Published jointly by Council of Australian Food Technology Associations, Inc and Australian Institute of Food Science and Technology Ltd.
All correspondence, including editorial and advertising, should be sent to the following address:
Food Australia, 11th Floor, 65 Berry Street, North Sydney, NSW 2060
(PO Box 1493, North Sydney, NSW 2059).
Tel: (02) 963 7672: Fax (02) 954 4327
Technical Editor: J.F. Kefford, MSc FTS, FAIFST.
Literature Editor: B.V. Chandler, PhD, FAIFST.
Foundation Editor: F.H. Reuter, PhD, FRSC, FRACI, FAIFST.
Journal Manager: Merilyn Malloch.
Production: Stella Fung
Subscriptions: Debra Dean
Subscription Rates: Australia $A58, foreign $A90, single copies $A4.95 (including 2nd class posting & handling), airmail $A114.
 ISSN 1032-5298

Volume 46 Number 5
May 1994

Food Australia

Formerly Food Technology in Australia

RESEARCH PAPERS

Control of browning during the thawing of custard apple pulp ★ 205
E. Pardede, K. A. Buckle and G. Srzednicki

Alternatives to sodium metabisulphite for blackspot prevention in prawns ★ 212
S.L. Slattery, D.J. Williams and S.M. Nottingham

Consumers and food product label information ★ 223
A. Worsley

AIFST 1993 CONVENTION PAPER

Applications of supercritical fluid extraction in the Japanese food industry 235
Tran V. Hung and M.A. Unger

PROFILE

Joe White Maltings Limited 231

COLUMNS

AIFST News	208	Literature	240
CAFTA	222	News	200
Conferences	204	New Product Lines	208
Diary	242	People	211
Education	216	Products & Services	232

★ Refereed paper

CAB AUDIT NO.3477

Food Australia, published monthly is the official journal of the Council of Australian Food Technology Associations Inc. (CAFTA) and the Australian Institute of Food Science and Technology Ltd (AIFST). It is designed to promote the scientific, technical and marketing aspects of the food manufacturing industries in Australia. Statements and opinion presented in the journal do not necessarily reflect the policies of CAFTA or AIFST, nor do CAFTA or AIFST accept responsibility for the accuracy of such statement and opinion. Editorial contributions are invited and may take the form of letters to the editor, research papers, scientific reviews, general-interest papers, news items, reports of meetings, advertorials, products and services.

Colour Separations by Stable Graphics, 17 Waterloo St, Surry Hills 2010 tel (02) 281 0382. Printed by Sydney Allen Printers Pty Ltd, 10-16 South St, Rydalmere 2116, tel (02) 638 6500, fax (02) 638 6531

RESEARCH PAPER

Control of browning during the thawing of custard apple pulp

E. Pardede, K. A. Buckle and G. Srzednicki

Pulp from custard apple (*Annona atemoya* Hort.) was treated with 0.1% ascorbic acid and stored in nylon/LDPE bags at -16.3°C. After 2 weeks, 1 month and 3 months, colour and total ascorbic acid were assessed during 6 h thawing at ambient temperature. Comparison of thawing methods - exposing to air, treatment with ascorbic acid solution before exposing to air, and thawing in a sealed package, showed that the last method is the best to control discoloration and degradation of ascorbic acid for up to 6 h in pulp that had been frozen for up to 3 months. Immersion of pulp in 0.4% ascorbic acid solution before exposure to air at ambient temperature prevents discoloration for up to 4 h of pulp frozen for 1 month, and up to 2 h of pulp frozen for 3 months.

Custard apple (*Annona atemoya* Hort.) is a popular fruit crop originating from Peru in South America. Most of the species are tropical although there are also some subtropical ones. The predominant varieties grown in Australia are African Pride and Pink's Mammoth which are hybrids between tropical and subtropical species. The main production areas in Australia are coastal Queensland and northern New South Wales. The fruits are mainly consumed fresh but can also be used in confectionery, pastries or as a flavouring in milk or ice creams. There are further prospects for potential use in other dairy products such as yoghurts.

As fresh fruit, custard apples have a short postharvest life of less than two weeks. One way to extend storage life is to pulp the fresh fruit and store the pulp frozen. However, pulp exposed to air undergoes discoloration due to polyphenol oxidase activity. Discoloration occurs during storage in the frozen state and continues throughout thawing, and causes loss of quality and value. Browning reactions result from the action of polyphenol oxidases which catalyse oxidation of phenolic compounds to orthoquinone, which subsequently polymerises to form dark-coloured pigments (Ponting 1960, Richardson 1976, Mayer & Harel 1979).

Since custard apple pulp is so susceptible to enzymic browning thawing in air at ambient temperature, the simplest thawing method, is not suitable . Prospero (1993) found that frozen custard apple without antioxidant displayed discoloration after 2 h exposure to air at ambient temperature and that metabisulphite was the most effective antioxidant for preventing discoloration. Ascorbic acid (0.1%) can also control discoloration, provided the pulp is thawed in a sealed pack at a maximum temperature of 10°C. Concern over adverse effects of sulphite for some consumers makes more attractive the use of non-sulphite antibrowning agents (Reyes & Luh 1962, Bauernfeind & Pinkert 1970).

Erika Pardede was a postgraduate student, Dr Ken Buckle is a Professor and Dr George Srzednicki is a Professional Officer in the Department of Food Science and Technology, The University of New South Wales, P O Box 1, Kensington, NSW 2033. Correspondence should be addressed to Prof. Buckle

The aim of this study was to examine methods to control the browning of frozen custard apple pulp during thawing.

Methods and materials

Custard apple fruits of cultivars African Pride and Pink's Mammoth were provided by Mr Cliff James, Denford Plantations, Knockrow, NSW. The packaging material used was a film of polyvinylidene chloride (PVDC)-coated nylon extrusion coated with low density polyethylene (LDPE) containing a small proportion of ethyl vinyl acetate (EVA), obtained from Astrapak Limited, Villawood, NSW.

Each custard apple was washed, cut in half across the stem and the halved fruit pressed on a metal screen. L-ascorbic acid (0.1% of total weight of the pulp) was added and the pulp was vacuum packed (80% air removed) and stored at about -16°C for 3 months.

Frozen custard apple pulp was removed from storage and thawed at ambient temperature by the following methods:

A. Pulp exposed to air for 6 h.
B. Pulp thawed in the sealed package for 6 h.
C. Pulp immersed in 0.4% L-ascorbic acid solution for 1 min, then exposed to air for 6 h.
D. Pulp sprayed with 0.4% L-ascorbic acid solution (30 mL), then exposed to air for 6 h.

Colour and total ascorbic acid were measured every 2 h for all four thawing methods. Colorimetry was performed with a Hunterlab colorimeter standardised against a white tile (L=92.0, a=-1.2, b=+1.5). Colour difference (ΔE) of two samples was measured by the relationship $\Delta E=[(L_1-L_2)^2+(a_1-a_2)^2+(b_1-b_2)^2]^{0.5}$. The ascorbic acid content was determined by a modification of the procedure of Brubacher & others (1985).

Results and discussion

There were significant thawing method-storage time, thawing time-storage time and thawing method-thawing time interactions affecting the discoloration and total ascorbic acid content of custard apple pulp packed in nylon/LDPE film (Figure 1).

Thawing inside the package (method B) gives the best

retention of quality as assessed by discoloration and total ascorbic acid content. No significant discoloration occurred during 6 h thawing of fresh pulp, and discoloration was noticeable after 6 h thawing only in pulp that had been stored frozen for 3 months.

Thawing in air (method A) or after spraying the surface with ascorbic acid solution (method D) produced noticeable browning, and discoloration was worse for product that had been stored frozen for more than 1 month before thawing. Immersion of the frozen pulp in ascorbic acid solution before thawing (method C) prevented discoloration for up to 4 h of pulp that had been stored frozen for 1 month. Again, as frozen storage time increased, there was less protection against browning afforded by the ascorbic acid.

Ascorbic acid levels decreased during 6 h thawing for each of the thawing methods, the lowest retention (41%) being for pulp stored frozen for 3 months and thawed by method D. Levels of ascorbic acid at each thawing time were highest for product immersed in ascorbic acid solution (method C), but discoloration of this product was greater than for pulp thawed in the package, especially at longer thawing times.

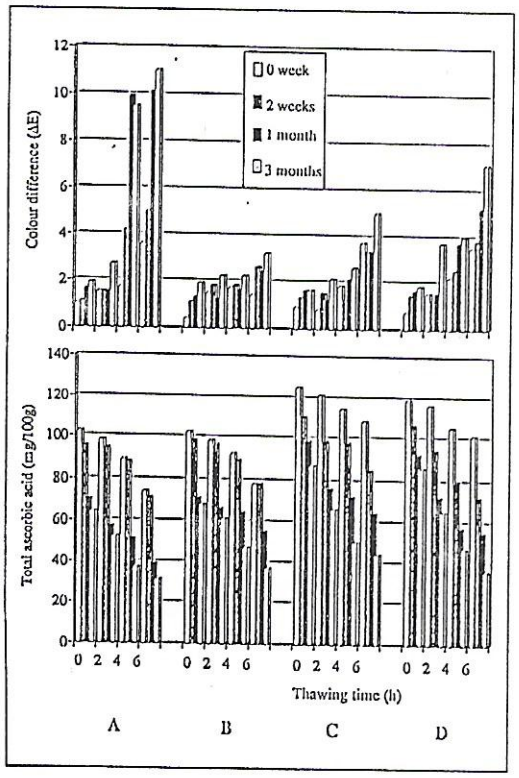

Figure 1. Discoloration as measured by ΔE (top) and ascorbic acid content (bottom) of custard apple pulp thawed by four methods:
A: Pulp exposed to air at ambient temperature.
B: Pulp thawed in sealed package at ambient temperature.
C: Pulp immersed in 0.4% L-ascorbic acid solution for 1 min, and exposed to air at ambient temperature.
D: Pulp sprayed with 0.4% L-ascorbic acid solution (30 mL), and exposed to air at ambient temperature.

Conclusions

Thawing custard apple pulp at ambient temperature in sealed nylon/LDPE packages prevented discoloration and degradation of ascorbic acid during 6 h thawing of pulp frozen for up to three months. The immersion of frozen pulp in 0.4% ascorbic acid solution before exposure to air at ambient temperature was also effective in preventing discoloration during 4 h thawing of pulp stored frozen for up to one month, and for up to 2 h of thawing for pulp frozen for three months.

Spraying 0.4% ascorbic acid solution onto frozen pulp before exposure to air at ambient temperature prevented discoloration during 4 h thawing of pulp stored frozen for up to two weeks, for only 2 h for pulp stored frozen for up to one month, and did not prevent discoloration in pulp stored frozen for three months.

Higher concentrations of ascorbic acid may extend the thawing time before discoloration occurs, particularly for frozen storage periods beyond three months. The microbiological status of custard apple pulp during thawing at ambient temperature was not assessed in this study, but should be undertaken in order to assess final product quality.

References

Bauernfeind, JC & Pinkert, DM. 1970. Food processing with added ascorbic acid. Adv. Food Res. 18:219-305.
Brubacher, G, Miller-Mullot, W & Southgate, DAT (eds). 1985. Methods for the Determination of Vitamins in Food. Elsevier Applied Science Publishers, Essex: 76-84.
Mayer, AM & Harel, E. 1979. Polyphenol oxidases in plants. A review. Phytochemistry 18:193-215.
Pardede, E. 1993. A study on the thawing of frozen custard apple (*Annona atemoya*) pulp. MAppSc thesis. University of NSW, Kensington.
Ponting, JD. 1960. The control of enzymatic browning of fruits. In Schultz, HW (ed). Food Enzymes. AVI, Westport, CT: 105-23.
Prospero, RB. 1993. The stability of frozen custard apple pulp (*Annona atemoya*). MAppSc thesis. University of NSW, Kensington.
Reyes, P & Luh, BS. 1962. Ascorbic and isoascorbic acids as antioxidants for frozen freestone peaches. Food Technol. 16: 116-18.
Richardson, T. 1976. Enzymes. In Fennema, OR (ed). Principles of Food Science, Part I. Marcel Dekker, New York.