

ABSTRACT

Commercial corn tortillas are produced from dehydrated masa flour and have a very short shelf-life of 1-3 days due to their lack of firmness in the product. Commercial corn tortillas use hydroxyethylcellulose (CMC) to delay staling; however, CMC is not only expensive, but also imparts off-flavors to the product. Alternative additives such as glycerol and salt may provide to be a viable option.

The objective of this study was to investigate the physicochemical changes due to the addition of glycerol/salt and CMC to corn tortillas during storage conditions.

Tortillas were prepared using a 60:40 water/masa ratio, with 0.5% glycerol (db) 1% salt (db) or 0.5% CMC (db) and were vacuum packaged individually in high-barrier pouches. Molecular and macroscopic changes were studied using differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), dynamic mechanical analysis (DMA), and Instron mechanical analysis during two weeks of storage at 25°C.

During storage all samples exhibited an increase in amylopectin crystallization, with glycerol and salt tortillas showing the greatest increase. For all tortillas, the "freezable" water (FW) content decreased over the first 3-5 days of storage with no further change while moisture content remained constant. Glycerol and salt tortillas exhibited a more homogeneous composition throughout storage characterized by a shallowness of the slope of the main transition in DMA. CMC tortillas were significantly less stiff initially but became stiffer than control and glycerol and salt tortillas yet became stiffer at a greater rate over the second week of storage. To maintain the pliability during storage, glycerol and salt may be a viable alternative to CMC if used in combination with staling agents.

INTRODUCTION

Corn tortillas represent the fastest growing segment in the baking industry.

Fresh, homemade corn tortillas become stale after a few hours and are subject to mold, yeast, and bacterial growth because of their high moisture content.

Commercial corn tortillas are commercially made with CMC, potassium sorbates and sorbates to maintain a longer shelf-life.

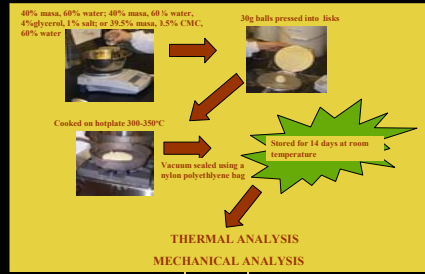
Glycerol has been added to bakery products, such as bread and wheat tortillas, to increase their pliability during storage.

The physicochemical effects of aging corn tortillas with the addition of glycerol and salt or the addition of CMC have not been reported in the literature.

OBJECTIVE

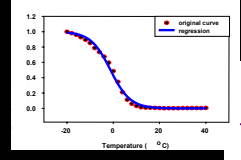
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MATERIALS & METHODS



	Weight Loss (%)
Control	52.7 ± 0.3
Glycerol & salt	50.4 ± 0.3
CMC	52.3 ± 1.1

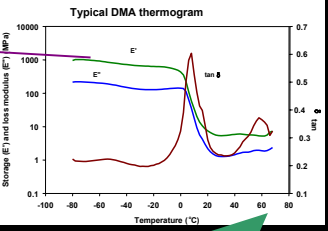
Table 1. Weight loss (attributed to moisture loss) obtained by TGA. Weight loss occurred 25-140°C in all tortillas. Glycerol and salt tortillas had a 2% lower mc than control and CMC tortillas; however, mc did not change for any tortilla treatment over time.



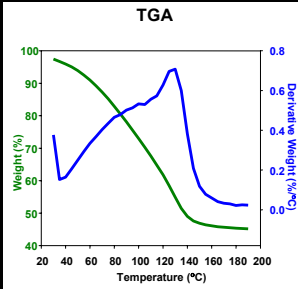
A modified Fermi equation (Peleg, 1993) for fitting E' (T) -20°C to 40°C:

$$f = (1-b)/(1+Exp((x-T)/a)) + b$$

a = slope, T = midpoint Temp (°C), b = constant

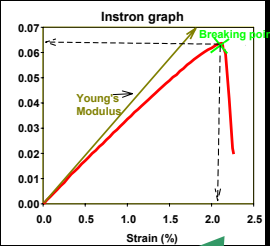
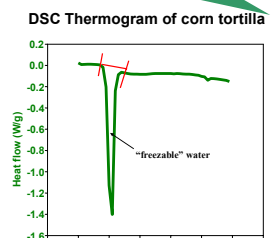


DMA 2980 TA Instruments, New Castle, Delaware
Tension Film Clamp
Multi frequency mode
Temperature Range: -80-100 °C
Temp. Ramp 2°C/min
Frequency 1.0Hz



TGA 2960 TA Instruments, New Castle, Delaware
Temperature range: 25-200°C
Temp. ramp 20°C/min
High resolution: 3°C

DSC 2920 TA Instruments, New Castle, Delaware
Temperature range: -50-200°C
Temperature ramp: 5°C/min
Pans: high volume o-ring
Empty reference pan



Instron 5542 Instron Corporation, Canton, Mass.
Ambient conditions
Upwards crosshead speed of 2mm/min
Tension clamp

RESULTS & DISCUSSION

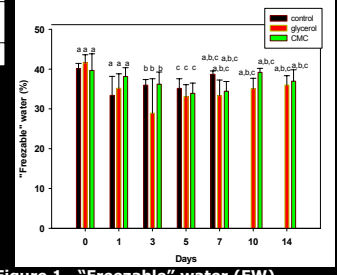


Figure 1. "Freezable" water (FW) calculated from the enthalpy of the DSC thermogram at 0°C. FW was shown to be 40% in all samples at day 0, regardless of composition. However, FW decreased with storage time during the 1st week of storage.

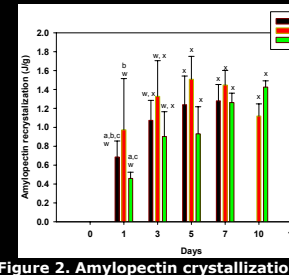


Figure 2. Amylopectin crystallization calculated from the enthalpy of the thermogram at 60°C. Amylopectin crystallization was significantly different between compositions (denoted by significantly different over time (denoted by w,x) but not in combination with composition and time. An increase in amylopectin crystallization was observed at day 7 for tortillas with glycerol and salt tortillas containing the greatest crystalline amylopectin for the first week of storage.

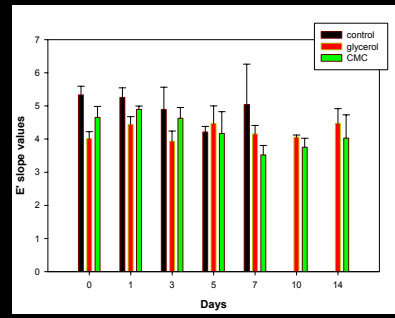


Figure 3. Slope values of the E' of the DMA fitted with the modified Fermi equation. The slope values were significantly lower in the glycerol and salt tortillas, suggesting a more homogenous matrix. With time, glycerol and salt tortillas maintained homogeneity while control and CMC tortillas increased in homogeneity.

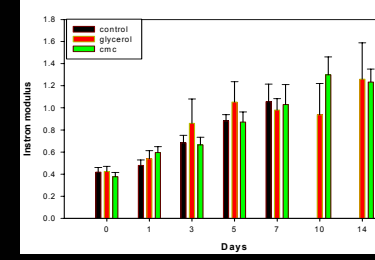


Figure 4. Instron Universal Testing Machine modulus (stiffness) of all 3 compositions over days of storage. Initial stiffness was lower in CMC tortillas and control for the first week of storage. In contrast, the glycerol and salt tortillas were less stiff as compared to CMC tortillas in the second week of storage.

CONCLUSIONS

CMC tortillas were significantly less stiff initially than the control and glycerol and salt tortillas yet became stiffer at a greater rate over the second week of storage.

A similar trend to stiffness was observed with amylopectin crystallization. Therefore; stiffness may be attributed in part to the degree of amylopectin crystallization.

Glycerol and salt tortillas maintained homogeneity and less FW through out storage as compared to the control while all tortillas maintained mc through out storage.

REFERENCES

Biliaderis, C.G., Page, C.M., and Maurer, J.J. (1986a) On the multiple melting transitions in starch/monoglycerides systems. Food Hydrocolloids 1:279-295
Fessas, D. and Schiraldi, A., 2000. Water sorption properties in wheat flour dough I: dielectric thermogravimetry approach. Food Chemistry 68:1-8.
Peleg M. (1993) Mapping the stiffness-temperature-moisture relationship of biomaterials at and around their glass transition. Rheol Acta 32:575-580