

Milled Flax as a Nutraceutical and its Use in Baked Goods

How flax can be used in food products for health benefits

Introduction to Fortification

Nutraceutical –

a product isolated or purified from foods that aids in the prevention and/or treatment of disease(s) and/or disorder(s)

Examples:

Items with antioxidant properties

- Resveratrol in red grape products
- Flavonoids in citrus, tea, wine, and chocolate

Items that improve arterial health

- Isoflavonoids in soy and clover

Items that lower risk of cardiovascular disease

- α-Linolenic acid in flax or kiwifruit seeds
- EPA and DHA omega-3 fatty acids in fish oil

Fortifier –

a micronutrient (an essential trace element or vitamin) added to food

Applied to retail products worldwide

Examples:

- Vitamin D and its application in dairy products
- Potassium iodide, commonly added to table salt
- Fluoride, folic acid, and niacin (common fortifiers; less well-known by the public)

In general, the public has little knowledge or familiarity with the specific nutritional benefits of fortifiers

Flax Additives and their Properties

Introduction to Flax Usage

- Flax is the seed from *Linum usitatissimum*
- Highly versatile, has applications in multiple industries
- One of the most popular food additives
- Useful in solid, liquid, and powder forms



Fortification Methods

Biofortification

- Selective breeding
- Genetic modification

Home fortification

- Nutritional items
- Micronutrient powders

Commercial and industrial fortification (most common)

- Folic acid, fluoride, other micronutrients

Properties of Flax

Classified as a nutraceutical

Flax has high amounts of the following key substances: (Dahl, et al., 2005)

- Dietary fiber
- Antioxidants
 - Secoisolariciresinol diglucoside (SDG), a lignan
 - Flax is the richest known source of lignans, which work as antioxidants
- Omega-3 (ω-3s) fatty acids
 - Flax is the most widely-available botanical source of α-Linolenic acid (ALA)
 - Flaxseed oil is six times richer in ω-3s than most fish oils
 - The ω-3 oils are essential for humans; are one of the leading substances sought for their functional properties (Starling, 2009)

Beneficial qualities:

Anti-arrhythmic quality (Ander et al., 2004)
(suppresses abnormal rhythms of the heart)

Anti-atherogenic quality (Dupasquier et al. 2007, 2006)
(prevents fat deposits from forming in arteries)

Anti-inflammatory qualities
(Dupasquier et al., 2007)

Improves vascular function
(Dupasquier et al., 2006)

Research Focus

Investigates the uses of flax as a component in food
Aspects of the study:

- Evaluating the general recognition of the benefits of flax and the acceptance of flax fortification by the subjects in the study
- Includes a subjective evaluation of the taste of the finished products

The larger objective of this study is to evaluate the potential and appeal for products with flax as a fortifier

Current home-manufactured and commercially-manufactured flax foods



<http://cookeatshare.com/recipes/chocolate-chip-flax-seed-brownies-healthy-gluten-free-snacks-for-kids-625707/>



<http://therawchef.com/wp-content/uploads/2012/10/raw-food-recipe-Thai-Flax-Crackers.jpg>

Rationale

Source	Amount	Vitamin D Content	Vitamin D Type
Fortified Milk	8 oz.	100 IU	D ₃
Fortified Orange Juice	8 oz.	100 IU	D ₃
Infant Formulae	8 oz.	100 IU	D ₃
Fortified Yogurts	8 oz.	100 IU	D ₃
Fortified Butter	3.5 oz.	50 IU	D ₃
Fortified Margarine	3.5 oz.	430 IU	D ₃
Fortified Cheeses	3 oz.	100 IU	D ₃
Fortified Breakfast Cereals	1 Serving	100 IU	D ₃

Fig. 1. Applications of Vitamin D
http://0.tqn.com/d/dermatology/1/0/7/7/rd_Fortified.jpg

Questionnaire

Consumer aspects are important to determine effectiveness, including:

- Consumers' knowledge and opinions of flax being used to modify food and being used in fortified products
- The ability of consumers to compromise good-tasting foods for more healthful alternatives

Results

Question One: Familiarity



Question Two: Diet Acceptability

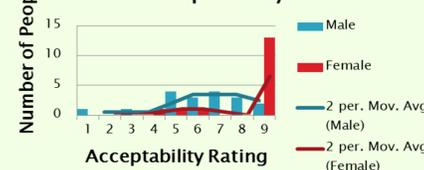


1. How familiar are you with the specific nutritional benefits of flax?
2. How acceptable would you be to consuming flax in your diet on a regular basis?

Question One: Familiarity



Question Two: Diet Acceptability



Rationale

Product development

Taste and aroma are obstacles in development of a functional and acceptable product:

- High ALA content increases susceptibility for oxidative rancidity, which negatively affects the taste and aroma of the product (Aliani et al., 2011)
 - Low levels of flax addition may be suitable
- Baked products are very suitable for fortification and clinical trial use:
- Widely consumed
 - Can be frozen until needed
 - Require little preparation once thawed
 - Can be readily transported
 - Baking does not affect ALA or SDG amounts (Chen et al., 1994) (Muir et al., 1996)
- Milled flax is suitable, as it has less detectable texture than ground flax, and is more stable than flaxseed oil under high temperatures



Golden flax
<http://organiceyourlife.com/wp-content/2011/09/Golden-Flax-Seed1.jpg>



Flax meal
http://www.whole-body-detox-diet.com/images/flax_meal.jpg



Brown flax
<https://www.myherbs.net/images/stories/virtuemart/product/brown-flax-seed.jpg>



Flaxseed or linseed oil
<http://www.weightlossbody.com/images/stories/food/flaxseed-oil.jpg>

	1 tbsp. whole flaxseed (10 g)	1 tbsp. ground flaxseed (7 g)	1 tbsp. flaxseed oil (14 g)
Calories	55	37	119
Total Fat (g)	4	3	14
Saturated Fat (g)	0	0	1
Carbs (g)	3	2	0
Fiber (g)	3	2	0
Protein (g)	2	1	0
Calcium (mg)	26.1	17.9	0
Iron (mg)	.6	.4	0
Omega-3s (g)	2.3	1.6	7.2
Omega-6s (g)	.6	.4	1.7

<http://www.fitsugar.com/Nutritional-Comparison-Flaxseeds-Flaxmeal-Flaxseed-Oil-17932789>

Methods and Results

- Product development
- Sensory evaluation with 35 participants from New York suburban communities

Each participant received:

- Six scale sheets each containing fifteen scales
 - Whole wheat rolls
 - Blueberry-orange muffins topped with pecans
 - Cheddar-herb biscuits
- (each with and without added flax)

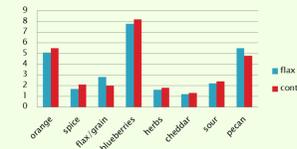


Questionnaire:

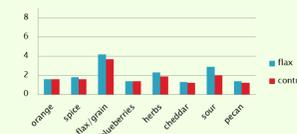
- Basic demographic data – age, race, and gender
 - Familiarity with flax benefits
 - Willingness to adapt daily diet to include flax
- Fifteen hedonic scales used
- Intensities of various flavors
 - Desirability of the product

Average sensory evaluations of product flavors and aromas

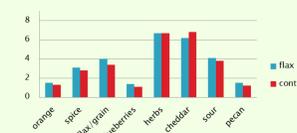
Blueberry-orange pecan muffins



Whole wheat rolls



Cheddar-herb biscuits



Images

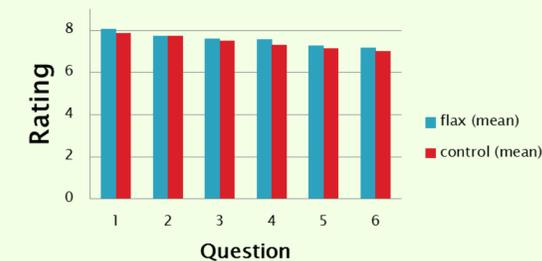


Cheddar-Herb Biscuits with Flax



Results

Average Likability of Products



1. How convenient is the product to eat?
2. How professional of a quality or commercially-made does the product appear to be?
3. Compared to currently available similar products, is the product quality better, worse, or about the same?
4. Overall, how satisfied are you with the product?
5. How well do you like the product?
6. How likely are you to recommend the product to people that you know?

Conclusions

- Development of a product with flax, with its benefits maintained in baking, in products with high acceptability scores
- Female and younger subjects found to have greater acceptability of flax and more declared knowledge of flax benefits
- Flax products developed with similar or better acceptance than controls; additive found to be insignificant or beneficial to product flavor and aroma
- Flax products hold potential as natural and simple additives to foods and other edible products

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