CFW RESEARCH

Reformulating Tortillas with Zero Trans Fat

FELICIANO P. BEJOSANO,[1,2] J. NOVIE ALVIOLA,[1] AND RALPH D. WANISKA[1]

ABSTRACT

Due to growing health concerns about trans fat, the U.S. FDA has mandated that trans fat content be included on food labels by January 1, 2006. Because declaring the amount of trans fat in foods may affect their marketability, reformulation strategies to decrease trans fat content are needed. Most of the tortillas currently in the market are formulated with hydrogenated shortening, which has a high trans fat content. The objective of this study was to determine the effects on tortilla quality of replacing high trans fat shortening with oils and shortenings that have zero or minimal trans fat content. Soybean oil, palm oil, palm oil-based shortening, and interesterified oil shortening were tested for tortilla processing properties. Tortilla quality, based on opacity, diameter, and textural attributes, was not significantly affected by the use of solid fats such as palm oil-based and interesterified oil shortenings. Fats with a low melting index, such as oils, also showed potential as alternatives for high trans fat shortening, although some adjustments in the processing procedure would be needed to produce acceptable tortillas. The study shows that with the proper selection of alternative fats quality tortillas with 0 g of trans fat per serving can be made without the use of high trans fat shortening.

Compared with saturated fats, little health risk traditionally has been associated with unsaturated fats. Recent studies have shown, however, that trans fat can have detrimental effects on health and that many of the foods we consume regularly contain trans fat. Nutritional studies done in the 1980s, for example, found that Scandinavian subjects who consumed large amounts of saturated fats had significantly lower incidences of coronary heart disease than their American counterparts who consumed smaller amounts of saturated fats but higher amounts of trans fat (7).

Most of the tortillas currently in the market are made with hydrogenated shortenings that have trans fat contents of approximately 12–30% (8). In light of health concerns about trans fat, there is a growing demand for alternative fats that will not contribute to the trans fat content of tortillas. There are a variety of alternative fats from which to choose. Generally, unmodified vegetable oils do not contain significant amounts of trans fat, but they are mostly liquid at room temperature and may not have the desired functionality of solid shortenings. One exception is palm oil, which is partially solid at room temperature in its unmodified form. Solid fats with 0–4% trans fat can be produced without hydrogenation through interesterification, fractionation, or blending of saturated and polyunsaturated oils.

Interesterification is a process that converts liquid oils into solid shortening through rearrangement or redistribution of the fatty acids on the glycerol fragment of the molecule (6). Fractionation relies on differences in melting points and triglyceride solubility to separate the oil fractions, allowing selection of fractions that have higher melting points. For example, palm oil can be separated into a liquid fraction called palm olein (used for frying) and a solid fraction called palm stearin (1).

This study aims to identify acceptable replacements for hydrogenated shortenings in zero trans fat tortilla formulations.

MATERIALS AND METHODS

Flour tortillas were prepared from a standard formula of 1.0 kg of flour (bleached, enriched, and malted flour with 10.4% protein [ADM Arkady, Enid, OK]), 120 g of shortening or oil, 15 g of salt (United Salt Corporation, Houston, TX), 6 g of sodium bicarbonate (Arm & Hammer, Church & Dwight Co., Princeton, NJ), 5.8 g of sodium aluminum sulfate (Ashland Distribution Co., Columbus, OH), 4 g of sodium propionate (American Ingredients Co., Grandview, MO), 4 g of potassium sorbate (Ashland Chemical Co., Columbus, OH), 2.5 g of sodium-2-stearoyl lactylate (American Ingredients Co.), 2.5 g of succinylated monoglycerides and distilled monoglycerides (Eastman Chemical Company, Kingsport, TN), 2.5 g of fat-encapsulated fumaric acid (Bakeshure FT, Balchem Corp., Slate Hill, NY), and distilled water at 38°C. For the fat portion of the tortilla formulation, different types of solid shortenings and oils were tested, including hydrogenated shortening (control), interesterified shortening, saturated/unsaturated oil blend shortening, palm oil-based shortening, regular palm oil, and regular soybean oil.

Tortillas were processed using the procedure described by Bello and coworkers (5), with the following modifications: shortening was mixed at low speed for 6 min, and dough temperature (32 ± 1 degree Celsius) was controlled using 38°C water and heated coils wrapped around the mixing bowl. Dough balls (36 balls, 43 ± 1 g each) were formed in a Duchess divider-rounder. The dough balls were allowed to rest for 10 min in a proof chamber (32–35°C, 70–75% RH) and transferred to the processing line. Each dough ball was hot-pressed between heated platens (1,150 psi, 201°C) covered with nonstick coated sheets (1 mm thick). Press time ranged from 1.20 to 1.30 sec depending on the fat used. Regular oils produced softer doughs that required shorter press times to produce tortillas with diameters and thicknesses similar to those from firmer doughs made with solid shortening.

The pressed dough was passed through and baked in a three-tier oven at 180°C for 30 sec. Baked tortillas were allowed to cool for 3–4 min under ambient conditions and then packed in polyethylene bags. The tortillas were stored for 20 days at 22°C.

Freshly baked tortillas were evaluated for their color, opacity, diameter, thickness, weight, pH, and moisture content. A texture analyzer (TA.XT2i, Texture Technologies Corp., Scarsdale, NY) was used to measure changes in tortilla texture during storage using a two-dimensional extensibility method (3). A subjective rollability test (4) was also used to evaluate the tortillas at 1, 2, 5, 8, 12, 15, and 20 days of storage at 22°C.

RESULTS AND DISCUSSION

Tortillas made with the control fat (hydrogenated shortening) had at least 1.3 g of trans fat per serving (Table I), which must be declared in the label. Tortillas made with the alternative oils and shortenings had 0 to <0.5 g of trans fat per serving and

[1] Texas A&M University, College Station.
[2] Corresponding author. Phone: 979/845-8377; Fax: 979/845-0456; E-mail: fbejosan@ag.tamu.edu.

DOI: 10.1094/CFW-51-0066

could be labeled as having zero trans fat content.

Good quality tortillas were made when alternative fats were substituted for hydrogenated shortening. Tortillas made with solid nonhydrogenated fats had physical properties similar to those made with hydrogenated shortening, as did those made with regular unmodified oils (Table I). Replacing the hydrogenated shortening with nonhydrogenated and regular oils did not result in significant differences in opacity, moisture, pH, thickness, weight, and specific volume. Most of the differences observed were in color measurements. Tortillas made with regular soybean oil had a slightly darker color (lower *L* and higher *a* values) than those made with other oils and shortenings but were still generally acceptable.

Although the pattern is less clear with the shortenings, unmodified oils had lower melting points than solid fat shortenings and tended to produce tortillas with softer textures than the control, as indicated by a lower extensibility modulus (Fig. 1). This finding was similar to that of Aini and Maimon (1), who studied the use of palm oils with different proportions of liquid and solid fractions for bread and found that higher levels of the liquid fraction resulted in softer bread texture. They also noted that palm oils tempered at higher temperatures had less solid fat content than those tempered at lower temperatures and produced breads with better texture and keeping quality.

Al-Hooti and coworkers (2) found, however, that without an emulsifier in the white bread formulation, bread crumb softness was significantly reduced when a palm oil blend with equal proportions of liquid and solid fractions was used. When they added an emulsifier, bread texture was the same as that of the control bread (formulated with hydrogenated shortening). Our tortilla formulation contained an emulsifier (so-

Table I. Effect of fat type on tortilla properties

Tortilla Attribute	Fat Ingredient[a]								LSD ($\alpha = 0.05$)
	S-1	S-2	S-3	S-4	S-5	O-1	O-2	O-3	
Opacity (%)	75	76	77	78	78	78	76	78	6
Moisture (%)	33.9	33.9	33.8	33.7	33.3	33.3	33.6	33.9	0.8
pH	5.38	5.45	5.47	5.43	5.46	5.48	5.50	5.36	0.15
L color value	81.38	80.53	80.66	82.14	83.11	82.11	84.94	78.11	0.78
a color value	0.48	1.02	1.22	0.28	1.63	0.21	0.11	2.42	0.26
b color value	18.83	19.31	19.39	19.35	20.70	18.57	19.10	18.87	1.21
Diameter (cm)	16.9	16.9	16.9	17.6	17.6	17.9	17.5	17.3	0.6
Thickness (cm)	0.31	0.30	0.29	0.28	0.28	0.29	0.28	0.28	0.03
Weight (g)	41.5	41.8	42.0	41.8	41.3	41.8	41.5	41.5	1.2
Specific volume (cm^3/g)	1.70	1.63	1.59	1.66	1.70	1.77	1.67	1.63	0.16
Trans fat (g)[b]	1.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	

[a] S-1: Hydrogenated shortening (control); S-2: interesterified shortening; S-3: saturated/unsaturated oil blend shortening; S-4 and S-5: palm oil-based shortening; O-1 and O-2: regular palm oil; and O-3: regular soybean oil.
[b] Grams of trans fat per 55-g tortilla.

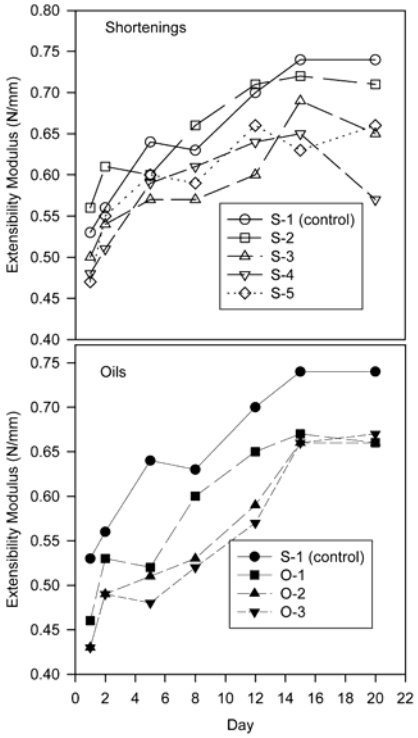

Fig. 1. Effect of fat type on changes in the extensibility modulus of flour tortillas during storage. S-1: Hydrogenated shortening (control); S-2: interesterified shortening; S-3: saturated/unsaturated oil blend shortening; S-4 and S-5: palm oil-based shortening; O-1 and O-2: regular palm oil; and O-3: regular soybean oil.

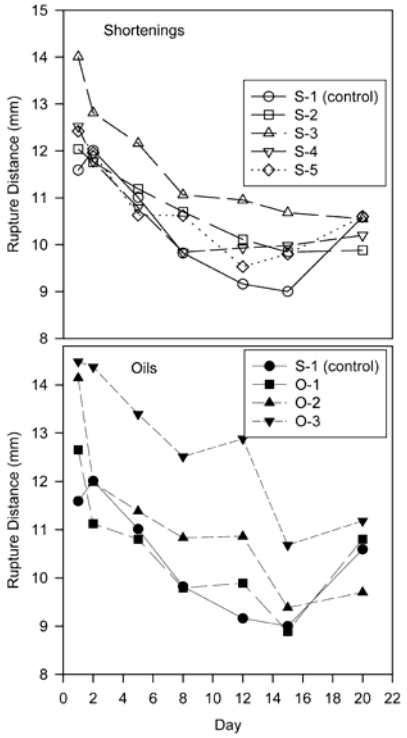

Fig. 2. Effect of fat type on changes in the rupture distance of flour tortillas during storage. S-1: Hydrogenated shortening (control); S-2: interesterified shortening; S-3: saturated/unsaturated oil blend shortening; S-4 and S-5: palm oil-based shortening; O-1 and O-2: regular palm oil; and O-3: regular soybean oil.

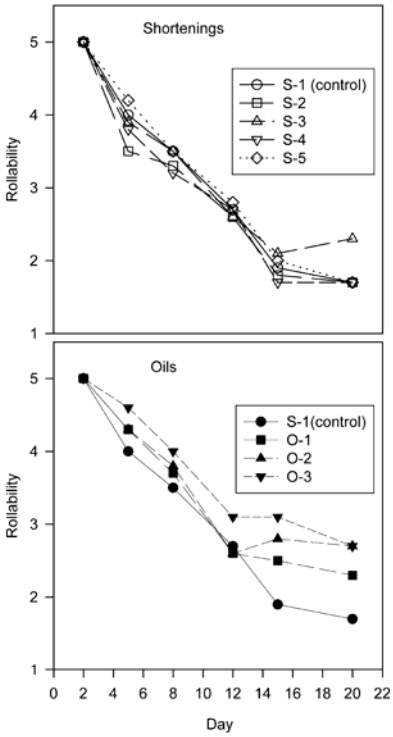

Fig. 3. Effect of fat type on changes in the rollability of flour tortillas during storage. S-1: Hydrogenated shortening (control); S-2: interesterified shortening; S-3: saturated/unsaturated oil blend shortening; S-4 and S-5: palm oil-based shortening; O-1 and O-2: regular palm oil; and O-3: regular soybean oil.

Table II. Effect of fat type on texture and rollability of tortillas after 12 days in storage

Fat Ingredient[a]	Rollability Score	Extensibility Modulus (N/mm)	Rupture Distance (mm)
S-1	2.7	0.70	9.2
S-2	2.6	0.71	10.1
S-3	2.6	0.60	11.0
S-4	2.7	0.64	9.9
S-5	2.8	0.66	9.5
O-1	2.6	0.65	9.9
O-2	2.6	0.60	10.9
O-3	3.1	0.57	12.9
LSD ($\alpha = 0.05$)	0.3	0.14	1.8

[a] S-1: Hydrogenated shortening (control); S-2: interesterified shortening; S-3: saturated/unsaturated oil blend shortening; S-4 and S-5: palm oil-based shortening; O-1 and O-2: regular palm oil; and O-3: regular soybean oil.

dium-2-stearoyl lactylate); as a result, tortilla quality was not adversely affected when the control shortening was replaced with alternative fats. This finding indicates that a robust base formulation helps preserve product quality when replacing a particular ingredient or when small changes in processing conditions occur.

During storage, the values for rollability, extensibility, and flexibility across samples followed somewhat similar trends, and most of the differences were not statistically significant (Figs. 1–3). At 12 days of storage, tortillas formulated with regular soybean oil had significantly higher rollability scores and rupture distances than those made with other types of fat (Table II). Thus, the use of unmodified oils produces tortillas with 0 g of trans fat and may also improve tortilla texture and shelf stability.

CONCLUSIONS

Unmodified oils, especially those that are liquid at room temperature, produce softer doughs when they are substituted for hydrogenated oil shortening, and as a result, processing conditions should be adjusted accordingly. Our study indicates good quality tortillas can be made without the use of hydrogenated shortenings. Nonhydrogenated shortenings (solid fats), such as interesterified oil, saturated/unsaturated oil blend, and palm oil fractions, and unmodified oils (no trans fat), such as palm and soybean oils, can be used instead to produce tortillas with quality comparable to those made with hydrogenated shortenings but with 0 g of trans fat.

References

1. Aini, I. N., and Maimon, C. H. C. Characteristics of white pan bread as affected by tempering of the fat ingredient. Cereal Chem. 73:462, 1996.
2. Al-Hooti, S. N., Sidhu, J. S., Al-Saqer, J. M., Al-Amiri, H. A., Al-Othman, A., Mansour, I. B., and Johari, M. Developing functional foods using red palm olein: Objective color and instrumental texture. Int. J. Food Prop. 7(1):15, 2004.
3. Bejosano, F. P., Joseph, S., Lopez, R. M., Kelekci, N., and Waniska, R. D. Rheological and sensory evaluation of wheat flour tortillas during storage. Cereal Chem. 82:256, 2005.
4. Bejosano, F. P., and Waniska, R. D. Functionality of bicarbonate leaveners in wheat flour tortillas. Cereal Chem. 81:77, 2003.
5. Bello, A. B., Serna-Saldivar, S. O., Waniska, R. D., and Rooney, L. W. Methods to prepare and evaluate wheat tortillas. Cereal Foods World 36:315, 1981.
6. Institute of Shortening and Edible Oils. *Food Fats and Oils*, 8th ed. ISEO, Washington, DC, 1999.
7. Juttelstad, A. The marketing of trans fat-free foods. Food Technol. 58(1):20, 2004.
8. List, G. R. Decreasing trans and saturated fatty acid content in food oils. Food Technol. 58(1):23, 2004.