



**Soy Solutions to
Trans Fat-Free Baking**

SOY



SOY: It is the Answer



In the quest to create trans fat-free baked goods that retain all the flavor and quality of the original form, the answer has emerged. That answer is soy—**new soy-based oils and interesterified trans-free shortenings**. Researchers at Iowa State University conducted a scientific study to determine whether it was possible to retain the quality attributes of commercial bakery products using a one for one substitution replacing hydrogenated vegetable shortening with a trans fat-free soy ingredient alternative.

THE STUDY DETERMINED THAT:

- **One for one substitution works successfully with soy ingredients**
- **Trans fat-free soy maintains the gold standard of baked goods**
- **Lessens the strain, stress and cost of reformulation**
- **Soy helps keep the label clean and ingredient listing short**
- **Brings bakers in compliance with FDA regulations for trans-free foods**

BLUEBERRY MUFFINS

Yield: 120 muffins @ 3 oz each

Ingredients	American	Metric	Bakers %
Cake Flour	2 lbs 3.25 oz	1000 g	41.67 %
Bread Flour	2 lbs 3.25 oz	1000 g	41.67 %
Soy Flour	14 oz	400 g	16.66 %
Sugar, granulated	3 lbs 5 oz	1500 g	62.5 %
Salt	0.5 oz	15 g	0.625 %
Baking Powder	3 oz	90 g	3.75 %
Eggs, whole	2 lbs 3.25 oz	1000 ml	41.67 %
Eggs, whites	14 oz	400 ml	16.66 %
Milk, whole	4 lbs 6.5 oz	2000 ml	83.33 %
Soybean Oil (ULLO)	1 pint 5 oz	600 ml	25 %
Vanilla, extract	1.75 oz	50 ml	2.08 %
Blueberries, fresh, frozen or dried	3 lbs 5 oz	1500 g	62.5 %
Lemon zest	1 oz	30 g	1.25 %
Total	21 lbs 1.5 oz	9.585 kg	399.37 %

Method:

- Sift the dry ingredients into a large bowl, which will help blending, removing impurities and aerate ingredients (cake, bread and soy flour, sugar, salt and baking powder).
- In a separate bowl combine liquid ingredients and blend well. (Eggs, whole and whites, Soybean Oil and Vanilla).
- Combine the blueberries and lemon zest with a little of the dry ingredients, set aside.
- Preheat oven to 425°F/218°C but turning down the oven to 375°F/190°C immediately after the muffins are placed inside the oven.
- Add the liquid ingredients to the dry ingredients until just blended, followed by the blueberries and lemon zest.
- Portion the batter into paper-lined muffin pans.
- Bake at 375°F/190°C for 12-15 minutes, golden brown and done.

Note:

- In the muffin method, the liquids and the dry ingredients are mixed separately and then stirred together until just combined to prevent tunneling.
- Blueberries should be the last ingredient added to a muffin batter, just before the batter is poured into the muffin pans. Avoid over-mixing as it may cause breakage and color bleeding. Fresh, frozen or dried blueberries are the best forms of blueberries for muffins.

Ingredient Declaration: Made with **Ultra Low Linolenic Soybean Oil (ULLO)** to reduce trans fatty acids. Test results December 12, 2008. Formula tested and reformulated for the use with Ultra Low Linolenic Soybean Oil (ULLO) and soy flour by Klaus Tenbergen, CMB, CEPC, Culinology® Program Director & Assistant Professor, California State University, Fresno.



The researchers compared five different soy-based shortening or oil substitutions in a variety of commercial baked goods including yellow cake, muffins, icing, bread rolls and biscuits, some of the most common and high-volume commercial bakery products. Using instrumental, physical and sensory analysis the study revealed that the interesterified shortenings performed up to gold standards in the widest range of applications when replacing hydrogenated vegetable shortenings.

Ultra Low Linolenic Soybean Oil (ULLO) worked well in products where oils are typically used (cakes, muffins) without formula modification.

This single variable study was the first to examine the performance characteristics of a wide range of trans-free soy ingredients, performed as an open research project at a public institution. This provides valuable data and results to the open marketplace.

“We tested two new interesterified soy-based shortenings,” says Lester Wilson, Ph.D., professor of food science at Iowa State University, Ames, Iowa and principal investigator in the study. “This research provides valuable information to food formulators about the performance and taste they can expect using these soy-based oils and shortenings in their own baked goods. We have every reason to believe the results we obtained are transferable from the lab to commercial operations.”

HIGH-RATIO YELLOW CAKE

Yield: 18 cakes @ 8 inches or 3 full size sheet cakes

Ingredients	American	Metric	Bakers %
Cake Flour	4 lbs 8 oz	2040 g	90 %
Soy Flour	8 oz	225 g	10 %
Sugar, granulated	5 lbs 4 oz	2380 g	105 %
Intesterified Trans-free Shortening	2 lbs 8 oz	1135 g	50 %
Salt	2 oz	56 g	2.5 %
Baking Powder	4 oz	113 g	5 %
Milk Powder, dry	8 oz	227 g	10 %
Corn Syrup, light	12 oz	340 g	15 %
Water	16 oz	454 g	20 %
Eggs, whole	10 oz	284 ml	12.5 %
Eggs, whites	2 oz	56 ml	2.5 %
Lemon, extract	1 oz	28 g	1.25 %
Total	16 lbs 3 oz	7.338 kg	323.75 %

Method:

- Sift the dry ingredients and combine with the shortening, corn syrup and water in a bowl of a 20 quart mixer fitted with a paddle attachment. Blend 5 minutes on a low speed.
- In the meantime, combine the remaining liquid ingredients in a separate bowl. Add the liquid ingredients to the creamed-fat mixture in three additions. Scrape down the sides of the bowl after each addition. When completely mixed, remove batter from machine.
- Pour the batter into prepared sheet pan or cake forms. Pan should be filled only half way.
- Bake at 360°F/183°C until a cake tester comes out clean and the cake springs back when lightly touched, approximately 16 to 18 minutes for cakes and 30 minutes for sheet cakes.

Ingredient Declaration: Made with **IE All Purpose Shortening**, containing interesterified soybean oil, which is used in applications where a reduction in trans fatty acids is desirable. Formula tested and reformulated for the use with IE All Purpose Shortening, containing interesterified soybean oil and soy flour by Klaus Tenbergen, CMB, CEPC, Culinology® Program Director & Assistant Professor, California State University, Fresno.

Soybean Oils with Reduced or No Trans Fats

Product	Baking Applications	Benefits
Standard Soybean Oil² Soybean oil pressed from standard soybeans and processed traditionally. Commonly marketed as vegetable oil.	<ul style="list-style-type: none"> • Some baked goods, snack foods 	<ul style="list-style-type: none"> • Processed without partial or full hydrogenation, thus no trans-fatty acids¹ • Virtually free of saturated fats known to increase "bad" cholesterol (LDLs) • Cost-effective • Readily available and consistent supply
1 Percent Ultra-Low Linolenic Soybean Oil² Oil processed from soybeans bred to have less than 1% linolenic acid. Less linolenic acid results in oil that is stable without partial hydrogenation.	<ul style="list-style-type: none"> • Rotary molded cookies • Sheeted and rotary cut cookie • Crackers (laminated) • Spray for sheen and finish on crackers • Spray for topical seasoning application • Sponge cake • Muffins • Dry mixes • Bread • Bread surface seasoning • Yeast-raised Danish 	<ul style="list-style-type: none"> • Stable without hydrogenation • Trans fat-free¹ • Virtually free of saturated fats known to increase "bad" cholesterol (LDLs) • Non GMO soybeans • Low melting point • Excellent shelf stability • Clean sensory profile
<3 Percent Low Linolenic Soybean Oil² Oil processed from soybeans bred to have less than 3% linolenic acid. Less linolenic acid results in oil that is stable without partial hydrogenation.	<ul style="list-style-type: none"> • Any application (hot or cold) where liquid or semi-solid shortenings are used. Not as commonly used in baking applications 	<ul style="list-style-type: none"> • Stable without hydrogenation • Trans fat-free¹ • Virtually free of saturated fats known to increase "bad" cholesterol (LDLs)
Expeller Pressed 1 Percent Low Linolenic Soybean Oil² Soybean oil from 1% linolenic soybeans processed by expeller pressing and physical refinement rather than chemical extraction. The combination of 1% linolenic soybeans and expeller pressing leads to an extremely stable oil without any hydrogenation.	<ul style="list-style-type: none"> • Deep-fried foods 	<ul style="list-style-type: none"> • Stable without hydrogenation • Trans fat-free¹ • Virtually free of saturated fats known to increase "bad" cholesterol (LDLs) • Non GMO soybeans • Natural because no chemicals used in expeller pressing or physical refinement
Expeller Pressed and Physically Refined Soybean Oil² Soybean oil from standard soybeans processed by expeller pressing and physical refinement rather than chemical extraction. Expeller pressing retains naturally occurring antioxidants that provide the oil's stability without any hydrogenation.	<ul style="list-style-type: none"> • Anywhere in the baking industry where oil is utilized 	<ul style="list-style-type: none"> • Eliminates need for hydrogenation • Trans fat-free¹ • Virtually free of saturated fats known to increase "bad" cholesterol (LDLs) • No chemical solvents or caustics used • Can be used with any type of soybean-standard or low-linolenic • Natural, organic, GMO, and non-GMO available
Chemically Interesterified Soybean Oil² Blend of fully- and non-hydrogenated soybean oils that performs like partially hydrogenated soybean oil but with lower levels of trans fatty acids. Processed with a chemical catalyst.	<ul style="list-style-type: none"> • Baked goods 	<ul style="list-style-type: none"> • Processed without partial hydrogenation, thus no trans-fatty acids¹ • May be labeled, "interesterified soybean oil" • Slightly higher in saturated fats but not those known to increase "bad" cholesterol (LDLs) • Functions like semi-solid shortening
Enzymatically Interesterified Soybean Oil Blend of fully- and non-hydrogenated soybean oils that performs like partially hydrogenated soybean oil but with lower levels of trans fatty acids ¹ . Processed with an enzymatic catalyst.	<ul style="list-style-type: none"> • Baked goods • Margarines 	<ul style="list-style-type: none"> • Processed without partial hydrogenation, thus no trans-fatty acids¹ • May be labeled, "interesterified soybean oil" • Slightly higher in saturated fats but not those known to increase "bad" cholesterol (LDLs) • Functions like semi-solid shortening • More precise and cost-effective than chemical interesterification • Less harsh on the environment than chemical interesterification
Soybean Oil-based Liquid Cake Shortening Unique vegetable oil blend based on soybean oil that performs well in batter type applications. Contains no trans fatty acids or cholesterol. Does contain emulsifiers.	<ul style="list-style-type: none"> • Batter type applications • Cakes • Cookies • Brownies • Muffins 	<ul style="list-style-type: none"> • Zero trans fat and no cholesterol • Increases moisture content and extends shelf life • Kosher certified • Better texture, higher volume and consistent results

¹ Per serving
² Standard soybean oil contains about 7 percent linolenic acid

STUDIES SUCH AS THE "EFFECT OF NEW SOYBEAN OILS AND TRANS FAT-FREE SHORTENING ON QUALITY OF BAKED PRODUCTS," conducted at Iowa State University, help further industry knowledge and broaden the variety of available applications for exciting new ingredients such as the trans fat-free soybean oils and shortenings. Studies such as this are made possible through funding from the Iowa Soybean Association and the Soyfoods Council. Commodity organizations lend value to research projects with funding from growers, processors and partner companies.

The soybean oil industry continues to develop alternatives to partially hydrogenated oil to help food manufacturers, bakeries and foodservice establishments reduce or eliminate trans fats from their products, while maintaining the taste, texture and flavor of those foods.

This most recent study was conducted at Iowa State University with principal investigators including Lester Wilson, Ph.D., and Terri D. Boylston, Ph.D.

