CONVENTION PAPERS

Gold Coast, Queensland
6th — 10th May 1990

ASEPTIC PACKAGING OF TROPICAL FRUIT PUREES

A.R. ISAACS

SUMMARY

The object of this investigation was to develop high quality aseptically packaged mango and passionfruit puree products. Kensington mango puree (acidified to pH 3.5) and deseeded passionfruit pulp (pH 3.0) were sterilised in a scraped-surface heat exchanger, cooled to 20°C in a tubular heat-exchanger, and aseptically packaged in sterile laminate bags. Six sterilising time/temperature combinations were compared - 85°C/15 secs, 85°C/60 secs, 90° C/15 secs, 90°/60 secs, 95°C/15 secs, 95°C/60 secs. Products were assessed immediately after processing, and after eight months ambient storage, for microbial, physical, chemical, and sensory quality. All treatments were microbiologically sound and showed no enzyme activity. Sensory quality was very acceptable, and there was no evidence of heat damage. Quality (especially colour and flavour) decreased during storage in all heat treatments.

INTRODUCTION

Aseptic 'bag-in-box' packaging is becoming a commonly-used process for the preservation of fruit purees, juices, and concentrates. It should largely displace freezing and canning as a method or preserving bulk purees and concentrates for remanufacture. The major advantages of this technology are:

(a) lower transport and storage costs, compared with frozen products

(b) better product quality compared with canned products (the heat process is independent of the package size) and

(c) virtually no restriction on package size

Australian mango production is expected to rise dramatically during the next decade. Recent Departmental surveys have indicated a projected increase from the current 18,000 tonne to over 34,000 tonnes by 1996. Thus there will be an urgent need to expand domestic markets and to develop sizeable export markets. Currently about 1,800 tonnes of Queensland mangoes are processed, principally as frozen puree for remanufacture.

Australian passionfruit production was approximately 4,000 tonnes in 1987 and is expected to rise to 5,000 tonnes by 1991. A major proportion of the crop is processed, principally as frozen pulp for remanufacture. Production has fluctuated widely in recent years due to instability in domestic markets. Development of sizeable export markets would assist greatly in stabilizing the Australian passionfruit industry.

Bob Isaacs is a Senior Food Technologist at the Queensland Department of Primary Industries, Food Research and Technology Branch, Hamilton, Queensland, 4007.

No previous research on aseptically-packaged tropical fruit purees has been conducted by this Department, apart from preliminary work on mango puree. There are no Australian publications on this subject and little has been published overseas. Commercial aseptic packaging of mango puree in the Philippines has been reported (Anon, 1983). Mango puree is pasteurised in a scraped surface heat exchanger at 96° for one minute, and aseptically-packaged with a 'Scholle' filler at 29°C. No information on product quality was given in this paper. Chan and Cavaletto (1982) investigated changes in the chemical and sensory quality of aseptically-packaged papaya and guava purees. Anon (1982) described the aseptic packaging of papaya puree in Hawaii. The puree was adjusted to pH 3.5 with citric acid, sterilised at 94°C in a scraped surface heat exchanger, and aseptically-packaged at 27°C. No technical information on product quality was reported.

Szemplenski (1980) reported the aseptic processing of fruit purees for use in ice cream and yoghurt. Puree was mixed with water, sugar, and stabilizer (gum, starch or pectin), pre-heated in steam jacked pans to 50°C, and aseptically processed in a scraped surface heat exchanger at 93 to 121°C (depending on the produce) for 3 minutes. The product was aseptically-packaged at 26°C with a 'Scholle' bag-in-box filler. Advantages included elimination of the need for preservatives, improved flavour, refrigeration cost savings, packaging cost savings (up to 50% over alternative methods) and transport cost savings. Woodhams (1982) discussed the problems in aseptically processing fruit purees in a review paper. These included heat induced colour and flavour changes, sensitivity to oxidation (especially of oil fractions), sensitivity of cell structure to shearing, and the abrasion of machine parts and seals due to the presence of fibre and seed particles.

The objectives of this investigation was to develop high quality aseptically packaged mango and passionfruit puree products.

MATERIALS AND METHODS

Acidified kensington mango puree (pH 3.5) and deseeded passionfruit pulp (pH 3.0) were sterilised in a "Cherry-Burrell" scraped surface heat exchanger, cooled in "Spriroflo" tubular heat exchangers to 20°C, and aseptically packaged with an "Intasept" filler, into sterile metallised polyester bags.

Treatments

(1) 6 pasteurising time/temperature combinations

85°C/15 seconds, 85°C/1 minute, 90°C/15 seconds, 90°C/1 minute, 95°C/15 seconds, 95°C/1 minute

(2) 2 storage times

0 months and 8 months

Objective Quality Measurements

Samples were tested for pH, % acid, % soluble solids (brix), yeasts and moulds, colour (Hunter L, a, b), vitamin C, viscosity, enzyme activity, and settling (AOAC, 1984).

Sensory Evaluations

Puree samples were made up to drinks. A panel of 20 laboratory staff rated the drinks on a 9 point hedonic scale (1 = dislike extremely, 9 = like extremely) for colour, flavour, and consistency. Colour was evaluated under white light, while flavour and consistency were scored under red light. Four samples were assessed at each tasting session.

RESULTS

Mango Puree (Unstored)

Physical and chemical tests showed few trends with severity of heat treatment. Settling was greatest for the 85c/15 sec and 95c treatments. (The higher the reading the less settling). Viscosity was lower at 95c and for the 85c/15 sec treatments. Colour values (L, a, b) indicated slightly less "redness" at 85c than at 95c. Soluble solids were also slightly lower at 85c. Ascorbic acid levels in all treatments showed a decrease from the 200 mg/100 g added before processing. This indicates some breakdown during heat sterilisation and/or possible conversion of ascorbic acid to dehydroascorbic acid. A similar trend was observed in preliminary work.

Yeast and mould counts were absent on all plates. Total counts were low. Previous preliminary work indicated colonies were Bacillus sp., and would not be capable of growth or spoilage at a pH as low as 3.5. It is interesting to note that heat treatment had little effect on these counts. Peroxidase, catalase, and polyphenoloxidase and pectinesterase activity was absent in all treatments.

Colour, flavour, and consistency scores were all high, averaging "like moderately" on the hedonic scale. Some panelists considered the 85c/15 sec (Rep 2) had an unusual flavour, which probably accounts for the lower score for this treatment. Overall, sensory quality of the unstored mango puree was very acceptable for all heat treatments.

Mango Puree (Stored)

All treatments were microbiologically sound and had no enzyme activity. The main heat treatment effects were a lower viscosity for treatments with a 15 second holding time compared to a 60 second holding time, a decrease in redness (Hunter "a" value) for the 90^{o}C/15 sec holding time; ascorbic acid levels were highest for the 95^{o}C treatments. Sensory quality was not significantly affected.

The main effects of ambient storage were a decrease in brightness (Hunter "L" value), yellowness (Hunter "b" value), and ascorbic acid.

Sensory colour and flavour scores decreased during storage but were still acceptable, while consistency ratings were unaffected.

Passionfruit Puree (Unstored)

Settling of the diluted drink was greater and more distinct than for mango, although there was no trend with heat treatment. Viscosity was greatest for the 85c treatments, and passionfruit was considerably less viscous than mango puree. Heat treatment had no effect on colour values (L,a,b). However, passionfruit was less bright (lower L), less yellow (lower b), and more red (higher a) than mango puree. pH, soluble solids, and acid levels were also unaffected by heat treatment. Ascorbic acid was not added before processing, although all treatments showed a drop from the level in fresh pulp (18mg/100g).

Microbiologically, all treatments showed an absence of yeasts and moulds and total counts were low (Counts were lower at 95c). Enzyme activity was also absent in all treatments.

Sensory colour scores were lower than for mango probably because of the darker colour of passionfruit drinks. Overall sensory quality of the unstored passionfruit puree was very acceptable and appeared to be unaffected by heat treatment.

Passionfruit Puree (Stored)

All treatments were microbiologically sound and showed no enzyme activity. The main heat treatment effect was a lower viscosity for the treatments with a 60 second holding time. Sensory colour and flavour scores were low in all cases, and heat treatment had little effect on sensory quality.

The main effects of storage were a decrease in viscosity, an increase in brightness (Hunter "L" value), a decrease in yellowness (Hunter "b" value), and ascorbic acid. There was a significant decrease in sensory colour and flavour scores during storage to unacceptable levels. Panelists comments indicated this was due to darkening and loss of characteristic passionfruit flavour.

DISCUSSION

These results are in agreement with the findings of Chan and Cavaletto (1982) for stored aseptically packaged papaya and guava purees. They reported that during pasteurisation, guava puree showed no loss of ascorbic acid and flavour, but significant losses in colour. After 6 months ambient storage, ascorbic acid loss was 30%, and significant changes in colour and flavour occurred. Papaya puree showed a 6% loss of ascorbic acid and a small change in colour during processing, but flavour was stable. After 6 months storage, the ascorbic acid loss was 56%, and non-enzymic browning was reported. Flavour was unchanged after 6 months ambient storage. In a later study on aseptically packaged guava puree, Chan and Cavaletto (1986) reported deaeration improved ascorbic acid retention, but did not affect colour or flavour stability.

Similar findings have also been reported for aseptically packaged orange concentrate. Kanner et al (1982) sterilised valencia orange concentrate (58° Brix) at 92-94°C for 30 seconds and packaged it with a "Dole" aseptic can filler. Non-enzymic browning occurred during storage at temperatures above 12°C, while flavour was unchanged after 8 months at 17°C. Ascorbic acid loss was approximately 40% after 6 months at 25°C.

CONCLUSION

This research indicates that high quality aseptically packaged mango and passionfruit purees can be achieved, but that quality decreases during storage. Further work is necessary to improve storage stability. Trials are in progress to determine the effects of added ascorbic acid, storage temperature, and packaging materials on shelf life.

ACKNOWLEDGEMENTS

This project is being funded by the Australian Special Rural Research Fund (ASRRF) and the Queensland Committee of Direction of Fruit Marketing (COD).

REFERENCES

Anon. (1982). Food Eng. Int. **15**: 57.

Anon. (1983). Food Eng. **55**: 180.

Association of Official Analytical Chemists (1984). Official Methods of Analysis A.O.A.C. Inc., 14th Edition (Arlington: Virginia).

Brekke, J.E., Cavaletto, C.G., Stafford, A.E., and Chan, H.T. (1975). Mango: processed products. (U.S. Department of Agriculture: ARS W-23, Washington D.C.).

Britnell, P. and Isaacs, A.R. (1989). Development of processed mango products. (QDPI: Brisbane).

Chan, H.T. and Cavaletto, C.G. (1982). J. Food Sci. **47**: 1164.

Chan, H.T. and Cavaletto, C.G. (1986). J. Food Sci. **51**: 165.

Isaacs, A.R. (1989). Acta Horticulturae. (In press).

Kane, J. and Isaacs, A.R. (1989). The market potential for Australian mango products in New Zealand. (QDPI: Brisbane).

Kanner, J., Fishbein, J., Shalom, P., Harel, S. and Ben-Gero, I. (1982). J. Food Sci. **47**: 429.

Nagy, S., Shaw, P.E., and Veldhuis, M.K. (1977). Citrus Science and Technology Volume 2 p. 511. (AVI Publishing Company: Westport, Connecticut).

Owusu-Yaw, J., Marshall, M.R., Koburgher, J.A., and Wei, C.I. (1988). J. Food Sci. **53**: 504.

Szemplenski, T.E. (1980). Amer. Dairy Rev. **42**: 26G.

Woodhams, D.J. (1982). Aseptic processing of viscous and particulate products in Aseptic Processing and Packaging. (University of Auckland: N.Z).