan diets are mostly or even completely composed of plant-based food, which increase the risks of some nutrition deficiencies such as calcium, iron, zinc, vitamin B-12, vitamin D, riboflavin, and especially long-chain omega-3 fatty acids (Craig, 2009). For our experiment, we focused on the intake of long chain omega-3 fatty acids in the vegetarian and vegan populations. There are two omega-3 fatty acids, eicosapen-taenoic acid (EPA) and docosa-hexaenoic acid (DHA). Omega-3 fatty acids are essential fatty acids that cannot be produced in the human body, and they must be provided in the diet. The major source of the two types of omega -3 fatty acids are fish (Kennedy, Luo, & Ausman, 2012). Thus, the avoidance of fish in the diet has increased the risk of inadequate intake of omega-3 fatty acids in vegetarians and vegans. Due to the nutrition concerns in people who consume a vegetarian or vegan diet, our experiment is designed to improve the nutrition intake of omega-3 fatty acids for vegetarians and vegans. In our experiment, whole milk is substituted with hemp milk, a plant-based nondairy milk product that is rich in omega-3 fatty acids. Therefore, vegetarians and vegans are still able to meet their nutrition needs with a plant-based diet.

Review of Literature

Due to the increase of popularity in consuming a vegetarian and vegan diets, potential nutritional implications associated with these diets should be aware in order to avoid certain nutrition deficiencies. Craig (2009) found that vegetarians and especially vegans "tend to have lower blood concentrations of EPA and DHA" compare with meat-eaters. Although omega-3 fatty acid supplements could be sources for vegetarians and vegans to reach their daily requirement, these supplements should be taken with caution because it might cause harm to the body if excessive amount is taken by individuals (Craig, 2009). Thus, the best way to get their daily requirement of omega-3 fatty acid is from food sources, and plant-based milks could be good dietary sources for vegetarians and vegans to increase the intake of omega-3 fatty acids in their daily diet.

There are a lot of nondairy milk alternatives in the market, why we want to use hemp milk as the substitution for whole milk in our experiment? The human body needs an optimum balance of omega-6 and omega-3 fatty acids; the range for vegetarians should be between 2:1 and 4:1 (Marsh, Zeuschner, & Saunders, 2011). Vahanvaty, U. S. (2009) found that hemp seed contains 3: 1 ratio of omega-6 to omega-3 fatty acid, which is within the optimum range. Also, hemp is naturally rich in omega-3 fatty acid, and thus the hemp milk is a good source of essential fatty acids for vegans who omit fish and other animal products (Bidlack & Rodriguez, 2012). Additionally, hemp milk is safe to consume because it comes from a plant source and it is mercury free. Thus, people do not need to worry about the toxicity of mercury like it has in fish (Vahanvaty, 2009).

The long chain omega-3 fatty acid is not only an essential nutrient to keep the body functioning, but also promote a lot of health benefits to people in all ages. Omega-3 fatty acid

plays a very important role in the growth and function of the nervous system and tissue. Inadequate intake of omega-3 fatty acids would result in deficits in the development of nerve tissues, neurotransmitter metabolism, learning ability and visual function in human (Innis, 2008). Thus, adequate intake of omega-3 fatty acids is very important for brain development in children and adolescents. Pregnant women and breastfeeding women need higher intake of omega-3 fatty acids because maternal nutrition has great effects on the development of the fetus (Craig, 2009). If the mother consumes adequate amount of essential fatty acids, the intake of DHA from the mother will transfer to the infants before and after birth, which has significant influences on the neural development of the infant as breast milk is the only food for infants with breastfeeding mom (Innis, 2008). Kennedy, Luo, & Ausman (2012) found that maternal intake of omega-3 fatty acid contributes to the DHA levels in breast milk. Therefore, poor intake of omega-3 fatty acid in pregnant women would result in implication of neural development in various degrees, and pregnant women, especially those who are vegetarians or vegans should ensure that they have adequate intake of essential fatty acids.

In addition, omega-3 fatty acids help reduce the risk of cardiovascular disease. Kennedy, Luo, & Ausman (2012) found that consumption of 250mg of omega-3 fatty acids per day has been showed to reduce risk of mortality from heart disease. Omega-3 fatty acids help reduce the level of plasma triacylglycerol in the blood. In addition, it is also associated with reducing tissue inflammation and the risk of certain types of cancer (Ursin, 2003).

Method

Whole milk chocolate pudding was selected to be the control. We started the experiment by melting one ounce of semisweet chocolate chips with half cup of whole milk by using a double boiler. Next, we stirred it constantly until the chocolate chips melted and completely

blend with the milk. In another bowl, we mixed two tablespoons of sugar, one tablespoon and two teaspoons of cornstarch, a pinch of salt, and a half cup of whole milk together until smooth. Then, we added and stirred it into the double boiler with the melted chocolate and milk. We put the top of the double boiler directly over the heat and stirred it constantly. We brought the mixture to boil and waited one minute. One minute later, we removed the pot from the heat and added vanilla. After the control was done, we repeated the same steps above for the other two modifications, the extreme and half and half. The extreme chocolate pudding used one cup of hemp milk and the half and half chocolate pudding used a half cup of hemp milk and a half cup of whole milk. After finished making the three varieties, pre-tests were being done by five different people who were selected randomly to make sure the products are acceptable to different population.

Objective Evaluation

Percent sag and line-spread tests were being used for the objective evaluation. By using percent sag, we were able to know the tenderness of the chocolate pudding. First, we poured the control chocolate pudding paste into a mold. We waited an hour to let the chocolate pudding to cold down and become solid. Then, we measured the height of the chocolate pudding in container by using a toothpick. Unmold the chocolate pudding and let it sit for five minutes; then measure its height. Using the formula, (Depth in container – depth on plate /depth in container) x 100 = percent sag, to get the percent sag of the gel. Repeat the same steps to get the percent sag for the half and half and the extreme.

The viscosity of the chocolate pudding was tested by line-spread test. First, we placed a mold on the center of the concentric ring. Then, we poured the whole milk chocolate pudding

paste into a mold. Remove the mold and allow the pudding to spread out. After five minutes, we recorded the result. Repeat the same steps for the other two varieties.

Subjective evaluation

Twenty-five tasters were randomly selected to taste the products. The control, half and half, and extreme chocolate pudding were precooked and stored in refrigerator two days ago. They were placed on a small plate with different sample numbers on it. Tasters were not allowed to know which sample was the control, nor the ingredient substitution. They were asked to rate the chocolate pudding samples from one to seven on a scorecard, based on their characteristics. The scorecard also included a yes/no question. The question asked the tasters if they would buy the products or not (Figure 1). After the day of trial, we gathered all the data and calculated the mean score of each characteristic and the percentage of acceptability of the products.

Figure 1 – The scorecard of chocolate pudding

Please rate each characteristic on a scale of 1-7
7 = Like extremely
6 = Like moderately
5 = Like slightly
4 = Neither like nor dislike
3 = dislike slightly
2 = dislike moderately
1 = dislike extremely

Characteristic	Sample		
	831	**921**	**435**
Aroma			
Appearance			
Consistency			
Texture			
Flavor			
Would you buy this product? (Yes/No)			

Results and Discussion

Two objective evaluations were being used in this test. They were percent sag and line-spread test. According to Foods Experimental Perspectives written by M. McWilliams, percent sag is a

test to compare the tenderness of a gel (2008, pg. 78). The percent sag of the control, whole milk chocolate pudding, was 15%. The half and half was 11.5%, and the extreme, hemp milk chocolate pudding, was 7.7% (Table 1). McWilliams pointed out in her book that "the greater the percent sag, the tenderer is the gel" (2008, pg.78). The whole milk chocolate pudding had the greatest percent sag which means it was the tenderest of all. On the other hand, the extreme product was the firmest. The reason we obtained this result was because of the sugar and saturated fat content of the milk. Whole milk contains 12 grams of sugar and 27 % of saturated fat in a cup verse the hemp milk has no sugar content and contains only 3% of saturated fatty acid. McWilliams said that sugar have a softening effect on corn starch. It causes the starch gel to be tenderer (2008, p.180). Also, the functional role of fat is contributing tenderness to the final product. Therefore, the whole milk chocolate pudding is more tender than the half and half and extreme pudding.

Table 1 – The objective evaluation, Percent Sag, to compare the tenderness of the products

	Time	Height of the product with mold	Height of the product without mold	Percent Sag
Whole Milk	5 minutes	2.6 cm	2.2 cm	15 %
Half and half	5 minutes	2.6 cm	2.3 cm	11.5 %
Hemp Milk	5 minutes	2.6 cm	2.4 cm	7.7 %

In the line-spread test, whole milk chocolate pudding spread to 6 after five minutes. Half and half chocolate pudding spread to 7.5 and hemp milk chocolate pudding spread to 8. (Table 2) This result was also related to the sugar and saturated fat content of whole milk and hemp milk. McWilliams claimed that sugar has the ability to reduce the paste viscosity and gel strength. (2008; pg. 177) Since whole milk contains more sugar than hemp milk, the control had the lowest viscosity verses the extreme had the highest viscosity. In addition, the whole milk is

higher in saturated fat (27%) than the hemp milk (3%). Since saturated fatty acids have high melting point, it could solidified easily at the room temperature (McWillam, 2008, p.240). Thus, the viscosity of the whole milk chocolate pudding was lower than the modifications because it turned to solid form quicker than the hemp milk.

Table 2 – The objective evaluation, line-spread test, to compare the flow resistance of each product

	How far it spread?	How far it spread after 5 minutes
Whole Milk	6	6
Half and half	7.8	7.8
Hemp Milk	8	8

Even though the result of these two evaluations showed that the whole milk pudding is more tender and higher flow resistance than the half and half and hemp milk chocolate pudding, it didn't translate and effect the mouthfeel of the product. In the pre-test, five out of five tasters were accepted the mortifications' texture and consistency. Also, in the subjective evaluation data showed that the average score of the whole milk's consistency was 70%, the half and half was 76% and the hemp milk was 74%. In addition, the texture of the whole milk got 73%, half and half was 79% and the hemp milk was 75%, in average. (Figure 2) These scores proved that even though hemp milk was the firmest and lower flow resistance, it didn't alter the mouthfeel of the modifications.

The appearance and aroma scores between the varieties were the closest. In average, the appearance and aroma of the whole and hemp milk chocolate pudding were 85%. The half and half chocolate pudding was 86% for appearance and 80% for aroma. On the other hand, the flavor had the greatest difference. The average score of whole milk was 84%, half and half was

73%, and the hemp milk was 66% (Figure 2). In the last question, we got 64% of the tasters claimed that they would buy the whole milk chocolate pudding. 56% of people voted yes on the half and half chocolate pudding and 48% stated that they would choose to buy the hemp milk pudding (Figure 3).

Figure 2 – The mean of the characteristic rating

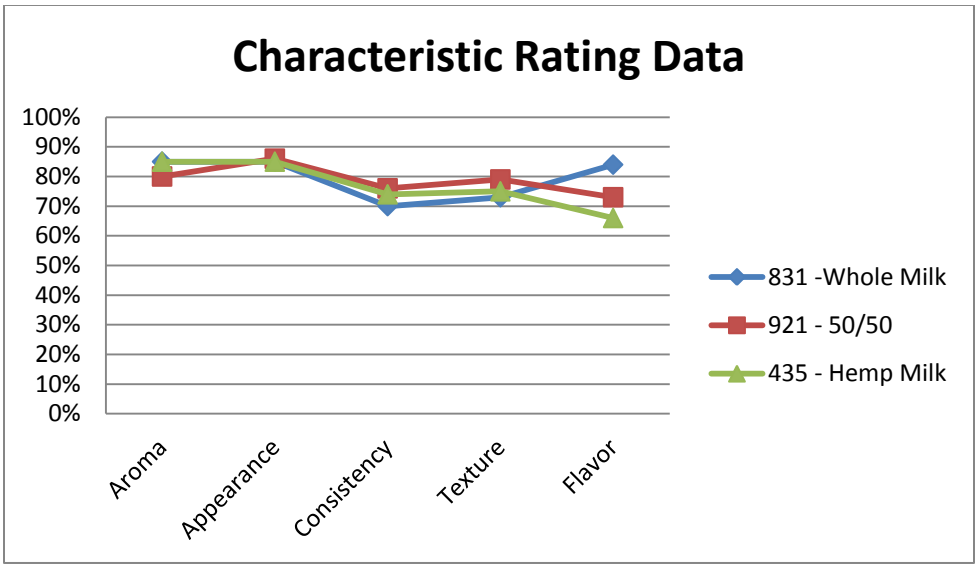
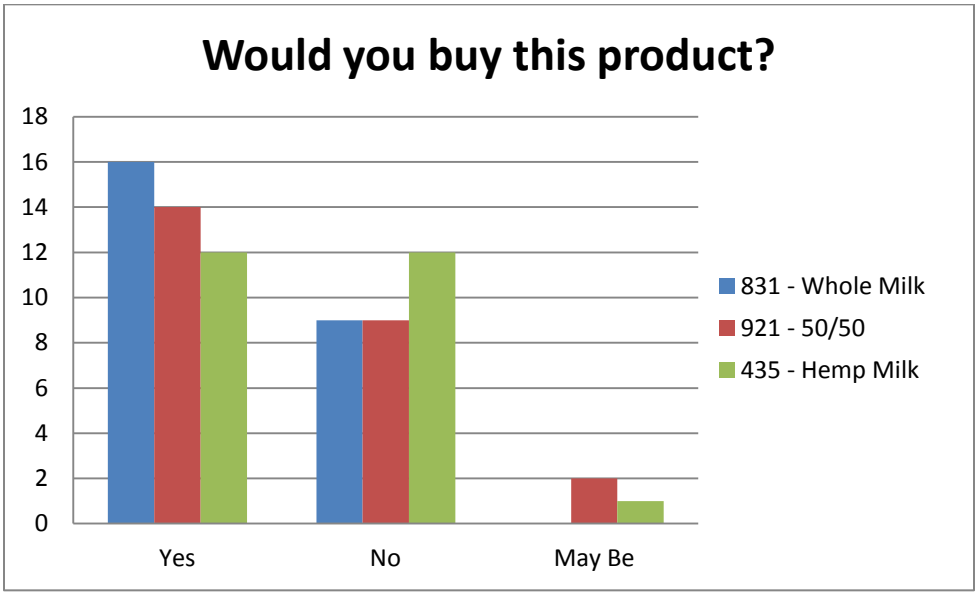


Figure 3 – The total of how many people will buy or will not buy the products.



Conclusion

Vegetarian and vegan diets are shown to provide many health benefits, but they might cause some nutrition deficiencies, especially inadequate intake of long-chain omega-3 fatty acids because of the exclusion of fish and other animal products in the diets. Thus, hemp milk is a good source of omega-3 fatty acids to be added in a vegetarian or vegan diet to increase the consumers' intake of DHA and EPA. Based on the results of the sensory evaluation from the consumer panel, the ratings of most of the characteristics were very similar, which indicates that the experimental samples (half and half, and the extreme) are quite acceptable to the tasters. Although the flavor was not as acceptable as the other characteristics, the average score of the extreme sample is 4.64 which is equivalent to 66% of the maximum score which was a pretty good result for a new product. Overall, further research is needed to improve the quality of our product. The next step for our experiment is to substitute the regular chocolate with vegan chocolate to make the product more appropriate to vegans.

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