



Crack Enhancement of Freezer Stored Cut and Peel Carrots



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Introduction

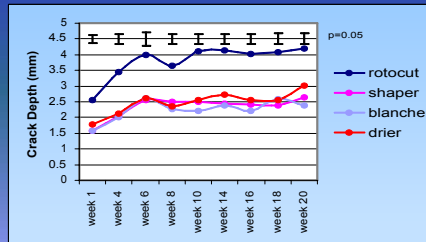
- ❖ Frozen cut and peel industry is of major economical importance to Atlantic Canada.
- ❖ A major challenge to this industry is development of cracks in frozen carrots.
- ❖ Cracked frozen carrots lower the product quality, profitability and consumer preference.
- ❖ Freeze crack is more likely to occur with cryogenic freezing, suggesting that the cracks are developing during processing and possibly enhanced in freezer storage.

Methods

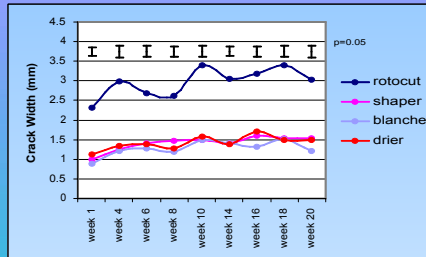
- ❖ Samples of Sugarsnax variety from the same field were taken from four major points of the processing line – the trans-slicer or rotocutter, the shaper, the blancher, and the drier.
- ❖ Samples were passed through a freezing tunnel and stored at -10°C for 20 weeks (wk).
- ❖ Sub-samples were removed every two wks for analysis.
- ❖ Crack morphology, membrane injury indexes (MII), and histological studies were performed.

Results

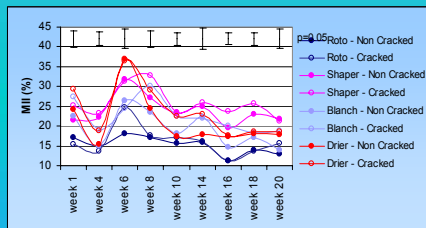
- ❖ Crack length, width, and depth all increased from wk 1 until wk 4 and little perturbation was observed after.
- ❖ Tissue damage was measured by MII with the lower readings translating to the highest membrane injury.
 - ❖ MII declined significantly from wk 1 to wk 4.
 - ❖ In wk 6 MII increased, indicating a possible repair mechanism.
 - ❖ This protection did not last.
 - ❖ Tissue membranes continued to degrade until the end of the study.
- ❖ Histological studies revealed that the cracks did not extend beyond the primary cambium or vascular tissues.
 - ❖ This suggests the cracks develop superficially perhaps by a combination of mechanical and freezing processes.



Crack width (mm) among the four treatments over 20 weeks freezer storage.



Crack depth (mm) among the four treatments over 20 weeks freezer storage.



Membrane Injury Index (MII) (%) between cracked and non-cracked carrots of the four treatments over 20 weeks freezer storage.

Discussion

- ❖ Slow freezing may cause the formation of a small number of large ice crystals that may puncture the cell wall.
- ❖ Freezer enhancement may be due to several reasons
 - ❖ Mechanical injury during trans-slicer process
 - ❖ Volumetric changes
 - ❖ Crust formation
 - ❖ Micro-cavities
 - ❖ Genotypes
 - ❖ Maturity of carrots
 - ❖ Mode and rapidity of freezing
 - ❖ Physical properties – density, moisture content, porosity

Conclusions

- ❖ Freezer temperature plays a critical role in crack enhancement of cut and peel carrots.
- ❖ Our data suggests that the cracks are developed in the trans-slicer process and enhanced during freezer storage.
- ❖ Future experiments are planned to optimize storage temperature and investigate such factors as genotypes on freezer enhancement.



Cracks observed in carrot samples of various treatments: A) Trans-slicer – week 16 B) Shaper – week 16 C) Blancher – week 8 D) Drier – week 20