

## **Development and Sensory Evaluation of a Soy Protein/Gingerbread Muffin**

**Laura Taylor**  
**Raga Bakhit**  
**Frank Conforti**

### **Abstract**

Recently, the Food and Drug Administration (FDA) authorized a health claim, to be used on food labels, stating that 25 grams of soy protein each day may significantly reduce the risk of coronary heart disease. In this research, a soy product was developed that may be used to encourage the consumption of soy containing foods by those at risk of heart disease. Gingerbread muffins were prepared according to seven different recipes mainly with variations in soy protein isolate (SPI) content and spices that were based on the comments of the sensory evaluators. Other ingredients were kept as constant as possible. The SPI content of the muffins varied from 8.6 to 14.7 g per muffin. Upon sensory evaluation of the products, it was found that the most highly rated muffin contained approximately 12.1 grams of soy protein. The incorporation of this muffin type into the diet would have a positive effect on lowering high plasma cholesterol levels in the consumer, and thus lessen the chance of heart disease.

### **Introduction**

Coronary heart disease (CHD) caused in part by high blood levels of cholesterol and low-density lipoprotein (LDL) cholesterol is the leading killer of the American population. Certain dietary measures can be used to reduce risks and even treat this disease. For example, the American Heart Association recommends a low-fat, low-cholesterol diet, high in fruits and vegetables as a strategy for lowering cholesterol levels and hence the risk of CHD.

Previous research has shown soy protein intake to be effective in preventing new and recurrent cardiovascular disease in human subjects through the reduction of plasma concentrations of LDL cholesterol (Nilausen and Meinertz 1999; Vitolins, Anthony, and Burke 2001). It is important to note that the effect of soy protein is more pronounced in persons at risk of heart disease, such as those whose hypercholesterolemia is moderate (Tsyganova, Klassina, and Konotop 2001) or

more pronounced (Bakhit et al. 1994). In addition, there are promising early findings on the protective effects of soy protein against hot flashes (Nagata et al. 2001), breast cancer risk (Shu et al. 2001), and osteoporosis (Choi et al. 2001). However, the strongest evidence on the beneficial effects of soy protein is its potential to lower the risk of CHD. Obtaining cardiovascular health benefits requires use of more soy protein in food products commonly consumed in the diet. A food item such as a soy protein muffin may prove to be a product that consumers will enjoy and purchase.

The addition of soy products to a diet can be monitored within a research environment, but doing so to the diets of the general public is not quite as easy; consumers, in general, do not associate soy with acceptable food taste (Erdman 1995). Acceptance and purchase of soy-containing muffins will be greatly influenced by whether or not the muffin is similar to non-soy products. The objectives of the study were to develop a muffin containing a level of soy protein that would be acceptable on a sensory level, and then through sensory analysis determine the level of consumer acceptance for soy protein isolate (SPI).

### **Research methods**

Muffins were prepared in the food laboratories of the Department of Human Nutrition, Foods, and Exercise at Virginia Polytechnic Institute and State University. Ingredients included soy protein isolate (Protein Technologies International, St. Louis, Missouri), bleached all-purpose flour, baking soda, cinnamon, ginger, nutmeg, ground cloves, butter, sugar, egg whites, molasses, water, applesauce, and skim milk. Table 1 lists the ingredients for each muffin variation. Each week for 5 consecutive weeks, two recipe variations were prepared, with the exception of the first week when only one recipe was prepared. Increments of soy protein isolate were used and spice amounts were altered to subdue any strong aftertastes.

All dry ingredients were combined in a medium bowl, then set aside for later use. In a large bowl, the butter and sugar were creamed prior to the addition of egg whites, molasses (thinned with water), applesauce, and milk. The mixture was blended well after the addition of each liquid ingredient. The dry ingredients were added in thirds to the liquid mixture and beaten with an electric hand mixer until just moistened so as not to over-beat. Paper- and foil cup-lined muffin tins were partially filled with equal amounts of dough and the 30 muffins were baked at 350° F (177° C) for 20-22 minutes. They were then removed from the tins and cooled on wire racks for 1 hour before sensory evaluation.

## Sensory evaluation

A Hedonic Scale, which was slightly modified, from Klein, Perry, and Adair (1995) was used for evaluating the muffins. Muffins were rated by 19 panelists on appearance, texture, flavor, and overall acceptability (Figure 1).

## Results and discussion

Sensory characteristics and the mean rating (out of possible 9 points) for each sample are presented in Table 2. The ratings of all characteristics were consistent; ratings either increased or decreased together.

Results of sensory evaluations of muffins A, B, C, and D were similar, with muffin D (12.2 grams SPI) having the highest ratings for most sensory attributes (Figure 1). Acceptability deteriorated for muffins containing more than 12.3 grams each of SPI (E and F). Efforts to improve the sensory quality of the muffins by changing other ingredients did not result in greater acceptability (G). Flavor and texture were fairly consistent in each product, though complaints of strong aftertastes resulted in an alteration of the amount of spices in the succeeding recipes. As the amount of soy protein isolate increased, participants detected a gritty texture contributed to the muffin by the soy. Therefore, it was concluded that the recipe for muffin D produced the most acceptable muffin. Subjects expressed verbal and oral appreciation of this muffin and indicated that they would be willing to purchase such a muffin.

## Conclusions

Soy protein isolate has been shown to reduce high blood cholesterol levels and, thus, is viewed by scientists as a dietary ingredient to reduce risk for CHD (Bakhit et al. 1995; Fache 1999). The substitution of soy in reduced-fat muffins was successful in providing data that soy-containing foods can taste similar to non-soy-containing foods. The amount of soy used in a food product must be tested so as not to impart the gritty and nutty component of the soy. Subjects enjoyed participating in the study and were helpful in aiding with recipe alterations to best suit their personal tastes. Future research in this area is highly recommended because of the great demand for cholesterol-lowering products to combat the threat of heart disease. Similar recipe development projects can be conducted in schools, 4-H groups, summer camps, and elder hostel groups in order to educate the public about inclusion of SPI in their favorite foods. Competitions and prizes for the winning recipes might be a way to encourage participation. Marketing a wide range of soy products can help many individuals in the general population to live longer and healthier lives.

**Table 1. List of ingredients for muffin variations**

Ingredients (grams)	Control	A	B	C	D	E	F	G
All-purpose flour	625	312.5	250	218.7	187.5	218.8	125	93.8
Isolated soy protein	-	212.5	255	276.3	297.5	318.8	340	361.3
Baking soda	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
Cinnamon	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Ginger	5	5	5	5	5	5	4	4
Ground cloves	2.5	2.5	2.5	2	2	2	2	1.5
Nutmeg	5	5	5	4	4	4	3	3
Butter	93.5	93.5	93.5	93.5	93.5	93.5	93.5	93.5
Sugar	132	132	132	132	132	100	100	100
Egg whites	87	87	87	87	87	87	87	87
Molasses	240	240	400	400	240	240	240	240
Hot water	60	60	60	60	60	60	60	60
Applesauce	425	425	425	425	425	425	425	425
Milk	162	162	244	244	162	162	162	162

**Table 2. Sensory results of muffin variations.**

Muffin	Control	A	B	C	D	E	F	G
Soy grams per muffin	0	8.6	10.4	11.2	12.1	12.9	13.8	14.7
Overall	7.0	7.4	7.1	7.0	7.4	5.3	6.6	5.6
Flavor	7.5	7.0	7.2	7.1	7.2	5.1	6.7	5.3
Texture	6.6	7.5	6.9	6.9	7.2	5.1	6.6	4.7
Appearance	6.9	8.1	7.4	6.7	7.5	5.1	6.5	5.7

1. Results are based on a Hedonic Scale. Highest rating is 9 for "Like extremely," and lowest is 1 for "Dislike extremely".

**Figure 1:** Hedonic score card for measuring acceptability of gingerbread muffin supplemented with soy protein (modified from Klein, Perry, and Adair, 1995)

**SENSORY EVALUATION SCORECARD**

Product \_\_\_\_\_ Date \_\_\_\_\_

Please evaluate the product by looking at it and tasting it.

Considering **ALL** characteristics, please indicate your overall opinion by checking one box:
 .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....

Dislike extremely ..... Neither like nor dislike ..... Like extremely

Taste the product as many times as needed and indicate how much you LIKE or DISLIKE the following:

**OVERALL APPEARANCE**
 .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....

Dislike extremely ..... Neither like nor dislike ..... Like extremely

**OVERALL FLAVOR**
 .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....

Dislike extremely ..... Neither like nor dislike ..... Like extremely

**OVERALL TEXTURE**
 .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....  .....

Dislike extremely ..... Neither like nor dislike ..... Like extremely

Share any comments about this product on the back of the form. THANK YOU!!

**References**

Bakhit, R.M., and S.M. Potter, and B.P. Klein, and D. Essex-Sorlie, J.O. Ham, and J.W. Erdman Jr. 1995. Intake of 25 g soy protein with or without soy fiber alters plasma lipids in men with elevated cholesterol concentrations. *Journal of Nutrition* 124:213-222.

Choi, E.M., and K.S. Suh, and Y.S. Kim, and R.W. Choue and S.J. Koo. 2001. Soybean ethanol extract increases the function of osteoblastic MC3T3-E1 cells. *Phytochemistry*56(7):733-9.

Fache, W.Y. 1999. Effects of soy protein and isoflavones on plasma lipid profiles in patients with cardiovascular disease. *Journal of Medicinal Food* 2(3/4): 261.

Erdman, J.W. 1995. Control of serum lipids with soy protein. *New England Journal of Medicine* 333:314.

Klein, B.P., A. Perry, and N. Adair. 1995. Incorporating soy proteins into baked products for use in clinical studies. *Journal of Nutrition* 125:666S.

Nagata, C., N. Takatsuka, and N. Kawakami, and H. Shimizu. 2001. Soy product intake and hot flashes in Japanese women: results from a community-based prospective study. *American Journal of Epidemiology* 153(8):790-3.

Nilausen, K., and H. Meinertz. (1999) Lipoprotein(a) and dietary proteins: casein lowers Lipoprotein(a) concentrations as compared with soy protein. *American Journal of Clinical Nutrition* 69:423.

Shu, X.O., F. Jin, Q. Dai, W. Wen, J.D. Potter, L.H. Kushi, Z. Ruan, Y. T. Gao, and W. Zheng . 2001. Soyfood intake during adolescence and subsequent risk of breast cancer among Chinese women. *Cancer Epidemiology Biomarkers Prevention* 10(5):483-8.

Vitolins M.Z., M. Antohoy, and G.L. Burke. 2001. Soy protein isoflavones, lipids and arterial disease. *Current Opinions in Lipidology* 12(4):433-7.

Tsyganova T.B., S.I. Klassina, and N.S. Konotop. 2001. Soya protein-lipid complex as a corrective agent of lipid metabolism and functional state in moderate hypercholesterolemia. *Vopr Pitan* 70(1):25-8. (Russian)

### **Authors**

Laura Taylor, Raga Bakhit, Ph.D., and Frank Conforti, Ph.D., Department of Human Nutrition, Foods and Exercise, Virginia Polytechnic Institute and State University.

The authors express their gratitude to Ruby Cox, Ph.D., R.D., and Joan Elledge, M. S., for their time and assistance with editing this manuscript. Our thanks also to the volunteer panelists for their invaluable suggestions.

### **Cite this article:**

Taylor, Laura, Raga Bakhit, and Frank Conforti. 2002. Development and sensory evaluation of a soy protein/gingerbread muffin. *The Forum for Family and Consumer Issues* 7(1).