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Progress in the development of avocado products

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ABSTRACT

The avocado industry in South Africa faces a number of problems, particularly in years of over supply. Traditional markets are not able to absorb increased supplies without substantial decrease in prices. A potential solution to this problem, is market differentiation, both in destination and product type. Work has been conducted on methods of supplying pre-ripened, ready to eat avocado into traditional and new markets in a convenience food packaging. Fruit were ripened, peeled and packaged as half fruit, slices and chunks. Work was initially conducted on methodology suitable to ensure a shelf life enabling sea transport. Of particular concern was the potential for browning, as well as taste and texture of the fruit. A flash freezing technique using liquid nitrogen was used. A number of anti-oxidants were also included, so as to prevent browning during the defrosting process. While the technology was successful in maintaining product colour for a period of months, product texture was compromised as was taste during the defrosting process. Work was then conducted on a fresh cut product suitable for airfreight. Preliminary results have been extremely promising with a product capable of a shelf life in excess of a week. No preservatives or additives are used.

INTRODUCTION

It is clear from production trends in South Africa that overall volumes will rise in the medium term, and in addition, considerable alternate bearing is characteristic of the industry. This creates difficulty for marketing, especially as South African production is geared to export with relatively little designated for the local market. This is in contrast to many other countries, where home based consumption is primary, while export is for surpluses or the best quality fruit. These factors make South Africa vulnerable to market dynamics, with considerable problems in an "on" year, leading to market over supply and price collapse. With rising production trends, this is likely to become worse.

The South African industry has a number of choices in solving the problem. The solution probably lies in a combination of a number of these. Essentially, the choices include:

- Expanding present markets.
- Developing new markets for fresh fruit both locally and internationally.
- Product diversification through value adding.

The latter holds considerable advantages, which include:

- Use of fruit otherwise unsuitable for the export market.
- Withdrawal of volumes which would have oversupplied the market.
- An ability to control timing of supply to the market, thereby decreasing oversupply

peaks.

- An ability to enter markets which would otherwise be closed or very difficult to enter due to phytosanitary restriction.
- Product diversification, thereby expanding overall marketing opportunities. A trend to ready to eat prepared fruits and vegetables is emerging in many of the markets served by the South African avocado industry.

The purpose of this project was therefore the development of a number of alternative value added avocado products to satisfy the above criteria. The primary focus of the work was on edible products, with the exclusion of those already produced successfully in South Africa, with particular reference to pulp type products.

MATERIALS AND METHODS

Frozen products

In any processing, the primary problem likely to be encountered will be that of browning. Avocado has an extremely active polyphenol oxidase (PPO) system, which catalyses the oxidation of o-di phenols (Van Rensburg and Engelbrecht, 1986). This enzyme is situated in the thylakoid membranes of the chloroplasts, and does not usually come into contact with the phenolic substrate (Vaughan and Duke, 1984). However, any cutting of the fruit will naturally allow this mixing of the enzyme and its substrate, and therefore the browning reaction to take place. This is likely to occur at the time of processing, during product distribution or immediately prior to use. As the enzyme is not active at low temperature and in fact is denatured at –79°C (Kahn, 1977), and the initial objective was to produce a product with long term storage potential, freezing was investigated (Boyle, Feinberg, Ponting and Wolford, 1977). In order to prevent potential damage from ice crystals resulting in membrane or other structural damage (Harker, Redgwell and Hallett, 1997) freezing was by dipping fruit into liquid nitrogen. Procedures were thus as follows:

Fruits were allowed to ripen to a softness of 50 to 55 on a densimeter marked from 0 to 100, where 100 represented hard fruit and 50 to 55 a softness associated with eating ripe. Fruits were then cut in half longitudinally, the seed removed and either left as half fruit or cut into chunks. The fruit was then dipped into liquid nitrogen for freezing. Thereafter fruit was packaged and sealed in polyethylene bags. Storage was at –18°C.

As there was concern that browning could occur during the thawing process, the use of anti-oxidants and low pH were tested. Kahn (1977) showed that the pH optimum for avocado PPO is 5.5 to 6.5. A low pH at the cut surface will therefore decrease activity and thus the browning reaction. At a pH of 3 virtually no reaction occurred. The use of citric acid is often recommended for prevention of browning in avocado (usually in the form of lemon juice). The mode of action is probably linked to the decrease in pH at the cut surface of the fruit. Kahn also found that a 1 mm solution of ascorbic acid considerably inhibited the reaction. This compound may work at both the pH level and by forming a complex with the partially oxidised substrate, so that the final browning reaction does not occur. Therefore, the use of ascorbic acid and citric acid was tested. These compounds were added in solution form as a spray onto the cut fruit after freezing.

As the browning reaction is oxygen dependant, packaging with and without oxygen removal through the use of vacuum was also tested.

After storage of eight weeks, fruit were thawed in the packaging, and on removal checked for visual appearance, texture and taste, through the use of a taste panel.

Fresh cut products

Based on results obtained with the frozen product, as well as to develop a further range of products, work was conducted on fresh cut fruit with limited shelf life.

Fruit were allowed to ripen and were pre-

pared in the same manner as the frozen product. However, in addition to the ascorbic and citric acid additions, treatments containing avocado oil and salad dressing using avocado oil as a base, were used.

Packaging was as for the frozen products, with standard atmosphere and vacuum packaging. Storage was at 2°C.

Evaluations were conducted after one and three weeks.

RESULTS AND DISCUSSION

Frozen product

The visual assessment indicated that the best treatments required one of the additives, and that during the thawing phase, vacuum packaging was necessary. The combination resulted in an excellent product as shown in Figure 1, with no browning evident. All respondents in the taste panel considered the product attractive.

Fruit texture was not satisfactory, becoming excessively soft and wet as a result of thawing ice. It was presumed that the fruit cell wall structure was damaged by the freezing.

Fruit taste was generally poor. In the case of control fruits, a sharp to bitter taste was evident. This was presumed to be due to the release or modification of phenolics, resulting from cellular damage during the freezing or thawing process. While the ascorbic and citric acids masked the bitter taste, they in turn were too intense, such that the original avocado flavour was lost. The taste panel did not consider any of the treatments acceptable.

Fresh cut product

None of the fruits treated with any of the additives remained visually acceptable for longer than 24 hours. These fruits were therefore not evaluated further.

Packaging was important in terms of the fruits packaged untreated. Only vacuum packed fruits remained visually acceptable long enough for the process to be considered commercially acceptable. These packs, when stored at 2°C, had a visual appearance rated as excellent (Figure 2) for up to 21 days.

Texture and taste were not as acceptable as the visual appearance, although considered better than the frozen product. Slight softening was evident, indicating that notwithstanding the low temperature of storage and decreased oxygen in the packs, the ripening process continued, thus resulting in an over-ripe fruit. This also appeared to have an effect on taste, with an over-ripe or fermented taste. This may have been the result of anaerobic respiration, and will require further investigation. While a storage period of 21 days may have been excessive, fruit evaluated after six days was also considered to have an off taste and was softer than at the time of

Figure 1. Visual appearance of frozen avocado eight weeks after packaging.

Figure 2. Visual appearance of fresh cut avocado after storage at 2°C for 21 days.

cutting. Further work on modified atmosphere storage and temperature management will be necessary.

CONCLUSIONS

Both the frozen as well as the fresh cut product can be prepared in such a manner that visually, an excellent product can be placed in the market. The frozen pack has a shelf life adequate for sea freight and acceptable distribution time. Taste and texture problems will, however, have to be addressed. The fresh cut product appears to deteriorate very rapidly, even at low storage temperature, making distribution difficult. However, it is considered by the authors that further work using lower concentrations of the anti-oxidants used, as well as modified atmosphere packaging, may considerably assist in ensuring that this product will be acceptable in the market. The correct use of the anti-oxidants will also be valuable for a food safety perspective, as the decreased pH of the cut fruit surface will decrease the potential for microbial growth, especially in the case of decreased oxygen concentration in the pack (Pao and Petracek, 1997).

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