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ORIGINAL PAPER

Alteration of two ingredients in controlled granola energy bar sample yields better sensory appeal of color but not texture or flavor in a Bastyr community sample

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Abstract

Background *With people's schedules getting busier as the world changes, the need for increased access to quick and easy food, especially appealing energy bars, is in high demand.*

Objective *This study aims to evaluate which modifications in a popular recipe for an energy bar will result in a more pleasing and appealing product. After manipulating a Martha Stewart energy bar recipe, by processing oats into a finer mill and substituting dates for golden raisins, the texture, flavor, and color were evaluated by 25 randomized Bastyr University students. A Likert (1-9) scale to score each bar on texture, flavor, and color preferability was used. One-tailed t-tests were then used to analyze the subjects' preferences of each bar in the categories of flavor, color, and texture. Alpha was set at .05.*

Results *Results showed the taste alteration of switching raisins for dates did not produce significant results: $t(24) = 0.56$, $p > 0.05$, but alterations in the recipe did produce significant results in color preference, $t(24) = 1.95$, $p < 0.05$, while the results on the texture alterations did not result in significant, $t(24) = -1.2$, $p > 0.05$. Although results showed the alterations in ingredients did not change texture or flavor, color preference was increased in the manipulated bar.*

Conclusions *Overall, results showed that through modifications to the recipe, altering the texture of the oats and changing raisins for dates,, subjects preferred the color of the new energy bars but did not show a preference in texture or flavor.*

Introduction

As modern lifestyles require more time away from the home, there is a need for a nutritious and pleasing method of food portability. The energy bar may fill this need. One particular group that can benefit from a nutritious snack food is graduate students. However, this group has other limitations-namely, it is not cost -effective to buy commercial energy bars as snacks. In addition to the cost, bars may be needed to supplement the diet and therefore should have increased nutrient content as compared to other easily transported foods.

As it has been determined that these students require an energy bar that is both cost effective and nutritious, it is proposed that slight modifications to an existing popular recipe may illicit the results needed to produce a more pleasing bar in texture, flavor, and color. This control recipe (controlled variable), while popular, is not accepted by everyone, thus a few alterations may evoke results that are pleasing to a wider range of graduate students. The resulting bar samples from the control recipe have been found to be very dry and lacking in moisture. Therefore, a plan is proposed to alter a few ingredients in order to increase the level of satisfaction for mouthfeel, tested as 'texture', and flavor when the newly formulated energy bar recipe is tested among a sample population of graduate students.

While important food trends, the alterations in several ingredients are not proposed to address lactose- and gluten-intolerances, nor low-fat concerns. Novel ingredients are not substituted into the recipe to attract ethnic groups from the surrounding community, but rather to increase the flavor profile and add a more complex nutritional profile (1). Simply, the ingredients that are to be altered are aimed at affecting the appearance and sensory appeal of the experimental energy bar sample.

The busy schedule of graduate students was considered when making alterations to the control recipe. Rather than add an original ingredient, a modification was made to an existing constituent-the rolled oats. While rolled oats will give the control recipe a thicker texture, this texture may be too crumbly in an energy bar. By changing the texture of the oats (independent variable), from rolled to a more fine mill, the experimental energy bar will have a more pleasing, less chewy texture that will bind moisture better to alleviate the dry texture of the control bar. In addition to this, the golden raisins will be replaced with an equal amount of pitted, chopped dates (independent variable) to both modify the flavor and color (dependent variable), as well as provide a higher water content (2).

According to research conducted at the Aristotle University in Greece, the addition of β-glucan concentrates at considerably high levels of about 10-30%, in yeast leavened breads lead to a greater amount of water retention (3). Some β-glucan rich fractions from oats and barley may help increase the volume of a loaf when used in certain concentrations. This is thought to be due to the increased viscosity that results in

the dough. More importantly, pertaining to the experimental granola energy bars that will be produced, it is possible that the ground oats may offer an advantage in that the increased surface area will allow more of the starches to be exposed to water, and may improve the bar crumb structure by stabilizing air cells in the mixture (3). The exposure to water may also help in water-binding capacity, thereby producing a bar that is not nearly as dry (3) as the control energy bar (rolled oats). β-glucan addition to other food items such as muffins does not seem to alter their overall acceptability.

As part of this energy bar experiment, sensory characteristics were examined that included: texture, appearance, and flavor. Two tests used were the paired comparison test for difference and a hedonic scale rating of food. The paired comparison is a test of difference in which a specific characteristic is evaluated and the sample with the greater amount is identified (4). The hedonic scale rating is a type of descriptive test in which an array of words describe a range of intensity of a specific characteristic. Each step on the scale represents a subtle degree of intensity. The hedonic scale is even more specific in that it employs a word spectrum, such as unacceptable to very acceptable (4). These are used as a means to measure and describe sensory analysis subjectively.

In summary, the intention of this experiment is to create an energy bar that is different from the control sample (control variable) so that it has more sensory appeal to a sample population in which it is tested. By grinding the oats with a food processor and substituting the dates for raisins (independent variable) the experimental energy bar will provide a more pleasing texture, color and flavor (2,3,5,6). Although dates provide additional nutritional value, such as vitamin, mineral elements, and polyphenols, these may be assessed in future research. It is predicted that the recipe substitution and the texture modification will increase the experimental energy bar sample ratings (dependent variable) as compared to the control.

Methods

In creating both the control and manipulated bars, ingredients were found and purchased at a Seattle Quality Foods Center. The following recipe and ingredients were used for both bars with the manipulated bar substituting ½ cup dates for ½ cup raisins.

Basic Energy Bar Ingredients

1 pound rolled oats (Simple Truth Organic Old Fashioned Rolled Oats) *food processed oats used for manipulated bar
1 cup shredded, unsweetened coconut (QFC bulk foods)
1/2 cup sliced toasted almonds (QFC bulk foods)
2 tablespoons toasted sesame seeds (QFC bulk foods)
1/2 teaspoon coarse salt (EDEN coarse salt)
1/2 cup golden raisins (QFC bulk foods) *½ cup pitted dates used for manipulated bar (QFC bulk foods)
1/2 cup dried cranberries (QFC bulk foods)
1/2 cup safflower oil (Spectrum Brand)
2/3 cup honey (Virginia Brand)
1 teaspoon pure vanilla extract (McCormick brand
5 egg whites (Simple Truth Organic Cage Free Grade A Brown)
Recipe from Martha Stewart Living
*Manipulated recipe

Procedure

The oven was preheated to 350 degrees with the rack in the center position. Two 9x13-inch glass-baking dishes were lined with parchment paper and lightly oiled with safflower oil. Both recipes were made at the same time, using different bowls for each sample.

In a Cuisinart food processor, one pound of rolled oats was processed into a fine powder and put into a large bowl with coconut, almonds, sesame seeds, salt, cranberries, and dates; this was the manipulated bar. In a separate bowl for the control bar, one pound of whole rolled oats were combined with coconut, almonds, sesame seeds salt, cranberries and golden raisins. All ingredients were tossed together. In two separate bowls, batches of the wet ingredients were combined. The oil, honey, water, vanilla, and egg whites were whisked together. Next, the dry ingredients for the control bar were added to a batch of the wet ingredients and stirred together. The same was done for the manipulated bar. Each batch was then spread into its own baking dish and packed firmly.

The bars were baked for one hour at 350 degrees Fahrenheit and then set on the countertop for two hours to be cooled to room temperature. The cooled bars were cut in half lengthwise and then crosswise into 1 ½ inch-wide bars. The bars were then stored in their own air-tight glass Pyrex containers with the control bar labeled A and the manipulated bar labeled B.

Twenty-four hours after baking the bars, volunteers were recruited from Bastyr University. Twenty-five randomized participants were asked to taste and report their preferences between the control bar and the modified bar. A booth was set up outside the Bastyr Cafeteria during lunch period and random student traffic was asked to complete the test. The control bar was labeled A, and the modified (manipulated) was labeled B. Ingredients were not disclosed; students with food allergies were told the bars contained allergens and were allowed to decline participation. Participants tested and scored bar A first with bar B following. Each scorecard was deposited into a box by the participant after completing the experiment. Data was collected and interpreted. No data was thrown out.

Scorecard Design adapted from Foods: Experimental Perspectives (4).

Directions: Please look at and taste one sample of each bar, then rate each bar based on *texture, flavor, and color*; using the scale below. We appreciate your time and feedback- *Danielle Selden, Daniel Andras, Julia Patterson, and Jessica Gautney*

Texture: Please circle **ONE** number for each bar	Dislike Extremely **1**	Dislike Very Much **2**	Dislike Moderately **3**	Dislike Slightly **4**	Neither Like Nor Dislike **5**	Like Slightly **6**	Like Moderately **7**	Like Very Much **8**	Like Extremely **9**
Texture Bar A									
Texture Bar B									

Flavor: Please circle **ONE** number for each bar	Dislike Extremely **1**	Dislike Very Much **2**	Dislike Moderately **3**	Dislike Slightly **4**	Neither Like Nor Dislike **5**	Like Slightly **6**	Like Moderately **7**	Like Very Much **8**	Like Extremely **9**
Flavor Bar A									
Flavor Bar B									

Color: Please circle **ONE** number for each bar	Dislike Extremely **1**	Dislike Very Much **2**	Dislike Moderately **3**	Dislike Slightly **4**	Neither Like Nor Dislike **5**	Like Slightly **6**	Like Moderately **7**	Like Very Much **8**	Like Extremely **9**
Color of Bar A									
Color of Bar B									

Results

The intent of these alterations was to develop a bar with a more pleasing texture, flavor and color. The texture component of the bars was proposed to add a softer, more tender chew by grinding the oats. As shown in Table 1:

Table 1:

Sensory evaluation: Texture comparison of Control (Bar A) vs. Variation (Bar B)
t-Test: Paired Two Sample for Means

	Bar A	*Bar B*
Mean	5.16	5.56
Variance	2.223333333	3.09
Observations	25	25
Pearson Correlation	0.488982774	
Hypothesized Mean Difference	0	
df	24	
t-Stat	-1.206045378	
P(T<=t) one-tail	0.119777686	
t-Critical one-tail	1.71088208	

Table 1: T-Test results of collected sensory analysis data for Bar A and Bar B.

As shown above, the results on the texture alterations did not result in significant results, $t(24) = -1.2$, $p > 0.05$.

Table 2:

Sensory evaluation: Flavor comparison of Control (Bar A) versus Variation (Bar B)
t-Test: Paired Two Sample for Means

	Bar A	*Bar B*
Mean	5.08	4.8
Variance	3.16	4.25
Observations	25	25
Pearson Correlation	0.152354593	
Hypothesized Mean Difference	0	
df	24	
t-Stat	0.558068704	
P(T<=t) one-tail	0.29098331	
t-Critical one-tail	1.71088208	

Table 2: T-Test results of collected sensory analysis data for Bar A and Bar B.

As shown in Table 2, the taste alteration of switching raisins for dates did not produce significant results: $t(24) = 0.56$, $p > 0.05$.

Table 3:

Sensory evaluation: Color comparison of Control (Bar A) versus Variation (Bar B)
t-Test: Paired Two Sample for Means

	Bar A	*Bar B*
Mean	6.84	5.88
Variance	2.14	3.61
Observations	25	25
Pearson Correlation	-0.0521684	
Hypothesized Mean Difference	0	
df	24	
t-Stat	1.953092301	
P(T<=t) one-tail	0.031281881	
t-Critical one-tail	1.71088208	

Table 3: T-Test results of collected sensory analysis data for Bar A and Bar B.

As shown in Table 3, the alterations in the recipe did produce significant results in color preference, $t(24) = 1.95$, $p < 0.05$.

Discussion

This study demonstrated that there was an association with changing the ingredients in the control energy bar recipe to yield better outcomes in color preference but not flavor or texture, of the new recipe for the energy bar. The research hypothesis predicted that by

grinding the oats with a food processor and substituting the dates for raisins, the experimental energy bar would provide a more pleasing texture, color, and flavor (2,3,6). The results of the study indicate that two of the tested variables, texture and flavor, did not produce significant results in a t-test analysis. The texture preference for the experimental bar was found to be nonsignificant ($M = 5.56$, $SD = 1.76$) as compared to the control bar ($M = 5.16$, $SD = 1.48$); with nonsignificance of $t(24) = -1.21$, $p > 0.05$. As shown in Table 1, the sensory evaluation of texture provided a t-statistic of -1.21 with a t-critical value of 1.71, which shows no significance in the results obtained. Similar results were seen with flavor preference with the experimental bar ($M = 4.8$, $SD = 2.06$) and control bar ($M = 5.08$, $SD = 1.78$), with nonsignificance at $t(24) = 0.56$, $p > 0.05$. Table 2 explores the sensory evaluation in flavor comparisons lists at a t-statistic of 0.56 and a t-critical value of 1.71, which indicates the results are not significant. What does prove significant is the sensory evaluation for color, between the experimental bar ($M = 5.88$, $SD = 1.9$) and control bar ($M = 6.84$, $SD = 1.46$), with significance of $t(24) = 1.95$, $p < 0.05$. Color preference t-tests, Table 3, show a t-statistic of 1.95 and a t-critical value of 1.71, which provided results that were in fact significant in improving the color of the new product.

It was predicted that adding a higher moisture dried fruit product, dates in place of golden raisins, would produce a more tender and moist product, as suggested by the King Arthur Flour Company (3). Per the results, this did not prove to be a factor of significance in either flavor or texture among the tested sample population. However, by adding dates, the color of the bar became more appealing. This color change may be due to the browning characteristic found in certain phenolic-containing fruits, such as dates. This discoloration of dates is not due to the enzyme polyphenoloxidase, as the date lacks this enzyme. However, because of the phenolic compounds contained in dates and with the exposure of air over time, this produces a chemical reaction without polyphenoloxidase, which eventually turns the fruit brown (4). Research suggests that the dates included in the experimental energy bar product may have undergone this browning reaction, which may have contributed to the more golden color of the new recipe energy bars.

While it was proposed that the processed oats would contribute to a more pleasing texture, subjects did not appear to prefer the texture and this change should not be

considered in future tests. By modifying the oats, it was proposed that the new texture would be less crumbly and chewy, while being more tender and dense. The resulting energy bar was a bit more cakey, which was preferred by some subjects but was not pleasing enough to garner significant results. This may be due to the increased surface area exposure of the oat granules to the liquid component, which led to more bound water and less moisture present.

While some results did not produce significant data, these may have been explained by the limitations present. The study was conducted using a small sample size ($N = 25$ subjects) from the Bastyr student body. The participants were obtained using a voluntary tasting survey from a booth outside of the cafeteria, which may have been an unrepresentative sample of the whole population. A *Likert* scale was used to assess subjects' preferences but this may not be the best method. A more descriptive method may have been more suitable for this study, which uses words to describe the various sensory attributes of the energy bars. Subsequently, the alteration of the oats from rolled to ground may have required additional recipe alterations, such as increasing the moisture content and this was not tested. Finally, the possibility of sampling or data collection error must not be ruled out.

In summary this study demonstrated that the alterations of ground oats and pitted, chopped dates did not improve satisfaction for texture and flavor in the newly formulated energy bar recipe. This study however, did show that adding dates and grinding the rolled oats may have contributed to the significant findings in our color sensory comparison. These findings do not ensure causation or proving that this was in fact the actual cause for improving color, but rather an area needing further study. Other external variables that are outside the control of this study could have contributed to the results. Further research is needed to determine what particular additions and substitutions of ingredients to the control recipe are needed to improve sensory acceptance of the energy bar. It is suggested to conduct a follow-up study; with a larger sample size and a random sampling of subjects, to help yield more powerful results to suggest if any improvement of the energy bar is significant in the population.

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