Annals of the University of Oradea, Fascicle: Ecotoxicology, Animal Husbandry and Food Science and Technology, Vol. XVII/B 2018

Analele Universitatii din Oradea, Fascicula: Ecotoxicologie, Zootehnie si Tehnologii de Industrie Alimentara, Vol.XVII/B 2018

RHEOLOGICAL CHANGES OF GLUTEN DURING FROZEN STORAGE

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Abstract

It was taken in the analysis the texture of the finished product after the baking of two types of bakery products obtained from wheat flour was obtained: one obtained from a leavened dough, a bun and one obtained from a yeast-free dough, pita. Their characteristics were followed for eight days after obtaining. It has been observed that the hardening of the products occurred in both cases during the eight days.This was measured using a Rapid Visco type texture analyzer with which free water was measured by the doughiness of the dough one minute after baking at a temperature of 74-95 degrees Celsius, after cooling and during storage.

No difference was observed regarding the viscoelastic properties of the product made from dough than the one unleavened dough during storage of those eight days.The amylose solution decreased significantly immediately after baking in both and continued to decline over the storage period. Thermal analysis with a differential scanning calorimeter detected the recrystallization of amylopectin almost immediately after baking (1 min) in the pita, while the recrystallization of amylopectin in the bun was evident only after one day of receipt. Recrystallization of amylopectin in lipid continued to increase during storage.

Overall, the baking of buns (a higher temperature, a longer time and a higher baking medium humidity) resulted in a greater dispersion of amylose and amylopectin and its relegation to amylose in buns than in pita.

Key words: aging, paste, starch gelling, dispersion and relegation.

INTRODUCTION

Changes in texture and properties of starch to baked products during processing and storage have been extensively studied. Heating the starch granules in excess of water causes hydration, swelling, melting of the crystals (Tm) and the dispersion of the amylose and amylopectin molecules in the aqueous phase.Dispersed starches start to associate in an ordered structure when kept at temperatures lower than Tm. Since starch gels become more structured, the firmness of the products increases. Aging is a complex phenomenon and has been studied through many direct and indirect methods, such as the use of compressibility, the measurement of soluble starch. The moisture content, the duration of the processing, shearing and temperature process determines starch gelling and dispersion of starch during food processing.

The moisture content and the heating temperature also have an influence on the process of releasing amylose and amylopectin in the 8-10 model systems. Thus, the thermal treatment conditions have significant effects on the gelatinization and dispersion of the starches, potentially, the effect on the aging behavior of the food products.

Many bakery products are made with wheat flour as the main ingredient. The products differ according to the type and amount of substances used as technological adjuvants, the moisture content of the dough and the baking profiles over time and also the exposure temperature. For example, the baking time and temperature for buns is: 243 °C for 7 minutes and for pita to 183 °C for 0.5 minutes.Dough moisture and fat content also vary about 45% moisture and 4% fat for buns dough and 40% moisture and 6% fat for dough pita. Thus, the final products have characteristic textures and shelf life ranging from days to weeks.

Although there is a good understanding of the basic principles governing the quality and shelf life of individual products and the ability to manipulate these properties, the impact on textural properties and the shelf life as a function of the structure established during processing and storage are still unclear. The objectives of this study, therefore, were to characterize the textural, thermal properties of starch from bun and pita bread during storage and to make a correlation with the processing conditions.

MATERIALS AND METHODS

Preparing a sample

The buns and the pita bread have been obtained in the bakery lab of the Food Engineering Department of the Environmental Protection Faculty and stored in 1 mmplastic bags at room temperature (22 °C) until analyzed.

The amylose content and its solubility were measured by the same procedure for both buns and pita bread. The amylose content was determined as follows: weighed and milled (100 mg) samples were weighed in two volumes in 100 ml volumetric flasks. Then, 1 ml of 95% ethanol and 9.0 ml of 1 N NaOH were added, the flasks stirred and kept overnight at ambient temperature (21 °C). The amylose solvent was extracted using 0.1 N NaOH for

2 hours instead of 1 N NaOH for 18 hours, as mentioned in the analytical method.

RESULTS AND DISCUSSIONS

Notes about buns: the initial moisture content of the buns was 36 ·8 ± 0 ·31% and decreased below 0.5% during the 8 days of storage at 22 °C. The moisture content of commercial bread and buns is between 35 and 38% .Products resistance increased during storage. Conservation time was significantly correlated with the texture (firmness) of the bun bread. These observations are consistent with many bread retention studies. The shelf life of bread and buns was about 4 -5 days.

The elasticity characteristics of the buns have changed during storage. Compared to dough starch, the freshly baked product lasted longer until the peak viscosity reached, had significantly lower viscosities from 74-95 ° C, lower viscosity to degradation and higher regression viscosity.

These changes are due to the modification of the starch granules during preparation and to the structuring (reorganization) of the structure in the bakery product. These reorganized structures slowed down and limited the hydration of the starch-protein matrix during kneading. Greater regression viscosity could result from the amylose gel containing more rigid, hydrated structures in the paste suspension. Changes in storage viscosity did not reveal any significant trend, except for viscosity at 50 °C, which tended to increase up to one day of storage.

Notes on pita bread: the initial moisture content of the pita bread was 29% and the moisture content decreased less than 0.5% during the 8 days of storage at 22 °C. The moisture content of the commercial pita was between 29-32% 11 12. The stability of the pita has increased during storage, especially after 9 hours of baking. A DSC scan of the dough sample showed a peak at 65 ° C indicating gelatinization of the starch and a peak at 95 ° C indicating the melting of the lipid complex of amylose (Figure 4). The starch was completely gelatinized during the 30 s baking period, as evidenced by the lack of an enthalpy peak at 65 °C in the fresh product. After storage, the recrystallization of the amylopectin peak at 55 °C increased more than 10 times.

This study highlights changes in the textural, viscoelastic and thermal properties of the two baked products, buns and pita, which, in their processing conditions, have a finite product texture and a very long storage life.The objective of the study was not to directly compare the two products, but rather to understand changes in measurable properties as a function of processing media and during storage. Each bakery product has optimal wheat sources and flour milling conditions, which can contribute to starch gelling and downgrading during processing.This does not diminish the fact that drying or lack of maintenance "freshness" varies and the general principles of changes in starch properties during baking are known. The hydro-thermal conditions of baking melted starch crystals, destroy the granular structure of starch and cause amylase and amylopectin to be partially dispersed.

Amylose and amylopectin are dispersed from granules (inter-granular dispersion) and cavities inside the granule (intra-granular dispersion). Therefore, amylose contributes to the continuous phase and product structure during baking. After cooling to temperatures less than Tm of amylopectin (50 °C), amylopectin inside the gelatinized starch granule begins to associate. The relatively high concentration of amylopectin from the undiluted gelatinized starch granules increases the rate and magnitude of amylopectin-amylopectin and amylose-amylopectin in bakery products.Much of amylopectin is not dispersed during hydrothermal food processes as a result of insufficient inertia to disrupt swollen, gelled granules. Therefore, reassignment of amylopectin during storage occurs within the remaining gelatinized starch granules.The "downgraded" granules melt near 50 °C, but they swell later and less than the native grains of starch.

CONCLUSIONS

The results observed in this study can be seen as a function of the processing conditions of the two products. Buns are processed more harsh than pita, so they are baked at a higher temperature for a longer period of time over Tm and have higher humidity conditions during baking. Thus, the starch in the buns is probably dispersed and demoted to a greater extent than in the pita. This could explain why we noticed a greater reduction in the amount and rate of insolubility of the amylose.An increase in amylose dispersion and retrogradation during baking should reduce vascoelasticprmaterials because (1) a stronger amylose gel in the methanol extracted from the bakery products should limit the swelling potential; and (2) remaining starch granules are probably those that hydrate and swell during the kneading of baked products, and a smaller proportion remains after harder baking conditions. This could explain why the retention benefits of buns were lower at all storage times than those of pita. Intra- and inter-granular growth of starch has a substantial influence on product structure and shelf stability.

Thus, factors influencing product texture and storage stability appear to be a function of the starch source, hydrothermal processing medium and the degree of dispersion of the resulting starch. Therefore, it can be assumed that more stringent processing conditions lead to a greater dispersion of amylose and amylopectin and lead to a greater retrogradation of amyloses during processing and to shorter product stability Further studies under more controlled conditions are required to further test this hypothesis and to better understand the relationship between the product structure determined by the processing environment, product quality and the shelf life.

REFERENCES

1. American Association of Cereal Chemists. Approved Methods of the AACC. 9th Ed. Method 44-15A, Method 61-03, method 74-10. American Association of Cereal Chemists. St Paul, MN. 1995.
2. Attenburrow, G., Barnes, D.J., Davies, A.P., &Ingman, S.J. Rheological properties of wheat gluten. *Journal ofCereal Science* **12**(1990) 1–14.
3. D'Appolonia, B.L. and Morad, M.M. Bread Staling. *Cereal Chemistry* **58**(1981) 186–190.
4. Fessas, D. and Schiraldi, A. Texture and staling of wheat bread crumb: effects of water extractable proteins and 'pentosans'. *ThermochimicaActa***323** (1998) 17–26.
5. He, H., &Hoseney, R.C. Differences in gas retention, protein solubility and rheological properties between flours of different baking quality. *Cereal Chemistry***68** (1991) 526–530.
6. Klucinec, J.D. and Thompson, D.B. Amylose and amy-lopectin interact in retrogradation of dispersed high-amylose starches. *Cereal Chemistry***76** (1999) 282–291.
7. Liu, Q. and Thompson, D.B. Effects of moisture content and different gelatinisation heating temperatures on ret-rogradation of waxy-type maize starches. *CarbohydrateResearch* **314**(1998) 221–235.
8. MacRitchie, F. Evaluation of contributions from wheat protein fractions to dough mixing and bread making. *Journal of Cereal Science* **6**(1987a) 259–269.
9. Schiraldi, A., Piazza, L. and Riva, M. Bread staling: A calorimetric approach. *Cereal Chemistry***73** (1996) 32–39.
10. Waniska, R.D., Gomez, M.H. Dispersion behavior of starch. *Food Technology***46** (1992) 110–118, 123.
11. Whalen, P.J., Bason, M.L., Booth, R.I., Walker, C.E. and Williams, P.J. Measurement of extrusion effects by viscosity profile using the rapid ViscoAnalyser. *CerealFoods World* **42**(1997) 469–475.
12. Yasunaga, T., Bushuk, W. and Irvine, G.N. Gelatinisation of starch during bread-baking. *Cereal Chemistry***45** (1968) 269–276.