Effects of glycerol and salt on the physico-chemical properties of corn tortillas

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ABSTRACT

Traditional corn tortillas are produced from dehydrated masa and water, and have a very short shelf-life of 1-3 days. Commercial corn tortillas use carboxymethylcellulose and antimicrobial agents (propionates and benzoates) to delay staling and inhibit microbial spoilage, respectively. These additives are not only expensive, but they impart off-flavors to the product.

The objective of this study was to investigate the effect of alternative additives (glycerol and salt) on the physical properties of corn tortillas during ambient conditions.

Tortillas were prepared by mixing dry masa and water (2:3 w/w), with and without glycerol (4% w/w) and salt (1% w/w), and cooked briefly on a 325ºC griddle. Prior to packaging, samples were allowed to cool and lose moisture for various times up to 6 hours under ambient conditions (25 ºC, 50% RH). Molecular and macroscopic changes were measured using differential scanning calorimetry (DSC), thermogravitmetric analysis (TGA), dynamic mechanical analysis (DMA), and Instron texture analysis.

Moisture loss ranging from 0-13% was evident from both control and glycerol/salt containing samples. For all samples, DSC thermograms showed a major transition around 0ºC attributable to ice melting decreasing with storage. DMA results showed a similar transition at 0ºC, but also minor transitions at -60ºC and 50ºC. Glycerol/salt containing samples exhibited more homogeneous phase transitions and less variability than control samples. Furthermore, these samples had less "freezable" water than the control and were less stiff as compared to the control.

INTRODUCTION

Tortillas represent the fastest growing segment in the baking industry.

Fresh, homemade corn tortillas become stale after only a few hours.

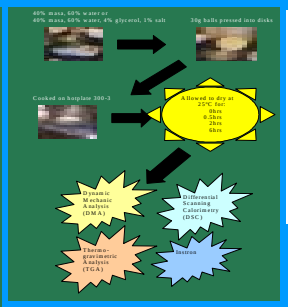
Corn tortillas are commercially made with CMC, proprionates and sorbates to maintain a longer shelf-life from a textural and microbial standpoint.

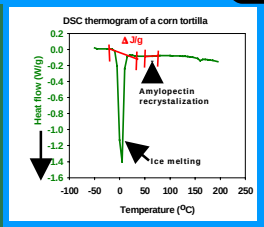
An alternative to these additives would be the use of polyols such as glycerol.

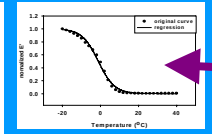
OBJECTIVE

The objective of this study was to investigate the effect of alternative additives (glycerol and salt) on the physical properties of corn tortillas during ambient conditions.

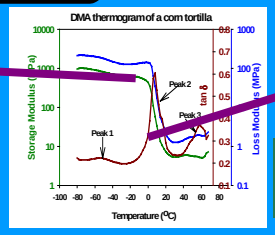
MATERIALS & METHODS

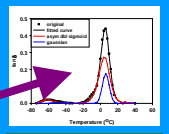




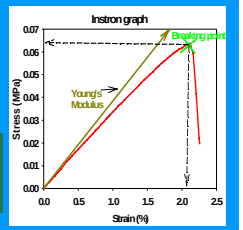


A modified Fermi equation (Peleg, 1993) for fitting E' (T) -20ºC to 40ºC f=1/(1+Exp((x-T)/a)) and -80ºC to -20ºC: f=(1-b)/(1+Exp((x-T)/a))+b a=slope, T=midpoint Temp (ºC), b=constant





The tan delta was deconvoluted using The least number of gaussian and asymmetric double sigmoidal curves (Vodovotz, et al 1996)



RESULTS & DISCUSSION

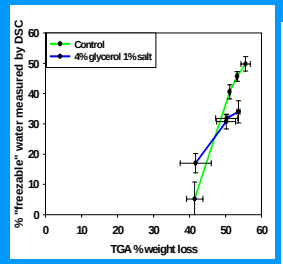


Figure 1. Weight loss (TGA) was found to be linearly related to % "freezable water" (DSC). The glycerol/salt samples had greater amounts of "freezable" water retention for the same moisture content as the control.

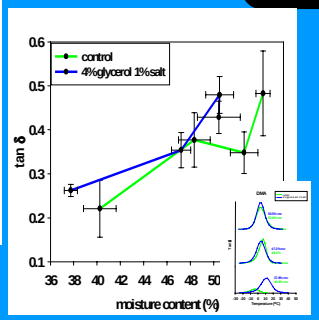


Figure 2. The asymmetric double sigmoidal curve was the main event in all of the deconvolutions of the DMA tan δ 0ºc peak (peak 2). Since the peak was dependant on mc, it may reflect ice melting. In the tortillas with glycerol and salt, the peak dropped slightly with moisture content and the transition shifted to the right. In the tortillas without these additives, the peak decreased greatly with a decrease in moisture content and shifted to the left.

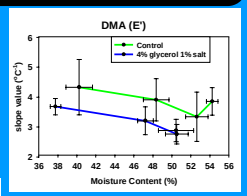


Figure 3. For both tortilla treatments, the temperature range of the main transition increased (higher slope) with decreasing moisture content (peak 1). The addition of glycerol and salt lowered the slope values for all moisture contents indicating a more narrow transition region.

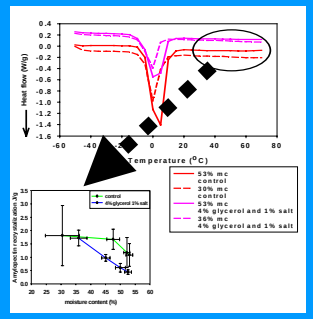


Figure 4. DSC results of corn tortillas at different moisture contents showed a melt at 0ºC (ice melting) and 50-60ºC (amylopectin). Decreased moisture content (increased storage time) led to an increase in amylopectin recrystalization. In general, amylopectin recrystalization occurred to a greater extent in the control samples.

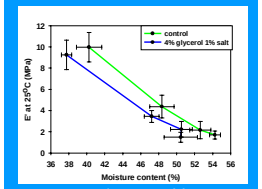


Figure 5. The DMA E' (storage modulus) illustrated stiffness of the tortilla. With both treatments, as moisture content decreased, the stiffness increased. The tortillas containing glycerol and salt maintained a lower degree of stiffness than the tortillas without these additives with decreasing moisture contents.

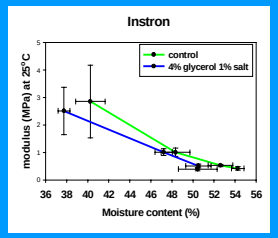


Figure 6. Texture measurements showed an increase in stiffness with a decrease in moisture content in both samples. The glycerol salt tortillas exhibited a slightly lower degree of stiffness than the tortillas without these additives.

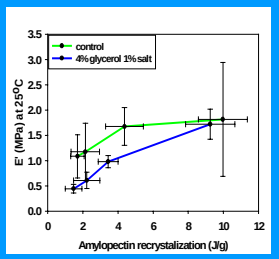


Figure 7. The **initial** stiffness (DMA) of the tortillas at ambient temperature with and without additives linearly correlated with the amount of amylopectin recrystalization. Once enough moisture was lost, amylopectin recystalization no longer contributed to the increase in stiffness of the tortilla.

Conclusion

The tortillas with additives exhibited:

- Water retention
- Amylopectin recrystalization
- Stiffness (both superstructural and molecular levels)
- Homogeneity of the transition regions

Glycerol and salt can provide structural flexibility and homogeneity to corn tortillas and potentially extend shelf-life through the reduction in moisture without significantly altering corn tortilla mechanical properties. Glycerol and salt may also increase the preservative effect against spoilage bacteria. Tortillas with these additives may delay the rate of staling in future storage studies.

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