Effect of CMC on the physico-chemical properties of masa-water mixtures

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ABSTRACT

CMC (Carboxylmethyl cellulose) is commonly added to corn tortillas to delay staling. CMC increases the viscosity of a masa/water mixture during thermal processing, and is hypothesized to compete with the masa constituents for water. During cooling, the gum may inhibit retrogradation of gelatinized starch granules, influencing the flexibility of the tortilla. Little is known about the interaction of the different components in the masa system at the super-structural level.

In this work, two different types of CMC ("A" and "B") with differing viscosities and guar gum were added at 10% level to a 55% and 65% moisture content masa mixtures, and heated in the Differential Scanning Calorimeter (DSC). Samples were stored at 4°C and analyzed by DSC and TGA after storage. DSC thermograph showed multi transitions. The enthalpy of the peak around 60°C attributed to amylopectin melting was the same among all samples with the same mc. The transition around 0°C was attributed to "freezable water". The CMC with the higher viscosity lead to increased "freezable" water in the heated masa/water mixtures with 55%mc. In addition, TGA results show that CMC has an impact on the distribution of water in the mixture.

INTRODUCTION

- Carboxymethylcellulose (CMC) is an anionic, water-soluble polymer derived from cellulose, which is widely used as food gum. The average number of OH groups substituted by carboxylmethyl groups per anhydroglucose unit is known as the "degree of substitution" (DS). The most widely used food grade CMC have a DS of 0.7.
- In corn tortillas, CMC is added to maintain a pliable texture and to extend shelf life.
- CMC is hypothesized to compete for water with other components in the dough and increase the viscosity of the mixtures, thus maintain the softness of tortilla.
- The behavior of CMC and the distribution of water in the food system have not been studied at a superstructural level.
- Thermal and thermomechanical analysis techniques have been shown to be particularly well suited for such characterization.

OBJECTIVE

The objective of this study was to characterize the impact of different types of CMC and guar gum on the superstructural characteristics of masa mixtures with 55% and 65% moisture content using thermal analytic techniques.

MATERIALS & METHODS

Masa mixed with CMC "A", CMC "B"or guar gum at 10% level (Total solid base).

Viscosity: CMC "A" < CMC "B" = guar gum

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Adjusted masa/water/CMC dough with 55% &65% moisture content and equilibrated for 2 hours.

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Scanned by DSC from -50°C to 165°C @ 5° C/min and hold at 165°C for 3 minutes.

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Stored for 0-14 days @ 4°C.

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- Analyzed by DSC 2920 – TA Instrument (Differential scanning Calorimeter) -50 °C to 210 °C @ 5 °C/min

- Analyzed by High-Res TGA 2950 – TA Instrument (Thermogravimetric Analysis). 25°C to 200°C @ 20°C/min with sensitivity 3.0 and resolution 3°C

RESULTS & DISCUSSION

DSC Results

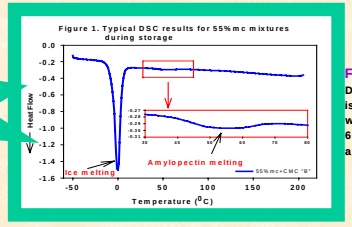


Figure 1: The transition in DSC thermograph around 0°C is attributed to "freezable" water. The transition around 60°C is attributed to amylopectin melting.

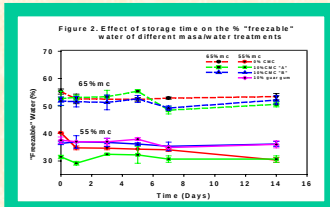


Figure 2. The samples with 65%mc has a higher percentage of "freezable" water. The samples with higher viscosity gum lead to increased percentage "freezable" water compared with the samples with the lower viscosity gums and without CMC for 55%mc mixtures.

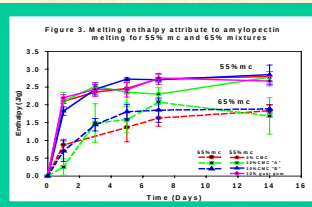
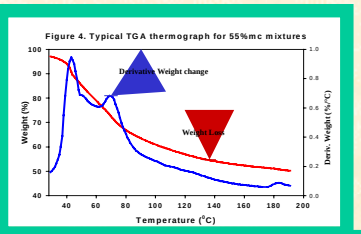
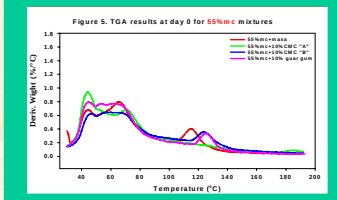
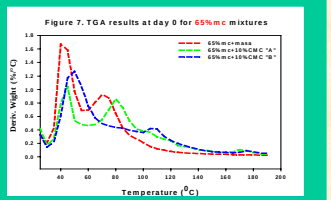


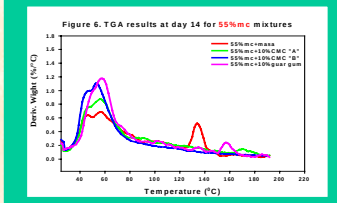
Figure 3. The samples with 65%mc has a lower melting enthalpy of amlopection than 55%mc mixtures probably due to dilution. The addition of different gums has no impact on the enthalpy of amylopectin melting within 55%mc mixtures or 65%mc mixtures.

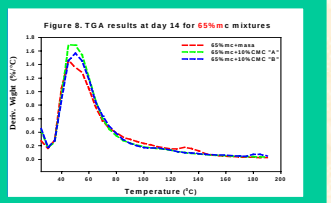
TGA Results











TGA Results: Derivative Weight indicates the rate of weight change as a function of time or temperature. TGA results show that CMC does have an impact on the distribution of water in the mixture. Water in 65% mc mixtures was lost easier in a narrower temperature range due to the larger amount of "freezable" water than 55% mc mixtures. Water was lost easier at day 14 than at day 0.

CONCLUSIONS

- DSC results indicated that the moisture content and the type of CMC affected the amount of "freezable" water and melting enthalpy of amylopectin during storage.
- TGA results showed that CMC and guar gum affected the water distribution in the mixtures. Water was not homogeneously partitioned within the masa/water/CMC mixture. Water-loss occured easier after storage.
- Although "freezable" water content didn't change significantly during storage (DSC), the ability to remove the water did (TGA).
- Tortilla with CMC had a softer and more flexible texture than tortilla with guar gum (qualitative observation).

REFERENCES

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Lindberg, J., Sirvio, H and Martinmaa, J. Rheological Studies On CMC. Cellulose Chemistry and Technology, 21: 379.