

2004 MAFMA Final Report

Project Title: Microbial Populations on Peeled Chestnuts and Their Inhibition
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1. Objective Summary

Bacteria populations increased on fresh chestnuts after harvest and during cold storage. Portions of the peeling process reduced microbial populations but after the chestnuts passed through entire peeling line, bacteria were found to have increased slightly. The shelf life of the peeled chestnuts after peeling was less than 14 days when stored at 4⁰C. The different sanitizer treatments did not significantly inhibit microbial growth.

2. Objective Accomplishments

All objectives were met, but not all of the answers to the problem of bacterial contamination have been solved. Our work indicated that fresh chestnuts that are harvested from trees do not harbor significant populations of bacteria, yeast or fungi; however, after cold storage at 0C, bacterial populations significantly increase. These increases were found to prior to the peeling process. Since starch is converted to glucose, which is easy used by spoilage microorganisms even at low storage temperature, a natural substrate exists for these microorganisms. Therefore, in all cases, chestnuts brought populations of bacteria to the peeling line. Portions of the peeling line reduced the population level. For example, the steamer portion of the line reduced microbial populations by one log, however after chestnuts passed through the washer/brusher, bacterial numbers were found to have increased. This may have been due to brush contamination. Chestnuts packed in both packaging materials had similar results and neither material had any significant effect on inhibiting the growth of microorganism. Mold did not grow on the chestnut samples probably because of vacuum packaging and lower storage temperature. Bacteria and yeast numbers increased very quickly in the packaged products stored at 10-12C. Therefore, low storage temperature can inhibit microbial growth. The shelf life of the chestnuts packed by different packaging materials and stored at 4-5C or 10-12C was less than 14days. The different sanitizer treatments did not significantly inhibit microbial growth. None of the treatments, packaging materials or storage temperatures had any significant effect on chestnut moisture content and water activity after 14 days storage. To extend the shelf life, modified atmosphere (MAP) or controlled atmosphere (CAP) can probably be used and further research is needed to find suitable gas compositions. Other sanitation methods might be used such as ozone treatment or pasteurization methods such as high pressure processing.

3. Unexpected findings, if any

The first unexpected finding of this study was the presence of bacterial contamination on the chestnuts prior to peeling. Chestnut in this study were harvested from the ground, and

immediately placed in cold storage. Long term cold storage was at 0C. This indicates that high bacterial populations are increasing between the shell and the kernel at a time when carbohydrates are being enzymatically altered to glucose, a sugar easily utilized by most bacteria, yeast and fungi. A time course study was not carried out on bacterial population growth in the time between harvest and peeling, but our studies indicated that microorganisms were negligible on chestnuts on the trees.

We were also surprised that different sanitizer treatments did not significantly inhibit microbial growth on peeled chestnuts stored at 4⁰C or 10⁰C. The 100 and 200 ppm chlorine solutions initially reduced the bacterial populations by 5 logs. The bacterial populations on chestnuts treated with 100 or 200 ppm chlorine solution increased to log 10⁷ and log 10¹¹ CFU/g after 2 weeks storage at 4⁰C and 10C, respectively. Peeled chestnuts treated with 100 ppm chlorine supported population levels of log 10⁸ and log 10¹¹ CFU/g after 2 weeks storage at 4C and 10C, respectively. These results showed that hypochlorite effectively reduced the number of bacteria on the chestnuts after peeling, but then a more rapid increase in bacterial growth rate occurred. Thus, the fresh peeled chestnuts had a shelf life of about 2 weeks when stored at 4⁰C and less than 2 weeks at 10⁰C which was not significantly different than those peeled chestnuts not treated.

The initial microbial populations on peeled chestnuts treated with ClO₂ gas and vacuum packed were reduced about 2 logs after 12 hrs exposure. After 2 weeks storage at 4C and 10⁰C, the microbial counts increased to 10⁹, which is higher than the results from hypochlorite treatment.

Finally, we were pleasantly surprised to find that no significant difference in sensory results (day 4) were found for any of the chestnut samples in appearance/color (1 = worst, 9 = best), off-flavor (1 = no off flavor, 9 = strong off flavor), texture (1 = very soft, 9 = very hard), and overall quality (1 = worst, 9 = best). After 15 days storage, the results showed no significant difference between any of the samples. Therefore, the chlorine concentration and treatment time did not affect the appearance/color and texture, nor the overall sensory qualities.

4. Practical impacts of research efforts.

a. Short Term Impacts

We now know that the shelf life of the peeled frozen chestnuts after thawing is less than one week. This should be placed on the labels, but we do not know if the chestnut industry has done this, yet. We have contacted the Midwest Nut Producers Council and Chestnut Growers, Inc. and suggested they clean the peeling line focusing on the brushes and the belts located distal to the brushes. We have also suggested that the cold storage conditions be altered to help inhibit bacterial growth on the fresh, non-peeled chestnuts as they wait for peeling. We have suggested they try ozone in the coolers and ozone generators have been set up for the 2006 season.

b. Long Term Impacts

The chestnut researchers and the chestnut industry in Michigan are together re-thinking harvest and storage mechanisms in terms of reducing bacterial contamination. A new grant focusing on other inhibitory options was submitted to the Michigan State University Project GREEN grants program and we have received \$40,000 to study this in the next two years.

5. Publications resulting from this research.

A masters thesis by Kuoch Yen, a graduate student in the School of Packaging was generated by the support of this grant entitled “Microbial Populations on Peeled Chestnuts and Their Inhibition.”