Abstract

Flax seed has recently been studied as a preventive strategy for cardiovascular health, diabetes, and symptoms of menopause and ovarian and breast cancers. Flax is a rich source of lignans, polyunsaturated fatty acids and fiber. Lignans are a major group of phytoestrogens. Alpha-linolenic acid, an Omega-3 fatty acid, makes up about 55% of the total fatty acids present in flaxseed. Flaxseed is also a rich source of dietary fiber, another reducing agent of cardiovascular disease risk. Two thirds of the fiber found in flaxseed is insoluble, meaning that it reduces constipation while the remaining one third may reduce cholesterol and the risk for heart disease. The methods of the study used two variable. The control had normal amounts of dietary fat and flour. The first variable added flax meal to the flour while the third variable used flax meal in place of fat.

Introduction

Flax seed has been used throughout the ages for medicinal and other practical uses. Recently, it has been studied as a preventive strategy for cardiovascular health, among other things. It is a rich source of lignans, a major group of phytoestrogens, and has reported anti-oxidant and anti-tumorigenic properties. Lignans are structurally related to estrogen. They can bind to estrogen receptors and create partial reactions similar to the sex hormones. This is why many menopausal women, who are advised against hormone replacement therapy, have begun to consume flax. A study conducted by Dodin et al showed that 40 g of flax seed, given to 199 menopausal women for 12 months, could reduce serum total cholesterol as well as reduce the severity of menopause symptoms.

Flax seed also had high levels of omega-3 fatty acids. These fatty acids have been linked to decreased cardiovascular disease, Alzheimer’s, Parkinson’s among many others. Alpha-linolenic acid, an Omega-3 fatty acid, makes up about 55% of the total fatty acids present in flaxseed. Flaxseed also contains 75-800 times higher levels of SDG, another omega03 fatty acids. Flaxseed is also a rich source of dietary fiber, another reducing agent of cardiovascular disease risk. Two thirds of the fiber found in flaxseed is insoluble, meaning that it reduces constipation while the remaining one third may reduce cholesterol and the risk for heart disease.

A study by Lucas et al showed that flaxseed lowered total cholesterol by 4.7%. However, they also found that when the flaxseed was given in a food, in this case muffins, it could lower cholesterol by 14.7%. Another study by Ogborn et al discovered that flax oil given to rats for 8 weeks could reduce renal injury. They also mention positive effects with lupus and glomerulosclerosis from other studies. Flax seed can be an important food source of needed PUFA. Therefore new ways of using this product in the food source could increase awareness and prevent inflammatory diseases such as heart disease. It is necessary to study how best to include flax seed into our food.
products; through addition to flour or substitution for fat? Both will increase consumption but which will produce a more acceptable, tender product?

Methods

Objectives: The design of this study was to find acceptable methods for using flax meal in the diet. Would consumers more likely choose a sample that had flax meal simply added to the mixture or is flax meal as a fat replacer acceptable to consumers? The objectives of this project were to measure the tenderness of the samples with a texture analyzer, measure the color changes with a colorimeter, and to measure taste by consumer paneling.

Variables: A control sample of chocolate chip cookies with normal amounts of fat (margarine) and flour was established. The variables included flax seed meal added to the flour and flax meal substituted instead of fat.

Composition: The samples were analyzed for dietary composition using Food Processor.

Procedures:
Control: Chocolate chip cookie

• ¼ cup (62.5mL/59.8g) of margarine
• ¼ cup (62.5mL/59.8g) of brown sugar
• 1/8 cup (31.25mL/29.96g) granulated sugar
• ¼ tsp (1.25mL) vanilla
• ½ eggs beaten
• ½ cup (113.4g) all purpose flour
• ¼ tsp (1.18g) baking soda
• 0.6g salt
• ¼ cup (56.7g) chocolate chips

• Preheat oven to 350°F
• Cream margarine and sugars
• Add vanilla and beaten egg
• In separate bowl, combine flour, baking soda, and salt, chocolate chips. Add to creamed mixture. Mix for 75 strokes
• Drop by teaspoonful onto cookie sheet leaving 2 inches between cookies
• Bake for 10-12 minutes, until golden
• Remove sheet and cool

Variable: Flax added to mixture

• ¼ cup (62.5mL/59.8g) of margarine
• ¼ cup (62.5mL/59.8g) of brown sugar
• 1/8 cup (31.25mL/29.96g) granulated sugar
• ¼ tsp (1.25mL) vanilla
• ½ eggs beaten
• ½ cup (113.4g) all purpose flour
• ¼ tsp (1.18g) baking soda
• 0.6g salt
• ¼ cup (56.7g) chocolate chips
1/16 cup (11.98 g) ground flax seed

- Preheat oven to 350F
- Cream butter and sugars
- Add vanilla and beaten egg
- In separate bowl, combine flour, baking soda, and salt, chocolate chips, and flax. Add to creamed mixture. Mix for 75 strokes
- Drop by teaspoonful onto cookie sheet leaving 2 inches between cookies
- Bake for 10-12 minutes, until golden
- Remove sheet and cool

Variable: Fat replaced with flax seed
- ¼ cup (179.4 g) flax seed meal
- ¼ cup (62.5mL/59.8g) of brown sugar
- 1/8 cup (31.25mL/29.96g) granulated sugar
- ¼ tsp (1.25mL) vanilla
- ½ eggs beaten
- ½ cup (113.4g) all purpose flour
- ¼ tsp (1.18g) baking soda
- 0.6g salt
- ¼ cup (56.7g) chocolate chips

- Preheat oven to 350F
- Cream flax seed meal and sugars
- Add vanilla and beaten egg
- In separate bowl, combine flour, baking soda, and salt, chocolate chips. Add to creamed mixture. Mix for 75 strokes
- Drop by teaspoonful onto cookie sheet leaving 2 inches between cookies
- Bake for 10-12 minutes, until golden
- Remove sheet and cool

Replications: The procedures were replicated three times with 10 samples produced per replication. This was possible because each sample was weighed out to be 3.0 grams.

Discussion

Flax seed has been implicated in the prevention of chronic disease and their risk factors. It has been targeted due to its main components, poly-unsaturated fatty acids, lignans, and fiber. Polyunsaturated fatty acids are responsible for brain and heart health. Lucas et al. gave 72 hamsters various doses of flaxseed. They saw an effective means in reducing the total cholesterol in the hamsters that had their ovaries removed. They also saw that all the dosage levels of flax seed reduced fatty streak area in the veins and incidence of lesions.

Flax seed/oil has been implicated in the treatment of diabetes. Velasquez et al. saw improved insulin levels in rats when given flax seed meal for 6 months. The original hypothesis of this study was that cookies with flax seed substituted for fat would produce
a less tender product than the control or variable with flax added to flour. The data suggests that this hypothesis may or may not be true.

**Nutrient Content**
The nutrient content of the cookies was analyzed with Food Processor.

**Control (one sample)**
- Calories- 106
- Fat- 6.6
- Saturated fat- 2.7
- Cholesterol- 15.5mg
- Total Carbohydrate- 11.4g
- Dietary Fiber- 0.5g
- Sugars- 6.3g
- Protein- 1.2g

**Flax meal added to flour (one sample)**
- Calories- 111
- Fat- 6.9g
- Saturated Fat- 2.7g
- Cholesterol- 15.5mg
- Total Carbohydrate- 11.7g
- Fiber- 0.6g
- Sugars- 6.3g
- Protein- 1.4g

**Fat substituted with flax meal (one sample)**
- Calories- 121
- Fat- 5.8g
- Saturated fat- 1.1g
- Cholesterol- 10.5mg
- Total Carbohydrate- 15.5g
- Fiber- 1.5g
- Sugars- 6.2g
- Protein- 3.2g

The nutrition facts show that replacing the fat from the control sample with flax meal will contribute more calories but also more fiber, less fat and less cholesterol. The variable with adding flax to the flour provided more calories and more fat than the control but also contributed more protein and slightly more fiber.

**Texture Analyzer**
The texture analyzer was originally set knife probe for force to compression. The pre speed was set at 2.0mm/s and the speed increased in 5.0mm/sec. The trigger was 4.0g. The analyzer measured the force needed to break the surface of the cookies. It was expected that the control and sample with flax added to the flour would be very similar. The control gave an 8.2grams of force reading while the variable with flax added gave
5.6 gram reading. This could have been a result of cooking times not being exactly the same or oven temperatures. The third variable with fat replaced by flax meal required 11.5 grams of force to break the surface of the cookie.

**Hunter Colorimeter**

The Hunter Colorimeter is used to measure changes in color that could be seen with the human eye. It was used in this experiment to determine if the flax meal created differences in the color of the product and thereby possibly affecting the acceptability of the cookie.

The results were averaged for the three trials and the L, a, b values are illustrated in graph 2. There were color changes from the control sample in both variables. The variable with flax added to the flour did not change as much as the variable with fat replaced with flax. It was expected to observe greater differences among the control and the variable with replaced fat.

**Consumer panel**

The consumer panel consisted of ten students for each trial that tasted all three samples and rated them, using a 9 point hedonic scale for taste and tenderness. The samples were given three digit numbers to prevent suggestion as to which was the better product. The consumers, on average, rated the control sample as an 8.5 in terms of taste and an 8.0 in terms of tenderness. The second variable, with added flax, was rated an 8.0 and 7.0 respectively. The third sample, replaced fat by flax, was given 7.0 and 6.5 in terms of taste and tenderness. These values are illustrated in graphs 3 and 4. It was expected to have greater variety of numbers than actually shown from the data. This suggests that the samples were all acceptable in taste and tenderness with the control sample being the most favorable.

**Conclusions**

Flax meal is an alternative way to increase the consumption of omega-3 fatty acids, fiber and lignans. These components are all indicated in research to promote cardiovascular health as well as prevent other chronic diseases. However, Suglin and Prasad, gave 15 healthy men 3 muffins with 32.7 total grams of flaxseed for 4 weeks. They measured their blood pressure and found that four weeks of flax seed supplementation does not affect blood lipid or pressure levels. This is an argument that flaxseed needs to be added to what is commercially available in order to affect chronic disease in consumers. The data from this study indicates that flax meal may also be a healthy alternative to fat in most baking recipes.

**Results**
Graph 1

Texture Analyzer

![Bar graph showing force (g) for Control, Flax + Mix, and Flax replacing fat.]

Graph 2

Hunter Colorimeter

![Bar graph showing L, a, and b values for Control, Flax + Mix, and Flax replacing fat.]
Graph 3

Graph 4

Results


