Final Lab Report

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NFSC 320L
December 9, 2011

Abstract:

Objective: To create delicious and healthy gluten and dairy-free breakfast muffin.
Methods: The original muffin prototype was compared to a line extension prototype each week for sensory and instrumental evaluation. The 9-point Hedonic Scale, Just About Right Scale, Intensity Scale, Descriptive Analysis, and penetrometer were used to define the acceptability of prototype variations that led to the final product.
Results: There were a total of six modifications, including one line extension, to the original blueberry gluten-free, dairy-free muffin. Statistical analysis was conducted via SPSS for final prototypes to assess acceptability and flavor via the "Just About Right" methodology. The prototype "Banana Nut" had significantly higher acceptance by consumers and including "Just About Right" flavor, when compared to the "Blueberry" prototype.
Conclusion: Is possible to create a delicious and healthy gluten-free, dairy-free muffin with strong consumer acceptability that fulfills the unmet need in the market for an alternative baked good with desirable texture, flavor, taste, mouth feel, and overall appearance.

Introduction:

The overall goal of section 5, unit 3 of the Science of Food Lab is to create an accessible food item to replace timely breakfast preparation. The item we decided upon is a gluten-free, dairy-free muffin with ample amounts of fiber, low amounts sugar and sodium, and high levels of omega-3 fatty acids. Targeted toward busy single parents, single persons, and busy families, this healthy muffin product will be a fast and easy way to start the day off with healthy and satiated.

Due to recent increases in the incidence of gluten allergy and gluten intolerance, the demand for gluten-free products has been steadily rising. Gluten-free products do not contain wheat, barley, rye, or oats(although some people can tolerate these) and are substituted with alternative flours like rice, almond, corn and others that do not contain gluten. With growing awareness and diagnosis of Celiac's disease and gluten intolerance, many people are transitioning to a gluten-free diet. Gluten intolerance is estimated to occur in more than one of every one hundred and thirty-three people (Wagner, 2006). However, the media has latched on to research linking gluten with weight-loss, brain function, gastrointestinal issues, and overall health. This attention combined with the high prevalence of people who have a medical reason for gluten abstinence has created a growing market for gluten-free options in a world where gluten is hidden in many food products. At the same time, lactose-free diets have been gaining attention as new products such as soy, rice, almond, and coconut milk-substitutes are available in the market.

Lactose intolerance is another bowel disorder that has seen increasing prevalence in people world-wide. Similar to gluten, many consumers are purchasing these milk-substitutes for reasons other than medical necessity, which is increasing demand for more lactose-free products to come-out on the shelves.

In the article ‘Top 10 Food Trends’ from Food Technology (Sloan, 2011), it is stated that people are becoming more interested in healthy eating, enjoying three meals, having concern about nutrient density, and eating at home more often. When deciding what to create, our unit considered these trends and managed to find five trends we could relate our product to. Trend five, titled “Get Real,’ mentions consumers are veering toward food that is less processed with preservative chemicals and flavor enhancers, such as monosodium glutamate. We considered whole foods for our ingredients that provide a variety of nutrients. Trend six, “The New Nutrient” shows that consumers are now interested in the nutrient composition of their foods. Although protein is being described as a “new nutrient superstar,” we can also boast about the fiber and omega-3 content in our healthy muffin product. The muffin also has very little salt and no added sugar, since we restricted the sodium and used blended dates as a natural sweetener. “Three Squares” is the eighth trend from the article, and has helped to enhance our product’s eligibility for purchase. This trend states that consumers are eating more breakfast, therefore more companies are creating convenience items that are easy to make in the morning. Because our muffin is so dense, it could easily be frozen and popped in the microwave for a hearty and balanced breakfast. Trend nine, “Prescriptive Eating,” explains that consumers would like to eat a diet that could decrease their health related issues rather than resorting to pharmacueticals. With high fiber and high omega-3 fatty acids constituents, we can claim that our muffin can lower the risk of heart disease (Mozaffarian et al., 2011 &Streppel et al., 2008). Of course, there are many other functions of fiber and omega-3 fatty acids, but relating them to preventative measures for heart disease is highly attractive to the target audience. Finally, trend 10, “Home Rituals,” claims that more consumers are concerned with healthy snacking while enjoying home entertainment with their families. Our muffin may also be eaten as a snack and qualifies as healthy. In terms of improving nutrition, the trends of 2011 look promising. For the food technologist, these trends pose somewhat of a challenge to making a prepared food item that is shelf-stable and nutritious at the same time.

The prevalence of lactose intolerance among the Caucasian population of North America is as high as 25 percent. In African American, Native American, and Asian American populations, however, lactose intolerance is estimated to be as high as 75-90 percent among (Medscape).

A sensory evaluation was done on gluten free breads by ten trained celiac assessors. They were looking for 17 descriptors for appearance, aroma, taste and texture (Pagliarini, Laureati, and Lavelli). Descriptors included porosity, crust and crumb color, softness by hand and mouth, cheese odor, corn odor and fermented odor, sweet, salty, adhesive and rubbery and the instrumental parameters associated to crust and crumb color and texture. (Pagliarini, Laureati, and Lavelli) There were 6 different breads that were compared and the breads were made with corn, rice, or both flours. Gluten is a concern so companies are using trained panelist to find the best possible way of improving a gluten free product, and this is what we are doing for our project.

While the demand for products meeting these needs increases, a recent study shows that the availability of gluten-free products is still quite limited. The problem with the rapidly growing market for gluten and lactose-free products is that the substitutes do not have the same physical properties as the originals. Therefore, companies who are trying to keep up

with the unmet need of the consumer often struggle to keep the same desired attributes of the food. Thus, the overall objective of our study is to create a muffin that is gluten-free, dairy-free, delicious, high in omega-3 fatty acids and fiber, and generally healthy. In our experiments, we have tested various additions of fruits, flour, and spices to increase overall nutrient content, sweetness, flavor, and texture. Our nutrition health claim states, "A diet rich in fiber reduces the risk of developing heart disease (by lowering blood pressure, improving blood lipids, and reducing indicators of inflammation)."

Materials and Methods

To produce a satisfactory healthy, gluten-free, dairy-free muffin, we experimented with different variables each week to improve flavor, texture, taste, mouth feel, and the porous quality of the muffin. To produce the best texture we started by experimenting with the type of blueberries, comparing dried with frozen. The frozen blueberry gave more flavor throughout the muffin. When the muffin was not sweet enough, we decided to add carrot and compare it with Granny Smith apple. Granny Smith apple gave a tart and sweet flavor that was desirable to consumers. The original muffin recipe contained two types of seeds, but due to consumer testing we decided to omit sesame seeds due to the comments about an overly-seedy muffin. By taking out sesame seeds we not only reduced seediness of the muffin but also decreased an off-flavor that the muffin possessed. To make the muffin a wholesome baked breakfast treat we decided to experiment with the addition of cinnamon and vanilla, which was well accepted by consumers. Once our Apple Blueberry Muffin was perfected, we added a line extension of a Banana Walnut Muffin to diversify our customer base.

To ensure that muffin had reproducibility we baked under consistent conditions each week, using the same measurement tools and techniques. This included working in the same kitchen unit, and using the same oven, and always preheating to 350 F. All the ingredients were measure in grams utilizing the same scale. Since there were four food science students making the product each week, each student completed the same tasks to keep consistency in product development. The food panelists for weeks 1-6 were the 11 students from the 3 other product development teams in the class. They were given score sheets differing week to week, and panelists were informed which was the control and which was the prototype muffin before scoring. However, The panelists were not given specific details about the muffins before sampling. For Week 7, the food panelists were guests of the class participants, or recruited from outside the classroom. All food panelists were untrained in sensory an descriptive analysis.

Statistics

The results from the likability and JAR scales were entered into SPSS to measure both means and frequencies. Excel was used to evaluate the comparisons between prototypes and by conducting a t-test. Descriptive Analysis generated a lexicon for the characteristics of the muffin. The Hedonic Scale and JAR Scale assessed the consumer's likability and acceptability of the muffin.

Results:

The Acceptability and JAR (Table 6) scales were used for sensory evaluations completed by the thirty-three randomly selected college students as they tested one sample of each muffin. For the blueberry muffin prototype, the mean Acceptability was 5.18 (standard

deviation 2.19) and 75.8% of analysts chose a JAR value between three and five. For the banana-nut prototype, the Acceptability and JAR mean scores were 7.15 (standard deviation 1.86) and 4.91 respectively (Table 6). Some of the positive feedback from testers about the banana-nut line extension was that it had a good banana aroma and flavor, excellent moisture content, and a nutty, earthy after-taste. Some negative feedback was that the banana flavor was too strong, and the earthy after-taste was unappealing. In a paired sample test of the acceptability between the Banana Nut and Blueberry muffins, the Standard Error Means were 0.323 and 0.381 respectively. Table 8 summarizes the qualitative responses given by the consumers during the final prototype analysis.

Discussion:

Limitations of this project are the potential biases that may have impacted the objectivity of the experiment, including our own bias/like of our product and hope for its success as well as the bias of panelists who were aware of our intentions and previous treatments. Further, panelists were not formerly trained prior to analysis and our lexicon was not developed before the start of the experiment. Although we did make attempts to control for human error (as discussed in the methods section of this paper), there is also the possibility of ingredient brand changes, ingredient freshness inconsistency, inaccurate measurements, and temperature changes. It should also be noted that the researchers themselves have had little of their own experience with product development before this project.

Conclusions and Recommendations:

In summary, we conclude that it is possible to create a delicious and healthy gluten-free, dairy-free muffin with strong consumer acceptability that fulfills the unmet need in the market for an alternative baked good with desirable texture, flavor, taste, mouth feel, and overall appearance. Furthermore, of the two flavors we produced, we found that the "Banana Walnut" muffin had the best general acceptability (JAR scale) during consumer testing and would be a good starting point for production. In view of the increasing demand for gluten-free products in the marketplace, this product could have high potential success. Currently, there are very few breakfast muffins available that meet the gluten-free, dairy-free specifications while remaining truly healthy (fiber rich, high in polyunsaturated fatty acids, vitamins & minerals etc.) in addition to maintaining a good flavor, texture, crumb, and density. The muffins could potentially be sold anywhere from health food stores to major grocery outlets, many of which now contain specified sections for allergen-free products.

In further research on gluten-free, dairy-free baked goods and muffins, it would be useful to compare the items currently available to the consumer in the marketplace. At present, few studies give a broad comparison of the sensory and instrumental measurements of the qualities of gluten-free dairy-free muffins and cakes. Many of these products vary in quality, texture, and acceptability among consumers. One could compare the available allergen-free muffins and cakes in order to gauge which attributes are acceptable or unacceptable to the consumer. Because the market is relatively new and expanding, this research could prove very useful in future gluten-free, dairy-free product development.

There are several areas that could have been better organized during our gluten-free dairy free muffin research. First, it would be useful to compare sensory attributes of prototypes with an equivalent gluten and dairy-containing muffin. Due to limited budget and time constraints, we were unable to produce more than one type of product, but it would be

beneficial to have a standard muffin for both sensory and instrumental analysis. Also, our sensory data would be stronger and more conclusive if we had access to trained panelists for sensory evaluation. Our inexperience as students new to the food science field is a further limitation in the data. This factor also leads to bias in our study. In addition to this, we could create a lexicon to uniformly evaluate sensory attributes before initial prototypes are created in the future. In this way, the sensory evaluations would remain more consistent and allow for more direct identification of specific product attributes. Finally, we could determine the sensory or hedonic scale to be used in consumer and bench-top evaluations before the initial prototypes are made, this way we would have a consistent scale from week to week that could more easily be quantified into consistent, useful data.

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