Further development of value added nashi products

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Food Science Australia

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FURTHER DEVELOPMENT OF VALUE ADDED NASHI PRODUCTS

HAL Project Number NA99001

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1.0 MEDIA SUMMARY

The nashi (or Asian pear), which has a sweet taste and a crisp texture, appeals to many people. But an estimated 20-50% of the production in Australia is classified low-grade because of minor physical defects. The majority of these defects do not affect eating quality.

Now it is possible to utilise low grade nashi in high value markets, as a team of scientists at Food Science Australia have demonstrated through a previous project (funded by the Australian Nashi Growers Association, the Horticultural Research and Development Corporation and the former Victorian Department of Natural Resources and Environment) by developing three value-added concept products: nashi chips (dried thin slices); nashi slices (intermediate moisture slices); and nashi based juices. These technologies developed for producing these new nashi products can also be successfully applied to a range of other fruits and could benefit manufacturers of snack-food, breakfast food and beverages.

The success of the value added nashi products in the market would depend on a variety of factors such as consumer acceptability, market application, economic viability of the manufacturing processes, shelf life and packaging technology. The aim of this project is to further develop these products to make them commercially viable by undertaking in-house consumer evaluations in Australia and Japan, laboratory screening and modification trials, pilot plant productions, consumer/market evaluation, cost/benefit analysis and preliminary packaging trials.

The production of nashi juice and modified slice and chips products were successfully scaled up in small scale commercial facilities and the products produced were used for large scale consumer/market evaluations. Consumers (both children and adults) found both nashi chips and slices acceptable with around 84% indicating they liked the products. About 77% of the children indicated that they would/would consider asking their parents to buy the products, 91% of the consumers surveyed liked the juice and 67% indicated they definitely or probably would buy the juice product.

Cost/Benefit analysis estimated that large scale production (based on building facilities from new) of the nashi chips and slices (processing 236 fresh tonnes per year) is a viable business with return on investments within three years. Small scale production (45 fresh tonnes per year) can only succeed if the distributor can be cut out of the marketing chain, with a return in four years.

The outcomes of this project have demonstrated that the value added nashi products are economically viable to produce and there is great potential for success in the market. It is recommended to actively pursue the commercialisation of these products by seeking commercial partners to place one or two of these nashi products on the retail market. It is anticipated that the successful commercialisation of the products will provide growers with an alternative of utilising their low grade fruit, a potential increase in profits and nashi consumption and an opportunity to open up new domestic and overseas market opportunities.

2.0 TECHNICAL SUMMARY

The nashi (or Asian pear) is an increasingly popular fruit in Australia but an estimated 20-50% of the production in Australia is classified low-grade because of minor physical defects. The majority of these defects do not affect eating quality.

Now it is possible to utilise low grade nashi in high value markets, as a team of scientists at Food Science Australia has demonstrated through a previous project by developing three value-added concept products: nashi chips (dried thin slices); nashi slices (intermediate moisture slices); and nashi based juices. The technologies developed for producing these new nashi products can also be successfully applied to a range of other fruits and could benefit manufacturers of snack-food, breakfast food and beverages.

In this project, these value-added nashi products were further developed to make them commercially viable by undertaking preliminary in-house consumer evaluations in Australia and Japan, laboratory screening and modification trials, pilot plant production, consumer/market evaluation, cost/benefit analysis and preliminary packaging trials.

The production of nashi juice and modified slice and chips products were successfully scaled up in small scale commercial facilities and the products produced were used for large scale consumer/market evaluations and shelf life evaluations. Consumers (both children and adults) found both nashi chips and slices acceptable with around 84% indicating they liked the products. About 77% of the children interviewed indicated that they would/would consider asking their parents to buy the products.

91% of the consumers surveyed liked the juice and 67% indicated they definitely or probably would buy the juice product. During shelf life evaluation using storage at refrigerated temperatures, it was found that there was no variation in taste, brix levels, pH and microbial growth throughout the six month storage period for the commercially produced nashi juice product. The product was also judged as microbiologically stable after six months of storage at ambient temperature. Visual and spectrophotometric analysis demonstrated that there were no major quality problems caused by browning of nashi juice products during storage.

Cost/Benefit analysis estimated that large scale production of the nashi chips and slices (processing 236 fresh tonnes per year) is a viable business option with a return on investment within three years. Small scale production (45 fresh tonnes per year) can only succeed if any distributors can be cut out of the marketing chain, thereby giving a return on investment in four years.

The outcomes of this project have demonstrated that the value added nashi products are economically viable to produce and there is great potential for success in the market. It is recommended to actively pursue the commercialisation of these products by seeking commercial partners to produce one or two of these nashi products for the retail market.

3.0 INTRODUCTION

Nashi (or Asian pear) is a fruit produced for both Australian and international markets. Nashi production in Australia has increased rapidly, with Victoria becoming the main producer. The majority of nashi are marketed domestically, with some (approximately 10%) exported to Asia. Like other fruit for fresh markets, low grade fruit due to minor physical defects and/or size are by-products of the high quality standard for the export and premium domestic markets. The majority of low-grade fruit is still of good eating quality and according to the 5-year strategic plan issue paper prepared for the Australian Nashi Industry (Rendell McGuckian 2001), an estimated 50 % of total production is classified as Class II and 20% as juice-grade fruit. At present, the juice-grade fruit is sold to juice processors (to be incorporated into pear juice) at 15c/kg and the class II is sold on local markets at 50c-$1.00/kg. These options often make little or no profit for the growers and can become a competitor to premium products.

Opportunities exist to convert low grade nashi into high value products such as fresh snack food, dried chips, beverages, fruit salad components, ingredients to breakfast cereal, bakery fillings and jams. In the importing developed countries of Asia such as Japan and Singapore, there exists a market for high value, high premium beverages and juices based on nashi. In the domestic market, beverage and juices based on nashi can be of great potential in offering new, exotic and refreshing drinks. Opportunity also exists in the snack food area where "healthy nashi chips" can favourably compete with other traditional snack products.

This project is a continuation of a previous completed project in which Food Science Australia investigated the technical feasibility of adding value to nashi. The study was initiated by Australian Nashi Growers Association, seeking better processing options and profit margins for their low grade fruit. In that project scientists at Food Science Australia developed 3 value-added concept products:

- Nashi "chips" - dried thin slices to be marketed as a shelf stable snack food;
- Nashi "slices" - intermediate moisture slices, which can be consumed as snack food or used as an ingredient for confectionery purposes;
- Nashi "juices" - beverages based on nashi.

These products were developed in a series of laboratories trials where several technologies were screened and compared to produce the most suitable value-added products. The technologies used for drying or juicing of apples have been adopted and modified for the drying or juicing of nashi. The first two products employed the use of a combination technology where osmotic dehydration is used as a pre-treatment to the conventional hot air drying.

The success of the value added nashi products in the market will depend on a variety of factors such as quality and safety of the product, packaging, shelf life, consumer acceptability, market application, economic viability of the manufacturing processes and packaging technology. The aim of this project is to further develop the value-added products to make them commercially viable. These included pilot plant production, consumer evaluations, cost/benefit analysis, packaging and modification trials.

It is anticipated that the successful commercialisation of the products will provide growers with an alternative of utilising their low grade fruit, a potential increase in profits and nashi consumption and may open up new domestic and overseas market opportunities.

SECTION A

4.0 LABORATORY AND PILOT SCALE DEVELOPMENT OF NASHI CHIPS AND SLICES

Prepared by: Kean Leong et al, Food Science Australia

EXECUTIVE SUMMARY

To make the value added products commercially viable and acceptable to the consumers, the products were further developed in the laboratory in relation to the sensory and physical aspects. The products were first evaluated by an in-house consumer panel and staff from a Japanese company to determine their sensory acceptability. The products and processes were then modified and improved by comparing the different osmotic solutions, the sugar levels and the types of packaging systems.

The preliminary in-house consumer evaluation has shown that the colour, overall texture, overall flavour and aftertaste of the semi moist product were liked significantly more than the air-dried chip products. The panellists also seemed to find the chips a little bit too sweet and chewy. 21 out of the 26 panellists ranked the semi moist slices as the most preferred. 89% of the panellists said they would buy the nashi slice in comparison to 73% for chip. Consumers are most likely to purchase the nashi products as either a snack food or when it is blended in a breakfast cereal. Feedback from a Japanese company also confirmed that the slices were better in texture and taste and they generally preferred a less sweet product.

A new product, a high moisture segment for freezing, was also developed. This nashi segment, in general, has better colour attributes as compared to slices and chips. The slices and segments have better sensory attributes than chips.

Based on the sensory and laboratory results, the processes for the production of the value added products were modified. These modified slice and chips products were then successfully scaled up in small scale commercial facilities. These products produced were used for large scale consumer/market evaluation and shelf life evaluation.

4.1 PRELIMINARY CONSUMER EVALUATION OF NASHI CHIPS AND SLICES

A small scale preliminary sensory evaluation was conducted to determine in-house consumer acceptability of the two nashi products in relation to appearance, texture and flavour characteristics and whether there is a significant difference in preference between the semi moist nashi slice and the nashi chip.

4.1.1 Method

Testing Environment

- The sensory sessions were conducted in the computerised sensory facility of Food Science Australia, Melbourne Laboratory, Werribee. Panellists were seated in individual booths for all the evaluations.

Samples Preparation and Serving

- Two nashi products were evaluated: dried nashi chip and semi moist nashi slice.
- Samples were presented to consumers in a random order, one at a time.
- Two pieces of each of the nashi products were presented at room temperature to each consumer on a 3-digit coded white plate.
- Plain water cracker biscuits and filtered water were used as palate cleansers.

Demographics of Consumer Panel

- A panel of 26 consumers (recruited in-house) completed the evaluations. There were 12 males and 14 females.
- All panellists were consumers of dried fruit.

Questionnaires Design

- The questionnaire consisted of rating the hedonic (liking) in relation to appearance, colour, texture, flavour and overall acceptability of the nashi products on a 100mm unstructured line scale. The left anchor (0mm) =Dislike Extremely and right anchor (100mm) = Like Extremely. Rating for intensity of sweetness and chewiness, were also collected using a 100mm unstructured line scale where the left anchor (0mm)= Not Enough, the mid point (50mm) was equal to "Just Right" and the right anchor (100mm) = Too Much. (See Attachment 3 for questionnaire).
- The panellists were asked whether they would buy the product, and if so, in what form they would purchase it.
- A comment section was also included in the questionnaire.

Data Entry and Analyses

- The sensory software Compusense Five was used for the development of the questionnaire.
- Analysis of variance was carried out on the consumers' responses and Tukey's HSD was used for pair wise comparisons of the means.
- All pair wise comparisons were at the 5% level of significance.

4.1.2 Results And Discussion

Figure 1 presents the mean scores on liking and overall acceptability for the dried chip and semi moist nashi products (n=26). The slices have relatively high acceptability scores of above 60 (out of 100) for colour, overall appearance, texture, overall flavour, aftertaste and overall acceptability. There were significant differences between the products in liking of colour, texture, overall flavour, aftertaste and overall acceptability (in section A, 4.6, Table 1**).** The colour, overall texture, overall flavour, aftertaste and overall acceptability of the semi moist product were liked more than that of the dried chip product (5% level of significance). There were no significant differences in the liking of overall appearance between the two products.

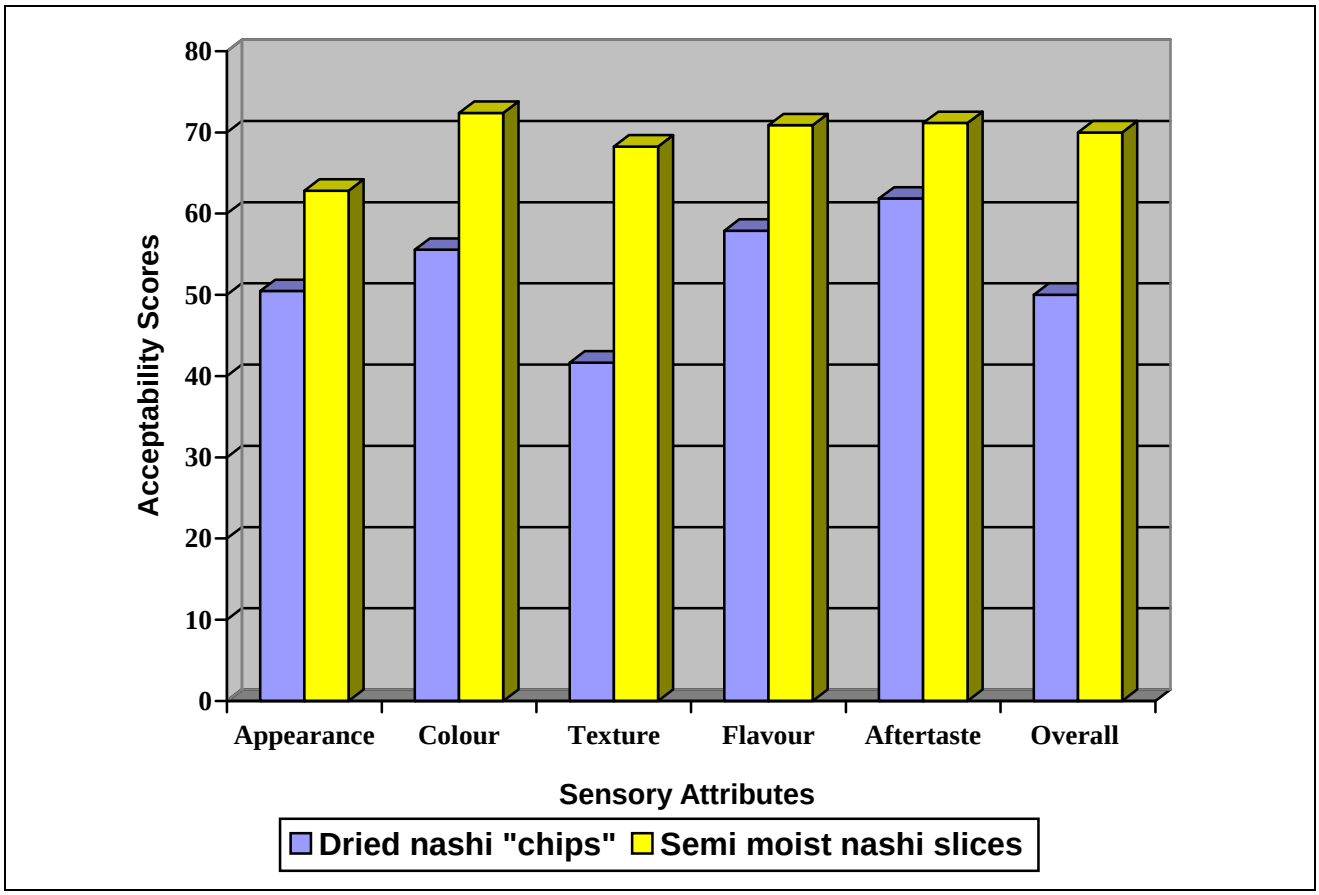
The sweetness and chewiness of the slices were found to be closer to panellist "just right" score for each attribute. The chip product score was towards the too sweet and too chewy end of the scale and with several panellists making specific comments about these attributes. Panellists also commented that the chips would have looked better without the skin on. If changes were to be made to the chips it is recommended that there be further development in

improving the chewiness and sweetness of the product. Removal of the skin may also help to increase the overall acceptability of the product.

21 out of the 26 panellists ranked the semi moist slices as the most preferred. Overall, the semi moist product (70/100) had a significantly higher overall acceptability score than the chip product (49/100).

89% of the panellists said they would buy the nashi slice in comparison to 73% for chip. Consumers are most likely to purchase the nashi products as either a snackfood or when it is blended in a breakfast cereal. (refer to Section A,4.6 for further details).

Fig 1: Preliminary Consumer Acceptability of Nashi Products



4.2 COMPARISON OF DIFFERENT OSMOTIC SOLUTIONS FOR SEMI MOIST SLICES

4.2.1 Method

Deleted for Confidentiality Reasons. The method is the jointly owned intellectual property of Food Science Australia and HAL. The techniques can only be made available for commercial use through a technology transfer agreement with HAL and FSA.

Physical, Chemical and Sensory Evaluation of Samples

Samples from each treatment were taken out for analysis before and after the process illustrated in Fig. 2. The samples were assessed at Food Science Australia, Werribee for colour, water activity (Aw), pH, brix and the rest were frozen and sent to Australian Government Analytical Laboratories (AGAL) for analysis.

After drying, three slices (one from each treatment) were assessed by five taste panellists for their flavour, texture and colour on a scale of 0 to 10, 0 being Dislike Extremely, 5 is Acceptable and 10 being Like Extremely. The panellists were also asked to rank the three samples in terms of overall liking.

The colour was measured objectively using a Minota CR200 on 12 slices of nashis (average of 3 measurements on a different area of each slice). Three slices were crushed and homogenized with a bar mixer and the mixture measured for pH, brix and water activity (Aw).

Preliminary Shelf Life Evaluation of Semi-Moist Slices

After the semi-moist slices were taken out of the forced air dryer, the samples were packaged using three different packaging systems for a preliminary shelf life evaluation as shown in Table 1 below. Colour measurements of the slices were taken at week 6 of storage.

Statistcal Analysis

The sensory (except the rankings) and objective colour measurements were analysed by GenStat statistical package (6th edition), Analysis of Variance. The ranking in the sensory evaluation was analysed by Friedman's Test On The Ranks

4.2.2 Results And Discussion

Physical, Chemical and Sensory Evaluation

Fresh nashis contained 12.3% total solids with fructose and glucose being the major components. The value added chips and slices contained 80-85% solids.

Ascorbic acid retention was the highest in Method B samples and lowest in the Method A samples after drying. SO_2 was the highest in the Method A samples (440ppm) and lowest in the Method B samples (260ppm). There seemed to be a decrease in SO_2 after the dehydration in all samples. Citric acid seemed to be well retained in all the treatments after hot air drying.

Looking at the total acidity (Tables 2, 3 and 4) and pH (Table 5) of the final products, the Method B dehydrated samples were the most acidic followed by Method A , and then closely by Method C.

Table 2: Nutrient Uptake of Slices A

		Fresh Nashi	Semi-Moist Nashi	Nashi Chip
Total solids	g/100g	12.3	21.7	81.3
Fructose	g/100g	5	4.6	25.1
Glucose	g/100g	4.2	4.1	22.6
Sucrose	g/100g	0.2	7.7	14.4
Maltose	g/100g	<0.1	<0.1	<0.1
Lactose	g/100g	<0.1	<0.1	<0.1
Ascorbic Acid	mg/100g	1.9	130	260
Citric acid	mg/100g	160	250	940
Total Acidity	g/kg	3.2	3.9	9.7
Sulphur dioxide	mg/kg	320	100	350
Brix				

Table 3: Nutrient Uptake of Slices B

		Fresh Nashi	Semi-Moist Nashi	Nashi Chip
Total solids	g/100g	12.3	25.4	84.7
Fructose	g/100g	5	15.4	47
Glucose	g/100g	4.2	3.8	15
Sucrose	g/100g	0.2	0.2	0.8
Maltose	g/100g	<0.1	<0.1	<0.1
Lactose	g/100g	<0.1	<0.1	<0.1
Ascorbic Acid	mg/100g	1.9	170	400
Citric acid	mg/100g	160	280	1030
Total Acidity	g/kg	3.2	4.2	12
Sulphur dioxide	Mg/kg	320	70	260
Brix				

Table 4: Nutrient Uptake of Slices C

		Fresh Nashi	Semi-Moist Nashi	Nashi Chip
Total solids	g/100g	12.3	19.5	83.9
Fructose	g/100g	5	3.8	27.3
Glucose	g/100g	4.2	4.5	25.9
Sucrose	g/100g	0.2	0.1	0.4
Maltose	g/100g	<0.1	1.2	2.8
Lactose	g/100g	<0.1	<0.1	<0.1
Ascorbic Acid	mg/100g	1.9	120	140
Citric acid	mg/100g	160	190	1090
Total Acidity	g/kg	3.2	4.1	10.6
Sulphur dioxide	Mg/kg	320	130	440
Brix				

From Table 5 the panellists found the appearance of 2 types pf dehydrated slices appealing, while samples of a third were significantly inferior. There were no difference however among

the three treatments in regards to taste and texture. However some panellists commented that they found one type of dehydrated sample to be a bit too sweet when comparing to samples from the other two treatments. In terms of general liking, the Method B dehydrated samples were ranked the best followed by Method A and Method C samples, although there were no significant differences between the three treatments in their preferential rankings.

In general, the Method B dehydrated slices seemed to be the most appealing in terms of sensory, low sulphur dioxide retention and high ascorbic acid retention. Their appeal may have been the moderate sweetness and the tangy taste due to the higher acidity, as compared to the other two products.

Table 5: Quality Indices Of Nashi Slices Produced By Different Osmotic Solutions

	Treatment		
	B	**C**	**A**
Sensory:			
Appearance	9.2 [a]	6.2[b]	9.4[a]
Taste	8.4	7.2	8.8
Texture	8.4	6.4	8.8
Rank	1.8	2.0	2.2
Water Activity (Aw)			
Fresh Nashis (control)	0.986	0.986	0.986
Nashis after osmotic	0.974	0.982	0.984
Nashis after air drying	0.488	0.512	0.574
PH			
Fresh Nashis (control)	4.33	4.33	4.33
Nashis after osmotic	3.67	3.76	3.76
Nashis after air drying	3.82	4.23	4.08
Brix			
Fresh Nashis (control)	11.5-12	11.5-12	11.5-12
Nashis after osmotic	22	17	19

For sensory evaluation raw data, refer to Section A, 4.6 Table 6 for details. Statistics analysed by Genstat (6th edition), Analysis of variance. Different alphabets indicated treatments are significantly different at p=0.05.

Preliminary Shelf Life Evaluation

In the previous project NA99001, the nashi chips were found to have a storage life of about 20 weeks at ambient temperature in air sealed high barrier packaging and the semi moist slices had a storage life of at least 17 weeks at refrigerated temperature in air sealed high barrier packaging.

Minota CR200 measured the colour objectively on 12 slices of nashis (average of 3 measurement on different area of each slice). The L value is a measurement of colour lightness, the a value the green-red and b value the yellowness of the samples. The Hue angle is an objective colour measurement of the rate of browning. A decrease in hue angle indicated the increase in browning. It was shown in the previous project that dehydration inhibited browning both in freeze drying, and more drastically in air drying, in which the hues were significantly higher than that without any pre-treatment. From Table 6, slices straight after dehydration has a lighter colour and less brownness than that of fresh slices, indicating that dehydration maintained or even improved the original colour of the slices.

Straight after drying, and at week 6 after storage, there was no significance colour difference in the slices of different treatments. The slices of all three treatments were significantly more yellow (L values) after drying than before drying. There were no significant differences in the a, b and Hue angle values before and after drying but there were significantly more variation (S.D) in L, a and b values after drying than before.

After 6 weeks of storage at 28°C, the samples of all the treatments were significantly more yellow than they were in day 1 before storage. However there was no significant objectively measured darkening (L value) or browning (Hue angle) although visually the samples were quite brown in comparing to day 1. There was also significantly more variable in the a values (ie. green-red) for all the treatments. The only significant difference between the different osmotic treatments was the greater variability of yellowness of Method B treated slices at 42 days than at 1 day.

In comparing the different packaging systems, the nitrogen packaged slices of all the treatments were significantly lighter (L value), greener or less red (a value) and greater signs of browning (Hue angle) than the air and vacuum packaged slices at 42 days.

From the results it was shown that there was no treatment effect on the colour of the samples during drying and storage. Drying and storage for 6 weeks seemed to cause the samples to become more yellow while nitrogen flushing packaging system seemed to prevent the samples from darkening as compared to the air and vacuum packaging systems.

Table 6: Objective Colour Measurement of Semi Moist Slices Under Different Treatments

	L		A		B		HUE
Treatments	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	
Day 0 before dehydration							
Control	60.52	1.71	-0.33	0.17	7.07	0.89	**92.67**
Day 0 after *dehydration*							
Method B	64.2	1.32	-0.77	0.16	9.05	0.94	**94.86**
Method A	64.27	1.27	-0.86	0.19	8.35	0.56	**95.88**
Method C	62.73	1.36	-0.91	0.18	9.52	1.31	**95.46**
Day 1 after Drying& before Packaging							
Method B							
Nitrogen	77.97	2.4	-0.47	0.92	22.77	1.75	**91.18**
Vacuum	79.03	3.14	-0.5	0.79	24.41	1.98	**91.17**
Air	77.37	2.03	-0.63	0.66	22.8	1.52	**91.58**
Method A							
Nitrogen	78.48	1.93	0.17	0.47	25.4	2.48	**89.62**
Vacuum	78.47	1.76	0.04	0.66	23.17	2.7	**89.90**
Air	75.01	2.53	-0.08	0.6	22.12	2.34	**90.21**
Method C							
Nitrogen	76.95	1.94	-0.62	0.56	21.8	1.87	**91.63**
Vacuum	77.61	3.25	-0.2	0.91	24.22	2.3	**90.47**
Air	77.72	2.76	-0.98	0.32	22.63	1.53	**92.48**
Week 6 in Storage at 28°C							
Method B							
Nitrogen Flushed	71.77	2.05	2.56	1.33	27.49	2.64	**84.68**
Vacuum Sealed	66.51	3.76	4.75	1.68	30.76	3.3	**81.22**
Air sealed	66.37	3.25	4.16	1.33	28.08	2.75	**81.57**
Method A							
Nitrogen Flushed	69.37	3.8	3.81	1.66	27.5	2.17	**82.11**
Vacuum Sealed	68.5	2.87	3.72	1.39	27.6	1.64	**82.32**
Air sealed	65.72	3.02	4.21	1.12	25.14	2.9	**80.49**
Method C							
Nitrogen Flushed	71.35	1.58	2.42	1.33	26.66	1.57	**84.81**
Vacuum Sealed	64.76	3.58	5.08	1.6	26.74	2.09	**79.24**
Air sealed	65.58	2.63	4.39	1.18	27.58	2.07	**80.96**

Statistics analysed by Genstat (6th edition), Analysis of variance. The L value is a measurement of colour lightness, the a value the green-red and b value the yellowness of the samples. The Hue angle is calculated from L,a, b values and is an objective colour measurement of the rate of browning.

4.3 PRELIMINARY EVALUATION OF NASHI PRODUCTS IN JAPAN

Samples of the dehydrated nashi slices and chips were sent to a major food company in Japan for evaluation. Staff from different age groups was asked to evaluate the products.

4.3.1 Method

The samples were prepared using the method outlined previously. The samples were then packaged and sealed in aluminium foil bags and brought to Japan via Food science Australia staff.

4.3.2 Results And Discussions

Company staff of different age groups was asked to evaluate the samples and Table 7 is the summary of their comments. Comments were received and modifications were made to the products to make them more acceptable for the overseas market as outlined below.

Table 7: Comments on the Sensory Attributes of Nashi Chips and Slices Provided by Staff of a Japanese Company

Nashi Product	Sensory Attributes		
	Appearance	**Texture**	**Taste**
Chips	Better, looks more like fruit because of peel	Not good, because sticky	Too sweet, not natural. Sweetness is too artificial
Slices	Not good, looks like banana	Good, because crispy	More natural, not too sweet but better with less sweetness

4.4 COMPARISON OF THE MODIFIED CHIPS, SLICES AND SEGMENTS

Following the comments from the Japanese company, the amount of sugar in dehydrated product was reduced and the chips were also rinsed three times after dehydration so as to reduce the stickiness (only the semi moist slices were rinsed in the original protocol).

Another product, a thicker segment with high Aw (~0.8) was also developed for the purpose of freezing. This product will be suitable as ingredients for nashi pies or garnishes for desserts such as ice cream. This product was suitable for freezing and suffered no drip loss and did not become mushy and brown after thawing as in the case of raw nashis. It also retained the juiciness and good texture of raw nashis.

The three modified valued added products: chips, slices and segments, prepared in three different dehydration methods, were then compared in relation to their sensory and objective colour properties.

4.4.1 Method

Deleted for Confidentiality Reasons. The method is the jointly owned intellectual property of Food Science Australia and HAL. The techniques can only be made available for commercial use through a technology transfer agreement with HAL and FSA.

Sensory and Objective Colour Evaluation of Samples

After drying, the colour of the slices was measured objectively by Minota CR200 on 12 slices of nashis (average of 3 measurement on different areas of each slice).

Three slices (one from each treatment) of each of the nashi chip, slice and segment samples were assessed by four taste panellists for flavour, texture and colour on a scale of 0 to 10; 0 being Dislike Extremely, 5 is Acceptable and 10 being Like Extremely. In this trial, the panellists were also asked to assess the sweetness of the products on a scale of 0 to 10; 0 being Not Sweet, 5 is Acceptable and 10 being Too Sweet. The panellists were also asked to rank the three samples in terms of overall liking.

Statistcal Analysis

The sensory (except the rankings) and objective colour measurements were analysed by Genstat (6^{th} edition), Analysis of Variance. The ranking in the sensory evaluation was analysed by Friedman's Test On The Ranks

4.4.2 Results

Statistical analysis of sensory values in Table 8 has shown that within each product type (slices, chips and segments) there are no significant differences in the appearance, taste, texture, sweetness and rankings associated with the dehydration methods.

According to the panellists, the segments were significantly better in appearance than the chips and slices. Both slices and segments were significantly more appealing in taste and texture than the chips. There was no significant difference in the sweetness between the different products.

Table 8: Quality Indices Of Different Nashi Products Produced By Different Osmotic Solutions

	Treatment		
	Method B	**Method A**	**Method D**
Chips:			
Appearance	6.30	6.50	6.75
Taste	5.50	6.00	5.75
Texture	4.75	4.75	5.50
Sweetness	6.25	4.75	6.50
Rank	2.00	2.25	1.75
Aw	0.325	0.321	0.381
Slices			
Appearance	8.00	6.25	7.50
Taste	6.75	6.25	7.50
Texture	7.00	6.00	6.75
Sweetness	5.75	5.75	5.00
Rank	2.00	2.75	1.25
Aw	0.600	0.776	0.548
Segments			
Appearance	8.75	8.50	8.50
Taste	7.00	7.50	8.00
Texture	7.75	7.75	8.00
Sweetness	5.50	5.75	5.25
Rank	2.50	2.25	1.25
Aw	0.762	0.864	0.805

For sensory evaluation raw data, refer to Part A, 4.6 Table 7 for details. Scores were made on a liking scale of 0 to 10, 0 being Dislike Extremely, 5 is Acceptable and 10 being Like Extremely. Statistics analysed by Genstat (6th edition), analysis of variance

Statistical analysis of the colour measurements in Table 9 shown that within each product type (slices, chips and segments) there are no significant differences in the a value, b value and Hue angle except for the L value. Method B treated product is significantly lighter than Method A treated product.

The objective measurements showed that segments and chips are significantly lighter than slices. Segments, chips and slices are significantly different in the a value with the segments having greater greenness than chips, followed by the slices. The slices are more significantly more yellow than the chips and segments. There were significant differences between the three products in regards to Hue angle. The slices were the most significantly brown while the segments were the least significantly brown. It seemed that the segments have the best colour while the slices have the worst in terms of lightness, brownness and greenness.

Table 9: Objective Colour Measurement Of Different Nashi Products Produced By Different Osmotic Solutions

	L	a	B	HUE

Treatments	Mean	SD	Mean	SD	Mean	SD	
CHIPS							
Method B	81.2	1.6	-1.45	0.39	19.11	1.54	94.34
Method A	80.94	0.91	-1.21	0.42	19.25	1.44	93.60
Method D	81.56	1.78	-1.22	0.45	18.38	1.69	93.80
SLICES							
Method B	77.65	2.51	-0.56	0.74	23.13	2.68	91.39
Method A	75.77	2.13	-0.92	0.53	26.05	2.23	92.02
Method D	76.88	2.07	-0.28	0.43	22.17	1.05	90.72
SEGMENTS							
Method B	81.97	1.1	-1.81	0.44	18.79	0.9	95.50
Method A	80.29	1.66	-2.51	0.46	20.48	1.44	96.99
Method D	81.29	1.83	-1.94	0.58	20.14	3.52	95.50

4.5 PILOT SCALE DEVELOPMENT OF NASHI CHIPS AND SLICES

Peter Stevens of A.A. Magarey & Sons produces fruit leather products for the local market from his small-scale production facilities in Adelaide. To test the possibility of scaling up the laboratory protocols at his facility, Peter Stevens was given the protocols (with a non-disclosure agreement signed) to conduct small preliminary pilot scale trials of the nashi chips and slices. Subsequent outcome of the trials demonstrated that it was possible to scale up the laboratory processes at a small-scale commercial processing facility.

Actual pilot scale production trials were then conducted at A.A. Magarey & Sons in May 2001 under the supervision of Kean Leong from Food Science Australia to produce nashi chips and slices for shelf life and consumer evaluation. A.A. Magarey provided nashis, the lease of the processing facilities and equipment, and half of the labour at a total cost of $2,382, charged to Food Science Australia. The chemicals/food ingredients and other equipment such as water activity and pH meters and the other half of the labour used were provided by Food Science Australia.

A second pilot scale production was conducted in October 2001 by Peter Stevens in his facility due to the browning of the samples from the first trial. A more efficient newly installed commercial heat pump dryer was used in the second to rectify the drying deficiencies encountered during the first production run.

4.5.1 Method

Deleted for Confidentiality Reasons. The method is the jointly owned intellectual property of Food Science Australia and HAL. The techniques can only be made available for commercial use through a technology transfer agreement with HAL and FSA.

Fig. 3: The slicing, dehydration and drying of the slices.

Microbiological and Chemical Analysis

Samples of both chips and slices before and after the dehydration were send to AGAL (first production trials) and Medvet Science (second production trials) for microbiological and chemical analysis. In the second production trials, analysis for chips and slices included pH, sulphur dioxide, total plate count (AS1766.2.1-1991), yeast and mould (AS1766.2.2-1997 & 1994), coliforms (AS1766.2.3-1992), E.coli (AS1766.2.3-1992), Salmonella (AS1766.2.5-1991), Staphylococci (AS1766.2.4-1994), B.cereus (AS1766.2.6.6-1991) and Listeria (TECRA Immunoassay). In the first production trials, analysis for chips and slices included total plate count (AVM1_22), yeast and mould (AS1766.2.2), coliforms (AVM1_09C), Staph. Aureus (AVM1_23) and additional E.coli (AVM1_09C) , Salmonella (AVM1_20B) and Listeria (AVM1_16B) for the slices..

Preliminary Packaging and Storage Trials for Pilot Scale Chips

The chips produced from the first production trials were packaged for shelf life trial using different packaging systems involving vacuum, MAP, foil and air sealed (Fig. 4). All the treatments, except for the samples packed in foil, were performed on a large-scale automated commercial packaging machine MultiVac Model R230 (Cryovac) (Fig. 5).

The chips were assessed for their quality using indices such as microbiological analysis, objective colour measurement, package headspace analysis and water activity measurement as outlined in Table 10.

Fig 4: Different packaging treatments of nashi chips

Fig 5: Packaging of nashi chips on MultiVac

Table 10: Experimental Protocol for Packaging and Storage Trials for Pilot Scale Samples

Types of packaging material (2):	2 types (aluminium foil and polyethylene[1]), 80g pack
Types of packaging system (4):	4 types- air (aluminium foil and polyethylene[1]), gas flushed and vacuum packed (polyethylene[1])
Storage conditions: (1)	25^{o}C for dried chips
Sampling Occasions (6)	monthly until end of shelf/storage life
Types of analysis:	water activity, moisture content, pH, colour and sensory

1.RX 816 series for top web and N562Y for bottom web (from CryoVac)

4.5.2 Results And Discussion

First and Second Pilot Scale Production Trials

About 6kg of each of the nashi slices and chips were produced during the first production trial. It was decided to remove the peel from the chips in these pilot scale productions as the peel appeared really dark after drying. Due to the low efficiency of the dryer involved, it took two days to dry both the chips and slices. As a result of the long exposure to air, the batch produced, especially the slices, had a darker yellow colour as compared to those produced during laboratory trials. Further investigation showed that by halving the load in the dryer, lighter colour slices were produced within 24 hours. Due to the colour of the products, a decision was made to repeat the trials for both chips and slices in late September when A.A. Magarey installed a new dryer with a higher efficiency rating. As a result, the consumer evaluation was delayed until October 2001.

In the first production trial, there were no microbiological concern in the chips and slices except 2 samples of the chips contained 100 mould/g of samples indicating some sort of minor mould contamination during production or handling. Analysis from the second trial confirmed the relatively safe status of the products (Table 11). There were hardly any viable organisms in the products analysed.

Table 11: Microbiological Status of Nashis Products and Osmotic Solutions In Production Trial 2

Microbiological Tests	Nashi Products		Units
	Chips	Slices	
Standard Plate Count	15[a]	≤10[b]	Cfu/g or ml[c]
Yeast Count	<10	<10	Cfu/g or ml[c]
Mould Count	<10	<10	Cfu/g or ml[c]
Coliform	<3	<3	MPN/g
Coliform (thermotolerant)	<3	<3	MPN/g
E coli	<3	<3	MPN/g
CP Staphylococci	<100	<100	cfu/g
B. cereus	<100	<100	cfu/g
Listeria Monocytogenes	ND	ND	in 25g
***Salmonella* spp.**	ND	ND	in 25g

a. Average of 4 samples only. 1 sample was below the detection limit of 10 org/ g
b. 1 sample was 10 org/g and 3 were below the detection limit of 10 org/g. A sample with 60 org/g was excluded.
c. cfu/g for chips and slices
ND – not detected
< – less than the detection limits

The final average SO_2 levels measured in the products were 736.9mg/L for the chips and 406mg/L for the slices. These levels were well below permitted levels listed in the Food Standards Code (vol 2) in Schedule 1.3.1. Citric and ascorbic acids are currently permitted without limits in the products developed in this study. The products are quite acidic with an average pH of 4 for the chips, and 3.9 for the slices. This will assist to keep the products relatively safe microbiologically.

Table 12: Chemical Analysis of Osmotic Solutions and Nashi Products in Production Trial 2.

Products	Osmotic Dehydration	SO_2 mg/L	Vit C g/L	Citric Acid g/L	PH
Nashi Chip Sample 1		739.8	NT	NT	4.09
Nashi Chip Sample 2		790.5	NT	NT	4.01
Nashi Chip Sample 3		515.3	NT	NT	4.00
Nashi Chip Sample 4		856.4	NT	NT	4.01
Nashi Chip Sample 5		782.7	NT	NT	4.04
Nashi Slice Sample 1		425.5	NT	NT	3.90
Nashi Slice Sample 2		443.3	NT	NT	3.77
Nashi Slice Sample 3		446.7	NT	NT	3.95
Nashi Slice Sample 4		399.2	NT	NT	3.83
Nashi Slice Sample 5		315.4	NT	NT	4.01

NT – not *tes*ted

Preliminary Packaging and Storage Trials

The packaging experiment for the chips was terminated as the samples turned brown at after 5 weeks storage. This may be attributed to the initial poor colour quality of the samples as described above and possible leakages in some of the packaging.

4.6 APPENDIX

Table 1: Product Mean Scores[a] for Each Attribute.

Attribute	Dried chip (mm)	Semi moist Slice (mm)	p-value	Tukey's HSD (5% level)
Liking of APPEARANCE	50.46	62.81	0.063	13.05
Liking of COLOUR	55.54 *b*	72.38 *a*	0.005	11.166
*JR - Chewiness Preference	64.58 *a*	53.62 *b*	0.011	8.192
Liking of TEXTURE	41.67 *b*	68.25 *a*	0.001	12.021
*JR- Sweetness Preference	62.50 *a*	54.40 *b*	0.024	6.959
Liking of OVERALL FLAVOUR	57.88 *b*	70.87 *a*	0.002	7.829
Liking of AFTERTASTE	61.85 *b*	71.15 *a*	0.020	7.716
OVERALL ACCEPTABILITY	49.12 *b*	70.42 *a*	0.001	11.151

[a] Any two mean scores on the same row not followed by a common letter are significantly different at the 5% level. Shaded rows indicate significant differences between samples. The higher the mean score the more liked the product in terms of the attribute assessed (0mm=dislike extremely ….100mm=like extremely). For "just right" (JR) scales 0mm=not enough, 50mm=just right and 100mm=too much.

Table 2: What form would you buy the nashi products in? (n=26)

Type pf product	Snackfood	Blended in breakfast cereal	Cooking	Baking	Other	Would not buy
	18	15	1	2	2	5

Table 3: Number of panellists and their preferred samples

Sample	*No. of Consumers most preferred sample*	*No. of Consumers least preferred sample*
Dried	5	21
Semi Moist	21	5

Table 4: Tukey's HSD(Rank) = 9.987 (5% Level)

Sample	*Rank Total*
Dried	47.00 a
Semi moist	31.00 b

*Critical values corresponding to specific levels of significance: 10%=2.71 5%=3.84 1%=6.63
*The samples differ at the 5% level. (9.84 >= 3.84), the lower the rank total the more preferred.
*Any two mean scores in the same column not followed by a common letter are significantly different at the 5% level.
* Table 3 and 4: Paired Comparison Test - Which sample do you prefer (1=Most preferred sample)

Comments Made By Panellists

The panellists' comments in relation to appearance, colour, texture and flavour characteristics of the semi moist and Dried chip nashi products are presented in Table 1.0. A variety of comments, both positive and negative, were made.

Table 5: Panellists comments on the sensory characteristics of semi moist and Dried chip nashi products.

Panellist	Sample	Comments
1	Dried chip	Too hard to chew, too sweet but good for putting in cereal in brekkie. Like the natural flavours.
1	Semi Moist	Like the tangy juicy flavour of this product. Good colour.
2	Dried chip	The skin of this sample was too hard to enjoy it fully
2	Semi Moist	Excellent!
3	Dried chip	A bit too pale, too sweet, very crunchy, I would prefer less crunchy
3	Semi Moist	Looks better without the rind, still slightly too sweet, texture fairly good
7	Dried chip	Nice fruity-sweet flavoured dried fruit chip.
7	Semi Moist	Nice sweet-fruity flavour.
8	Dried chip	Very nice, sweetness disguises nashi flavour, like chewy texture (but possibly slight too chewy), Very sticky to the touch
8	Semi Moist	More fresh nashi flavour
9	Dried chip	Very chewy - sticks to teeth
9	Semi Moist	Quite nice, a bit too sweet
10	Dried chip	Rind is a little chewy, good taste, slightly sticky in mouth, could do with more sample to evaluate
10	Semi Moist	Good taste, easy to chew, not to sticky, not to sweet or sickly, good crunch to fruit, could do with more sample to evaluate
11	Dried chip	It is lighter in colour and less sweet than I expect from a dried fruit but that isn't necessarily a bad thing. I like it.
11	Semi Moist	This is more what I expect from a dried fruit but I think I like the other on better.
12	Dried chip	Did not like the skin left on. Flesh had a motted appearance, did not find it appealing. Taste was too sweet initially but once gone there wasn't a lot of fruit flavour. Not acidic enough
12	Semi Moist	Wasn't acid enough in flavour. Little fruit flavour, slight chemical aroma (so2) as a guess
13	Dried chip	If the skin was not present, the product would be must better in chewyness, texture and flavour. The skin gives a bitter after taste.
13	Semi Moist	Initial sample shape was not becoming of its lovely flavour. May need to cut into small pieces, like dried paw paws, to enhance the overall initial appearance.
14	Dried chip	Don't like the peel, it is hard to chew.
15	Dried chip	Too thin and so couldn't get the full flavour. I disliked the skin. It distracted from the fruity flavour and wasn't a pleasant texture in the mouth. Not 'chunky' enough and lacked the chewiness.
15	Semi Moist	Light and fruity flavour. Would make a great nibbly. Very nice
16	Dried chip	Tough and too sweet. Flesh colour was good but skin looked dry and uninviting
16	Semi Moist	Tasted like a dried apple.
18	Dried chip	Do not like the peel with the final product which affects both the chewyness and colour
18	Semi Moist	Good
20	Dried chip	Ok except for texture - skin is off-putting
20	Semi Moist	Good product
21	Semi Moist	Product with skin on is more interesting and different from dried apple.
22	Dried chip	Much better
22	Semi Moist	Gritty texture and overpowering taste
23	Dried chip	Sample had a strong flavour but it was very chewy and too sweet
23	Semi Moist	Very sweet and had a good texture. It was not rubbery like other dehydrated fruits
25	Dried chip	Tastes great, but the texture kills it for me.
25	Semi Moist	Looks more like dried apple.
26	Dried chip	Get rid of the skin! Slightly sticky and yet you still get the slightly powdery texture
26	Semi Moist	A slight powdery & grainy texture which detracted from the product

Questionnaire Presented to In-house Consumer Panellists (Section A, 4.1)

Welcome Text

WELCOME TO FOOD SCIENCE AUSTRALIA SENSORY EVALUATION CENTRE

You will communicate with the system using the MOUSE.

The next screen will show a keyboard. To register as a panellist just type your surname then initial without a space. If your surname is 12 or more letters then stop at the 12th letter without your initial.

NOW TURN THE SWITCH ON NEXT TO THE HATCH TO RECEIVE YOUR TRAY WITH SAMPLES. PLEASE ENTER THE TRAY NUMBER WHEN ASKED AFTER REGISTERING.

IF AT ANY TIME YOU HAVE PROBLEMS THEN TURN THE SWITCH ON NEXT TO THE HATCH AND THE SUPERVISOR WILL COME TO SEE YOU.

Instruction Text

PLEASE READ ALL INSTRUCTIONS!!

You will be presented with a total of 2 Nashi Dried Fruit products, but one at a time.

Examine and taste each sample as required and evaluate all the characteristics listed. Using the mouse, touch the appropriate position on the line scale to correspond to your response.

You will only be given one piece of each sample so please ensure that you ready instructions carefully and take note of all characteristics.

After evaluating each sample, turn the switch on next to the hatch to receive your next sample. Cleanse your palate with water before tasting the first sample and after each sample. NOTE: There are THREE SCREENS of questions plus a COMMENTS SCREEN for EACH SAMPLE. Remember: If you have any questions please turn the switch on next to the hatch.

Question Number: 1

EXAMINE sample %01 and evaluate the following characteristics (100mm line scale)

Attributes: 2

OVERALL APPEARANCE
Dislike Extremely Like Extremely

COLOUR
Dislike Extremely Like Extremely

Question Number: 2

Now TASTE sample %01 and evaluate the following characteristics (100mm line scale).

Attributes: 5

CHEWINESS
Not Chewy Enough Just Right Too Chewy

OVERALL TEXTURE
Dislike Extremely Like Extremely

SWEETNESS
Not Sweet Enough Just Right Too Sweet

OVERALL FLAVOUR
Dislike Extremely Like Extremely

AFTERTASTE
Dislike Extremely Like Extremely

Question Number: 3

Evaluate Sample %01and rate the Overall Acceptability (100mm line scale).

OVERALL ACCEPTABILITY
Dislike Extremely Like Extremely

Question Number: 4

Comments on Sample %01 please.

Question Number: 5 – Standard Descriptor (may choose more than one answer)

WOULD YOU BUY THIS PRODUCT AND IN WHAT FORM WOULD YOU BUY IT?

Choices: 6

Snack Food
Blended in Breakfast Cereals
For Cooking
For Baking
OTHER: see next screen
Would not buy

Question Number: 6 – Comments from question 5

PLEASE SUGGEST OTHER REASONS FOR PURCHASING THIS PRODUCT.

Question Number: 7 – Time Delay / Signal

Now turn the switch on next to the hatch and return the sample you have just finished. Please cleanse your palate with water after each sample.

Question Number: 8 – Ranking
NOW THAT YOU HAVE TASTED BOTH SAMPLES PLEASE RANK THE 2 SAMPLES IN ORDER OF PREFERENCE WITH 1 BEING MOST PREFERRED AND 2 BEING LEAST PREFERRED.

Table 6: Sensory Evaluation Data of Semi Moist Slices Treated with Three Different Treatments

Sensory Quality Attributes																				
	A	**T**	**E**	**R**	**A**	**T**	**E**	**R**	**A**	**T**	**E**	**R**	**A**	**T**	**E**	**R**	**A**	**T**	**E**	**R**
	Panellist 1				**Panellist 2**				**Panellist 3**				**Panellist 4**				**Panellist 5**			
Method B	9	9	9	1	9	5	7	3	10	10	10	2	9	8	7	1	9	10	9	2
Method A	6	5	3	3	8	10	9	1	9	10	10	1	3	5	4	2	5	6	6	3
Method C	10	9	7	2	9	8	8	2	10	10	10	3	8	7	nil	3	10	10	10	1

Table 7 : Sensory Evaluation Data of Different Nashi Products Treated with Three Different Treatments

Sensory Quality Attributes																				
	A	**T**	**E**	**S**	**R**	**A**	**T**	**E**	**S**	**R**	**A**	**T**	**E**	**S**	**R**	**A**	**T**	**E**	**S**	**R**
	Panellist 1					**Panellist 2**					**Panellist 3**					**Panellist 4**				
Chips																				
Method B	6	5	1	6	2	4	2	4	5	3	8	7	6	8	2	7	8	8	6	1
Method A	6	5	2	6	3	5	6	4	4	2	8	8	8	4	1	7	5	5	5	3
Method D	6	5	5	5	1	6	6	5	5	1	8	6	6	7	3	7	6	6	9	2
Slices																				
Method B	9	6	6	6	3	6	4	5	6	2	8	8	8	6	2	9	9	9	5	1
Method A	9	6	6	6	2	5	4	4	4	3	5	7	7	5	3	6	8	7	8	3
Method D	9	6	4	6	1	6	6	6	5	1	7	9	8	4	1	8	9	9	5	2
Segments																				
Method B	10	8	10	8	1	6	6	6	6	3	9	7	9	4	3	10	7	6	4	3
Method A	10	9	9	6	3	6	6	7	5	2	9	7	9	7	2	9	8	6	5	2
Method D	10	8	8	6	2	6	7	6	5	1	9	8	9	4	1	9	9	9	6	1

A - General appearance of products

T - General taste of products

E - General texture of products

R - Ranking of products in terms of preference. (1) being liked the most and (4) being liked the least

S- General sweetness of products

Sample Questionnaire Presented to Panellists (Section A, 4.2 and 4.4)

Name: Date:
Product: Dried Nashi (Product 2)

Instructions

1. You will receive 3 samples labelled with a 3 digit number.
2. Evaluate the product for its colour, taste and texture in the order given. Rinse your palate with water between the samples.
3. Comment on what you like or don't like about the product.
4. After evaluating the products, rank the samples in order of overall liking in descending order.
5. Comment on any differences in the samples which may influence your preferences.

Sample 876

Colour/Appearance	**Taste**	**Texture**
___0 Dislike Extremely	___0 Dislike Extremely	___0 Dislike Extremely
___1	___1	___1
___2	___2	___2
___3	___3	___3
___4	___4	___4
___5 Acceptable	___5 Acceptable	___5 Acceptable
___6	___6	___6
___7	___7	___7
___8	___8	___8
___9	___9	___9
___10 Like Extremely	___10 Like Extremely	___10 Like Extremely

Comments (what do you like or dislike about the product) :

Sample 290

Colour	**Taste**	**Texture**
___0 Dislike Extremely	___0 Dislike Extremely	___0 Dislike Extremely
___1	___1	___1
___2	___2	___2
___3	___3	___3
___4	___4	___4
___5 Acceptable	___5 Acceptable	___5 Acceptable
___6	___6	___6
___7	___7	___7
___8	___8	___8
___9	___9	___9
___10 Like Extremely	___10 Like Extremely	___10 Like Extremely

Comments (what do you like or dislike about the product) :

Sample 023

Colour	**Taste**	**Texture**
___0 Dislike Extremely	___0 Dislike Extremely	___0 Dislike Extremely
___1	___1	___1
___2	___2	___2
___3	___3	___3
___4	___4	___4
___5 Acceptable	___5 Acceptable	___5 Acceptable
___6	___6	___6
___7	___7	___7
___8	___8	___8
___9	___9	___9
___10 Like Extremely	___10 Like Extremely	___10 Like Extremely

Comments (what do you like or dislike about the product) :

Please rank the samples in terms of overall liking

1. _____ **like the most**
2. _____
3. _____ **like the least**

Comments on any differences in samples that may influence your preferences :

SECTION B

5.0 COST / BENEFIT ANALYSIS OF VALUE ADDED NASHI CHIPS AND SLICES

Prepared by: Peter Stevens (B.Ag.Sc), A.A. Magarey & Sons

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Disclaimer:

This feasibility study is provided on a confidential basis to Food Science Australia and was based on information gained while producing trial batches of nashi chips, as well as some further investigations to extrapolate to a commercial situation. Peter Stevens and A.A. Magarey and Sons make no representations about the suitability of the information contained in this document for any purpose and therefore disclaim all warranties and claims about this information. The author accepts no liability for the future use of this information and suggests that anyone interested in taking this process further confirms these details themselves. This is not a full business plan

EXECUTIVE SUMMARY

At present, low grade nashis are sold to juice processors at prices of around 15c/kg to be incorporated into pear juice. Low grade nashi are also sold to local markets at values of 50c-$1.00/kg. An alternative processing option that increases the value of these nashis and yet returns 50c-$1.00/kg for the growers would be a desirable result**.**

Low grade nashis are mostly available out of storage. Most nashis are picked into bins, and then placed in cold storage to be sold from February to November. The fruit is then removed from storage as required, packed and sent to market. The low grade fruit is thus available for processing in a small but regular supply for these nine months. The processing option therefore needs to accommodate this raw material supply situation, rather than attempting to process large amounts just a few times of the year. The Australian Nashi Industry has two types of production situations: a small number of growers with large production volumes and areas within Shepparton, Victoria and a large number of geographically isolated growers with small volumes and areas of production spread throughout the rest of Australia. The processing alternatives need to address both situations.

This cost/benefit analysis detailed the calculation and estimation of the capital, operational and production costs of nashi chips and slices and seeks to determine the commercial viability of the products based on the returns on investment. A viable processing option that returns 50c to $1.00 per kg (fresh) to the growers would be a desirable result.

This analysis was based on setting up both large scale and small scale processing operations from scratch in Australia. Based on these assumptions, it estimated that large scale production of the nashi chips and slices (processing 236 fresh tonnes per year) is a viable business option with a return on investment within three years. Small scale production (45 fresh tonnes per year) can only succeed if any distributors can be cut out of the marketing chain, with a return on investment in four years. It is anticipated that the cost of production will be reduced and the return on investment will be improved if the production of the nashi value added products is incorporated into existing fruit processing facilities.

5.1 METHOD

Financial spreadsheets have been prepared by Peter Stevens using basic accounting templates. Both sets of tables were prepared with the assistance of qualified people.

Information regarding production costs was based on either actual ballpark quotes, production figures of closely related industries, extrapolations of pilot scale trial work or educated guesses. This is a feasibility study, not a full business plan and as such some estimations must be made.

Recovery Rates

In the second pilot trial production conducted by Peter Stevens, the estimated drying ratio was 6.8/1 for the nashi chips and 5.8/1 for nashi slices. The recovery ratio (fresh raw unprocessed/dried) was 9.1/1 for the nashi chips and 8.7/1 for nashi slices. Although the percentage recovery is slightly higher from the chips, for the purpose of this exercise we will consider them to be the same and based our calculations for the analysis on the recovery rate for the chips (9/1).

Set-up and Production Costs Calculations

As dried nashi chips and slices require basically the same process and equipment, estimates and calculations for the set-up and productions costs will be treated similarly.

The set-up costs for producing the nashi slices and chips are calculated based on building the facilities from scratch on existing land:

- Large scale - Sheds, processing equipments, dehydrator, and food safety plan.
- Small scale - Processing equipments, dehydrator, and food safety plan.

For one batch production run, it is assumed that it takes one day to process the fruits and then another day to finish drying the products. Based on this assumption, only three processing days per week are possible.

Based on processing 2,000kg of fresh nashis to produce 220kg of chips or slices per batch, the annual throughput for 40-week large scale production is 240 tonnes.

Based on processing 350kg of fresh nashis to produce 38kg of chips or slices per batch, the annual throughput for 40-week small scale production is 42 tonnes.

Packaging costs are not included in this analysis.

5.2 RESULTS AND DISCUSSION

Set-up Costs

The set-up costs for both large scale and small scale operations are shown in Table 1 and 2 respectively. These costs were based on information collected from suppliers and related industries at that time and were only rough estimates (see Section B, 5.5.2). It must be noted that the costs will be drastically reduced if the operation is incorporated into existing processing facilities. This will be particularly true for the large scale operation, where there is potential for existing fruit processing companies such as Sunbeam Foods or Robern Menz,

which already have most of the equipments and facilities, to take up the manufacturing process.

As mentioned, packaging set-up cost is not included in this analysis.

Table 1: Set-up Costs for Large Scale Operation

Facilities/Equipments Set-up	COST ($)
Shed:	52,000
Processing Equipment	
Peeler:	38,000
Slicer:	25,000
Dipping-Sulphur:	15,000
Dehydrator:	70,000
Q.A./Food Safety Prog. :	5,000
TOTAL	**205,000**

Table 2: Set-up Cost for Small Scale Operation

Facilities/Equipments Set-up	COST ($)
Shed:	$7,000
Processing Equipment	
Peeler x 2:	$78
Slicer:	$1,000
Dipping-Sulphur:	$2,500
Dehydrator:	$25,000
Q.A./Food Safety Prog. :	$2,500
TOTAL	**$38,078**

Raw Production Costs

The estimated raw production costs for large scale and small scale operations are shown in Table 3 and 4 respectively. The calculations were made based on eight hours a day, 3 processing and 3 drying days per week. It is however possible, if there are sufficient tonnages, to have more processing days by increasing the drying rates or having more dryers.

Table 3: Raw Production Cost for Large Scale Operations with Annual Throughput of 240 tons for 40 Week Production.

Production Volumes for Single Batch Run	**Weight (kg)**
Throughput volumes of fresh fruit per day	2,000
Volumes of valued added products produced per day (based on 9:1 recovery)	220
Daily Expenditure	**Cost ($)**
Labour for Peeling, Trimming, Slicing, Dipping, Drying, Packaging, Forklift Operation Management (8 hrs day)	$480
Input chemicals	$177
Contingency	$100
Electricity for dehydrator	$108
Total Cost	$865
Cost of producing 220kg valued added nashis products	**$3.93/kg**

Table 4: Raw Production Cost for Small Scale Operations with Annual Throughput of 42 tons for a 40 Week Production

	Weight (kg)
Throughput volumes of fresh fruit per day	350
Volumes of valued added products produced per day (based on 9:1 recovery)	38
Daily Expenditure	**Cost ($)**
Labour for Peeling, Trimming, Slicing, Dipping, Drying, Packaging (8 hrs)	240
Input chemicals –	88
Contingency	30
Electricity for dehydrator	27
Total Cost	385
Cost of producing 38kg valued added nashis products	**$10.13/kg**

The raw production cost for the small scale operation seemed to be three times higher than that of the large scale due to the relatively high labour cost in producing a small amount of products (six times less than that of the large scale). The reason was due to the assumption that only manual hand peelers were suitable for the small scale operation. This resulted in high labour requirements for peeling, slicing and coring but yet relatively low processing rate of 350kg of fresh nashis per day. However since these calculations have been made, a small automatic peeling and coring machine costing about $2,000 had been purchased by Peter Stevens which is capable of processing 10-15 nashi / minute. This will effectively reduced the production costs for small scale operators.

Total Production Cost

Taking depreciation into account, the total costs for producing the nashi chips and slices by both large and small scale operations were calculated as shown in Table5 and 6 respectively, together with a sensitivity analysis. The calculations are based on assumptions and

estimations on the capital costs, depreciation and production costs. It must be noted that packaging cost was not included in this analysis.

Based on a fresh fruit purchase price of 40 c / kg ($400 per tonne), the costs of producing the chips and slices are:

Large scale operation - $8.73 / kg
Small scale operation - $14.89 / kg

Unfortunately, the fruit purchase price is unlikely to be a lot more than juice price (see sensitivity analysis). The production cost seemed relatively high, partly due to some of the conservative assumptions made and partly due to the production process and the special characteristics of nashi fruits. Significant factors in the high production costs are:

- Labour requirements for peeling, trimming, dipping for small scale production.
- Recovery ratio of 9:1 due to high moisture content of nashis
- Large capital items (dehydrators) and electricity use based on the assumption that the facilities are built from scratch.

Table 5: Profit and Loss and Sensitivity of fruit price on Production Costs.

Large Scale

Total Capital Cost ($)	205,000	
Depreciation per annum ($)	30,750	Based on an effective life of 6.67 years (15%pa)
Fresh Fruit Cost for 1 kg dry (cents)	364.00	(=40c / kg wet, refer to Sensitivity Analysis for conversion)
Production Cost (cents/kg)	393.00	based on production run of 2000 kg fresh nashi.
Annual Throughput (t)	26	
Total Cost (cents/kg)	**873.48**	

Sensitivity Analysis - Total Cost for different fruit prices and annual throughputs

	Wet Fruit price (c/kg)					
	30	40	50	60	80	100
Annual Throughput (t / year)	**Fresh fruit cost for 1 kg of dried Nashi Product**					
	273	364	455	546	728	910
26	782.48	873.48	964.48	1,055.48	1,237.48	1,419.48
30	768.50	859.50	950.50	1,041.50	1,223.50	1,405.50
50	727.50	818.50	909.50	1,000.50	1,182.50	1,364.50
100	696.75	787.75	878.75	969.75	1,151.75	1,333.75

Table 6: Profit and Loss and Sensitivity of fruit price on Production Costs.

Small Scale

	Cost ($)	
Total Capital Cost	38,078	
Depreciation per annum	5,712	Based on an effective life of 6.67 years (15%pa)
Fresh Fruit Cost for 1 kg dry	364.00	(=40c / kg wet, refer to Sensitivity Analysis for conversion)
Production Cost (cents/kg)	1011.00	based on production run of 350 kg fresh nashi.
Annual Throughput (t)	5	
Total Cost (cents/kg)	**1489.23**	

Sensitivity Analysis - Total Cost for different fruit prices and annual throughputs

	Wet Fruit price (c/kg)					
	30	40	50	60	80	100
	Fresh fruit cost for 1 kg of dried Nashi Product					
Annual Throughput (t / year)	273	364	455	546	728	910
2	1,569.59	1,660.59	1,751.59	1,842.59	1,933.59	2,206.59
5	1,398.23	1,489.23	1,580.23	1,671.23	1,762.23	2,035.23
8	1,355.40	1,446.40	1,537.40	1,628.40	1,719.40	1,992.40
10	1,341.12	1,432.12	1,523.12	1,614.12	1,705.12	1,978.12

Market Chain Price Structure

Market chain price structures must allow for distributor and retailer margins. Table 7 showed the estimates of the allowable margins to bridge from the cost of production to retail price for large scale operation.

Table 7: Market Chain Price Structure

	Profit/Mark-up	**$ / kg dry wt.**
Cost of production		$8.17
Manufacturers selling price	+50%	$12.25
Distributors selling price	+ 60%	$19.60
Retail sale price	+67%	$29.00

Judging from the feedback of consumers from the consumer evaluation (refer to Section C), $29/kg (or $2.90/100g) seemed to be reasonable and feasible retail price for the nashi chips but not for the slices. About half of the consumers surveyed preferred to pay $2.30/80g size for the chips and $2.80/250g size for the slices. The price differences may either be due to consumers judging the price based on the specific size of the packet rather than on the amount of weight (80g chips and 250g slices were the same unit size) or that consumers were willing to pay more for the chips.

In small scale operations, because the cost of production is very high at $14.89/kg, it will only be viable if the distributors are taken out of the chain. This will mean that the small scale producer can market direct to the local retailers at a price of $19.60/kg.

Dried apple rings have been mass produced for decades, utilizing quite basic drying technologies. Dried apple rings wholesale for $6.00-$8.00/kg while other Australian produced dried fruit (i.e. apricots, pears, peaches) wholesale for $5.00-$10.00/kg. Fruit products, in the form of confectionery, can attract higher prices.

Thus market forces and the market categories in which these value added nashi products are marketed will be important in determining the prices that they can fetch.

Table 8 showed the return on investments in the second year, which was representative of a typical year.

Table 8: Return On Investments for Both Large Scale and Small Scale Operations

	Breakeven	**Return on Investments/year**
Large Scale	**Year 2 ½**	**39%**
Small Scale (no distribution)	**Year 4**	**24%**

Therefore according to the analysis, based on the stated assumptions, a large scale production unit processing 236 tonnes fresh per year has a good chance of success, breaking even in year 2 ½. A small scale production unit processing 45 tonnes fresh per year can only succeed if the distributor can be cut out of the marketing chain, breaking even in year 4.

5.3 CONCLUSION

- Currently Nashi chips are expensive to produce based on the assumptions behind the analysis. However it must be remembered that the calculations were based on setting up of a new business operation. Costs should be drastically reduced if it was assumed that the production of the nashi products will be incorporated into existing fruit processing facilities such as Sunbeam Foods and Robern Menz.
- Large Scale production (processing 236 fresh tonnes per year) has a good chance for success.
- Small Scale production (45 fresh tonnes per year) can only succeed if the distributor can be cut out of the marketing chain.
- The price paid to the grower can be a bit better than juice price but this processing option is unlikely to return the 50c to $1.00 / kg hoped for.

5.4 FUTURE DIRECTIONS.

Commercial processors operating in this product group should be approached to begin some commercial trials as the concept of the nashi chips looks promising.

Other products should be investigated, particularly ones that overcome the factors that resulted in high production costs. Possibilities include a confectionary product made from the juice of nashi (or any other fruit) that is shelf stable and fits into a high value niche. The more sought after the raw material is the more likely the price will improve to a level where it competes with poor quality fresh market fruit.

Nashi pulp is a very watery product that has not been investigated yet for possible uses.

5.5 APPENDIX

5.5.1 Business Feasibility

Table 1: Large Scale

		NASHI PROCESSING - BUSINESS FEASIBILITY								
			ASSUMPTIONS							
			YR0	YR1	YR2	YR3	YR4	YR5	RESIDUAL	
	VOLUME	Chips in kgs		26,400	26,400	26,400	26,400	26,400		
	PRICE	Chips $/kg, Tax excl.		$12.25	$12.62	$13.00	$13.39	$13.79		
	SDC (costs)	Nashi Chips		$8.73	$8.99	$9.26	$9.54	$9.83		
	TOTAL	Nashi	$205000							
	CAPITAL	Total capital equals the total of:- New Equipment, Refurbished Equipment, Ancillary Equipment								
	Euipment	Internal	15.0%		Nashi	INTERNAL	15.0%			
	Depreciation	Tax	20.0%		DEP'N	TAX	20.0%			
	MAINTENANCE		per kg	$0.19	$0.20	$0.20	$0.21	$0.21		
	INFLATION	Price	3.0%		3.0%	3.0%	3.0%	3.0%		
	INFLATION	Cost	3.0%		3.0%	3.0%	3.0%	3.0%		
	INFLATION	Volume	0.0%		0.0%	0.0%	0.0%	0.0%		
	DISCOUNT RATE		8.0%	NPV	$127,324					
	IRR		0.0%							
			CASHFLOW (5 Years)							
			YR0	YR1	YR2	YR3	YR4	YR5	RESIDUAL	
OPERATING ASSETS										
Initial capital injection			(205000)							
WORKING CAPITAL				0	0	0	0	0	0	
TOTAL (A)			**(205000)**	**0**	**0**	**0**	**0**	**0**	**0**	
PROFIT & LOSS										
VOLUME	Kgs Nashi Chips			26,400	26,400	26,400	26,400	26,400		
GROSS SALES				323,400	333,102	343,095	353,388	363,990		
NET SALES				323,400	333,102	343,095	353,388	363,990		
STANDARD DIRECT COST				(230472)	(237,386)	(244,508)	(251,843)	(259,398)		
DIRECT PROFIT			***0***	***92,928***	***95,716***	***98,587***	***101,545***	***104,591***		
DP % NET SALES				**28.7%**	**28.7%**	**28.7%**	**28.7%**	**28.7%**		
GROSS CONTRIBUTION			***0***	***92,928***	***95,716***	***98,587***	***101,545***	***104,591***		
GC % NET SALES			**28.7%**	**28.7%**	**28.7%**	**28.7%**	**28.7%**	**-21.6%**		
DEPRECIATION (C)				(30,750)	(30,750)	(30,750)	(30,750)	(30,750)	(51,250)	(205,000)
TRADING PROFIT (D)			**0**	**62,178**	**64,966**	**67,837**	**70,795**	**73,841**	**(51,250)**	
ADD BACK ACCOUNTING DEP'N				30,750	30,750	30,750	30,750	30,750		
LESS TAX DEPRECIATION				(41,000)	(32,800)	(26,240)	(20,992)	(16,794)	(67,174)	(205,000)
TAXABLE INCOME (D)			0	51,928	62,916	72,347	80,553	87,798		
TAX PAYABLE (E)				0	(17,656)	(21,391)	(24,598)	(27,388)	(29,851)	
PROFIT AFTER TAX (F) =D + E			**0**	**62,178**	**47,310**	**46,446**	**46,197**	**46,453**	**(81,101)**	
TAX BENEFIT ON RESID'L TAX WDV (G)									**4,492**	
CASHFLOW (F-C+G+A+B)			**(205000)**	**92,928**	**78,060**	**77,196**	**76,947**	**77,203**	**(5,668)**	
DISC FACTOR		8.0%	1.0000	0.9623	0.8910	0.8250	0.7639	0.7073	0.6549	
NPV			(205000)	89,420	69,550	63,685	58,777	54,605	(3,712)	
CUM NPV			**(205000)**	**(115,580)**	**(46,030)**	**17,654**	**76,431**	**131,036**	**127,324**	
INTERNAL RATE OF RETURN				***28.5%***						
PREPARED BY : Peter Stevens DATE: 12-Feb-03 VERSION:120					*28/06/2000*	Company Tax Rate 0.34				

Table 2: Small Scale (no distribution)

		NASHI PROCESSING - BUSINESS FEASIBILITY								
			ASSUMPTIONS							
			YR0	YR1	YR2	YR3	YR4	YR5	RESIDUAL	
	VOLUME	Chips in kgs		2,000	2,000	2,000	2,000	2,000		
	PRICE	Chips $/kg, Tax excl.		$19.60	$20.19	$20.79	$21.42	$22.06		
	SDC (costs)	Nashi Chips		$14.89	$15.34	$15.80	$16.27	$16.76		
	TOTAL	Nashi	$38,078	**						
	CAPITAL	Total capital equals the total of:- New Equipment, Refurbished Equipment, Ancillary Equipment								
	Euipment	Internal	15.0%		Nashi	INTERNAL	15.0%			
	Depreciation	Tax	20.0%		DEP'N	TAX	20.0%			
	MAINTENANCE		per kg	$0.19	$0.20	$0.20	$0.21	$0.21		
	INFLATION	Price	3.0%		3.0%	3.0%	3.0%	3.0%		
	INFLATION	Cost	3.0%		3.0%	3.0%	3.0%	3.0%		
	INFLATION	Volume	0.0%		0.0%	0.0%	0.0%	0.0%		
	DISCOUNT RATE		8.0%	NPV	($67,891)					
	IRR		0.0%							
			CASHFLOW (5 Years)							
			YR0	YR1	YR2	YR3	YR4	YR5	RESIDUAL	
OPERATING ASSETS										
Initial capital injection			(38,078)							
WORKING CAPITAL				0	0	0	0	0	0	
TOTAL (A)			**(38,078)**	**0**	**0**	**0**	**0**	**0**	**0**	
PROFIT & LOSS										
VOLUME	Kgs Nashi Chips			2,000	2,000	2,000	2,000	2,000		
GROSS SALES				39,200	40,376	41,587	42,835	44,120		
NET SALES				39,200	40,376	41,587	42,835	44,120		
STANDARD DIRECT COST				(29,780)	(30,673)	(31,594)	(32,541)	(33,518)		
DIRECT PROFIT			***0***	***9,420***	***9,703***	***9,994***	***10,293***	***10,602***		
DP % NET SALES				**24.0%**	**24.0%**	**24.0%**	**24.0%**	**24.0%**		
GROSS CONTRIBUTION			***0***	***9,420***	***9,703***	***9,994***	***10,293***	***10,602***		
GC % NET SALES				**24.0%**	**24.0%**	**24.0%**	**24.0%**	**24.0%**		
DEPRECIATION (C)				(5,712)	(5,712)	(5,712)	(5,712)	(5,712)	(9,520)	(38,078)
TRADING PROFIT (D)			**0**	**3,708**	**3,991**	**4,282**	**4,582**	**4,891**	**(9,520)**	
ADD BACK ACCOUNTING DEP'N				5,712	5,712	5,712	5,712	5,712		
LESS TAX DEPRECIATION				(7,616)	(6,092)	(4,874)	(3,899)	(3,119)	(12,477)	(38,078)
TAXABLE INCOME (D)			0	1,804	3,610	5,120	6,394	7,483		
TAX PAYABLE (E)				0	(613)	(1,227)	(1,741)	(2,174)	(2,544)	
PROFIT AFTER TAX (F) =D + E			**0**	**3,708**	**3,377**	**3,055**	**2,841**	**2,717**	**(12,064)**	
TAX BENEFIT ON RESID'L TAX WDV (G)									**4,492**	
CASHFLOW (F-C+G+A+B)			**(38,078)**	**9,420**	**9,089**	**8,766**	**8,553**	**8,428**	**1,948**	
DISC FACTOR		8.0%	1.0000	0.9623	0.8910	0.8250	0.7639	0.7073	0.6549	
NPV			(38,078)	9,064	8,098	7,232	6,533	5,961	1,276	
CUM NPV			**(38,078)**	**(29,014)**	**(20,915)**	**(13,684)**	**(7,150)**	**(1,189)**	**86**	
INTERNAL RATE OF RETURN				***6.7%***						
PREPARED BY : Peter Stevens DATE: 11-Feb-03 VERSION:120 28/06/2000 Company Tax Rate 0.34										

Table 3: Small Scale

		NASHI PROCESSING - BUSINESS FEASIBILITY								
			ASSUMPTIONS							
			YR0	YR1	YR2	YR3	YR4	YR5	RESIDUAL	
	VOLUME	Chips in kgs		5,000	5,000	5,000	5,000	5,000		
	PRICE	Chips $/kg, Tax excl.		$12.25	$12.62	$13.00	$13.39	$13.79		
	SDC (costs)	Nashi Chips		$14.89	$15.34	$15.80	$16.27	$16.76		
	TOTAL	Nashi	$38,078	**						
	CAPITAL	Total capital equals the total of:- New Equipment, Refurbished Equipment, Ancillary Equipment								
	Euipment	Internal	15.0%		Nashi	INTERNAL	15.0%			
	Depreciation	Tax	20.0%		DEP'N	TAX	20.0%			
	MAINTENANCE		per kg	$0.19	$0.20	$0.20	$0.21	$0.21		
	INFLATION	Price	3.0%		3.0%	3.0%	3.0%	3.0%		
	INFLATION	Cost	3.0%		3.0%	3.0%	3.0%	3.0%		
	INFLATION	Volume	0.0%		0.0%	0.0%	0.0%	0.0%		
	DISCOUNT RATE		8.0%	NPV	($67,891)					
	IRR		0.0%							
			CASHFLOW (5 Years)							
			YR0	YR1	YR2	YR3	YR4	YR5	RESIDUAL	
OPERATING ASSETS										
Initial capital injection			(38,078)							
WORKING CAPITAL				0	0	0	0	0	0	
TOTAL (A)			**(38,078)**	**0**	**0**	**0**	**0**	**0**	**0**	
PROFIT & LOSS										
VOLUME	Kgs Nashi Chips			5,000	5,000	5,000	5,000	5,000		
GROSS SALES				61,250	63,088	64,980	66,930	68,937		
NET SALES				61,250	63,088	64,980	66,930	68,937		
STANDARD DIRECT COST				(74,450)	(76,684)	(78,984)	(81,354)	(83,794)		
DIRECT PROFIT			***0***	***(13,200)***	***(13,596)***	***(14,004)***	***(14,424)***	***(14,857)***		
DP % NET SALES				**-21.6%**	**-21.6%**	**-21.6%**	**-21.6%**	**-21.6%**		
GROSS CONTRIBUTION			***0***	***(13,200)***	***(13,596)***	***(14,004)***	***(14,424)***	***(14,857)***		
GC % NET SALES				**-21.6%**	**-21.6%**	**-21.6%**	**-21.6%**	**-21.6%**		
DEPRECIATION (C)				(5,712)	(5,712)	(5,712)	(5,712)	(5,712)	(9,520)	(38,078)
TRADING PROFIT (D)			**0**	**(18,912)**	**(19,308)**	**(19,716)**	**(20,136)**	**(20,568)**	**(9,520)**	
ADD BACK ACCOUNTING DEP'N				5,712	5,712	5,712	5,712	5,712		
LESS TAX DEPRECIATION				(7,616)	(6,092)	(4,874)	(3,899)	(3,119)	(12,477)	(38,078)
TAXABLE INCOME (D)			0	(20,816)	(19,688)	(18,878)	(18,323)	(17,976)		
TAX PAYABLE (E)				0	7,077	6,694	6,418	6,230	6,112	
PROFIT AFTER TAX (F) =D + E			**0**	**(18,912)**	**(12,230)**	**(13,021)**	**(13,717)**	**(14,339)**	**(3,408)**	
TAX BENEFIT ON RESID'L TAX WDV (G)									**4,492**	
CASHFLOW (F-C+G+A+B)			**(38,078)**	**(13,200)**	**(6,519)**	**(7,310)**	**(8,006)**	**(8,627)**	**10,604**	
DISC FACTOR		8.0%	1.0000	0.9623	0.8910	0.8250	0.7639	0.7073	0.6549	
NPV			(38,078)	(12,702)	(5,808)	(6,030)	(6,115)	(6,102)	6,944	
CUM NPV			**(38,078)**	**(50,780)**	**(56,588)**	**(62,618)**	**(68,733)**	**(74,835)**	**(67,891)**	
INTERNAL RATE OF RETURN				***Negative***						
PREPARED BY : Peter Stevens DATE: 11-Feb-03 VERSION:120 28/06/2000 Company Tax Rate 0.34										

5.5.2 SET-UP COSTS

SHED

Large Scale

Shed space required to fit in a bin tipper, peeling machine, trimming table, slicer, dipping conveyors, dehydrators and wash down facilities would be approximately a 10m x 20m enclosed shed. This would need 3 phase power connection, water connected, hot water, washable floors, etc.

***Ballpark* Costing** :

Delta Sheds 10m x 30m x 4m:	$30,000
Site plans/council fees:	$2,000
Concrete floor:	$10,000
Plumbing/electrical:	$10,000
Total:	$52,000

Small Scale:

Assume to use the corner of an existing shed, lining, plumbing, electrical will be required.

***Ballpark* Costings**:

Wall lining:	$3,000
Plumbing/electrical:	$4,000
Total	$7,000

PEELING MACHINERY

Large Scale

Possibly Suitable Machines:

- **Modified commercial 'Pease' machines:** ~$38,000
  Throughput (approx.) 40 nashi/minute
  = 2,000kg/day

  Theoretically possible, to convert four single head machines to a more gentle, slow drive, with a better core gripping mechanism and built up into a 4 cup machine, which one operator can operate.

- ***ABL Pear Peeler***: $250,000

  Plus extra costs for corer/slicer
  Throughput: 100/minute (very few misses)
  =5 tonne/day.

  May be able to peel nashi, however, never been tested. Ardmona uses this machine for pears – a new one is being installed soon.

[Verbal communication with Smith & Searls, Melbourne – Don Hallywell (0398088006)]

- ***Pease Peeler, Corer***: $45,000

  4 cup (or 2 cup) peeler/corer
  Throughput: 60/minute)
  =3 tonne/7 hour day.

  This machine may not peel nashi, as set up for apples, and it doubtful within the normal set up range as they are built. These machines can be set for larger or smaller fruit, but larger fruit is more efficient (less waste, higher % return of processable fruit product).

Unsuitable Machines:

- ABL Pear Peeler, Corer, Slicer.
- Atlas Pacific.
- Pease Peeler, Corer – As set-up standard for apples.

Small Scale:

- **Apple Peeler/Slicer/Corer Peeler**: $39.00.

Throughput: 7 nashi/minute
=350kg/7 hour day.

A hand operated, single head apple peeler, which will peel and core and slice nashi (thin slice 5mm only) or peel only (not core). Will peel and core and thin slice 7 per minute.

SLICING MACHINERY

Large Scale :

- **Urschell Slicer/Dicer**: $24,200 (2nd/hand)
  Good quality *secondhand slicers* start from $5,000 for lower quality ones.
  (Ernest Flemming Processing Equipment, Sydney)
- **Pease Rapid Slicer** is used by one factory, not sure of price.

Small Scale:

- ***'Egg-slice' cutter*** hand operated: $1,000 (Ballpark)
  Slicer – utilize the hand operated peeler/corer for thin slices, and an 'egg slice' device for segmenting the thicker slices.
- **Pease** – hand operated segmenting machines are available but they don't do parallel slices.

DIPPING MACHINERY

Large Scale:

Dipping Tank with motor (2×0.6×0.3m) Approx $15,000

(Tripax Machinery, Melbourne)

Sulphur Dip

This is soaked for 10-15 minutes only, so similar machine would be suitable, with a variable speed motor = 180 litre dip.

Small Scale:

Wire Mesh Baskets in Stainless Steel Tubs: $2,500

This could be done by filling 'baskets' of fruit chips/slices and immersing them into stainless steel tubs – for a set amount of time, and moved on by hand. Machinery required would be plastic mesh 'baskets' and three stainless steel tanks approximately 500mm x 500mm x 500mm (i.e. commercial laundry trough).

DEHYDRATOR

Large Scale:

Approximate cost for 3 drying cabinets: $70,000
(Complete with fans, heat pump system, racks & trays)
(*Ballpark Price* : R & B Refrigeration – Adelaide)
Based on:
2,000 kg fresh nashi = 1,330 kg raw chips/slices.
1 drier tray 700m x 2m long holds 5kg chips = 266 trays for 1330 kg chips.
Racks can stacked 6 x 15 trays high per drier = 90 trays
Therefore needed 3 drying rooms x 90 trays to dry 266 trays of 1330 kg chips.
Each drying room would need to dry 450kg in either less than 20 hours, or less than 36 hours.

Small Scale

Approximate cost for 3 drying cabinets: $25,000
(Complete with fans, heat pump system, racks & trays)
(Ballpark Price – R & B Refrigeration, Adelaide)
Based on:
350 kg fresh fruit = 230kg raw chips.
230kg divided by 5kg per tray (700mm x 2m) = 46 trays.

PRODUCTION COSTS

Large Scale:

The calculations were based on using the Modified Pease Peeler during a 8 hour day, 7 hour machine operation.

-1 peeler operator
-1 trimmer
-1 filling drying trays, emptying trays, bulk packaging of product
-1 Forklift operator/manager/plant operator

32hours/day to process 2,000kg fresh fruit.

1 hour/operator does 63kg fresh fruit
Nominal cost $15/hour/operator
= $15/hour/operator divided by 63kg = 24c/kg fresh fruit

32 hours/day x $15/hour =$480

Small Scale:

The calculations were based on using the Hand Peeler during 8 hour day, 7 hour peeling and trimming.

- 1 peeler operator
- ¾ hour trimming and dipping
- ½ filling drying trays, emptying trays, bulk packaging of product

2 operators x 8 hour day = 16 hours to process 350kg fresh fruit/day.

1 hour/operator does 19.5kg fresh fruit.
Nominal cost $15/hour/operator
= $15 divided by 19.5kg = 77c/kg fresh fruit
16hours/day x $15/hour =$240/day

EXISTING PEELING MACHINE OPERATIONS

Lenswood Coldstores 29/10/01 (David Harris)

4 cup Pease peeler and corer.
Does commercial apple peeling, coring, dicing.
Nashi cored well, but did not peel.
Some peeled slightly, then spun on the core.
The machines run quite quickly and obviously the friction of the peeling blades starting was enough to break the core gripping the turning device.

Franklin Evaporators, Tasmania

Phil Gordon-Smith - 03 6266 3161 (Shed) or 03 6266 3388 (Home)
Have been drying apples for 100 years.
They use 5 Pease machines (4 heads each), peeling and coring apples.
One operator per machine and 1.2 operators trimming per machine.
Then they are sliced in a Pease Rapid Slicer.
The slices go into a continuous sulphur gas (SO2) tunnel for approximately 30 minutes.
This bleaches them, without washing out sugars.
Fill up wooden trays 6-8" deep, and dry at 100 degrees Celsius in a wood fired kiln (like a hops drier).
It dries in approximately 10 hours.
They process 20 tonnes/day on the 5 machines, i.e. 4tonnes/machine for a 7 hour day.
For apples they can process 75 apples per minute per head machine.
The knives must be very sharp to work well

Tasmanian Grower (approx. 1993-94)

Purchased a Pease machine (John & Jill Coombe).
Spoke to new owner, Neville Jolley (Sweet Water Pears) on 03 63281309.
They were trying to peel and core nashi to dry them.
The project failed (possibly because the dehydrator didn't work well enough), but they sold the peeler because they couldn't get it to peel the nashi.

Owen Whatley – 07 33902185

Peels apples in Brisbane.
PCS spoke to Frank (they just developed the Woolworths Apple Pie).
They will attempt to peel a few nashi and ring us back.

Hand Operated 'Pease' Peeler and Corer

Same mechanism as the 2 and 4 hand machines, but hand operated. The speed may be critical –
The core shears at a certain force applied by the peeling blade.

INPUT COSTS

DIPPING CHEMICALS – Cost per days production.

Large Scale:

Total cost	$175.34

Small Scale:

Total	$87.74

DRYING ENERGY CONSUMPTION

Large Scale

Approximately 4 x the power use will be required to operate the three larger drying rooms (compared with the drying room currently operated by A.A. Magarey & Sons).

$27 X 4 = $108/Batch

Small Scale

Approximately 32 hours operation will be required to dry nashi chips.

Power use will be 84c/hour, based on use of A.A. Magarey & Sons' drier, with power costs at 16c H tariff and 7c L tariff.

84c/hour x 32 hours = $26.88, say $27/Batch

FRUIT RECOVERY/DRYING RATIO RECOVERY

1,000kg of fresh nashis:		Slices	666kg	+ waste 333 kg
		Thin chips	740kg	+ waste 260 kg
	-	Dried Slices	-	115 kg

- Dried Chips - 110 kg

It is assumed only fruit of count 23 and above is used. This is based on the recovery rates from October 2001 pilot scale trial outlined below:

Method B (for slices) –

Fresh nashis	156 kg	
Waste (peel/core)	51 kg	(33% waste)
Cut up pieces for dehydration	105 kg	
Final semi moist slices	18 kg	

Drying Ratio = 105/18 = 5.8/1
Recovery Ratio = 156/18 = 8.7/1

Method A (for chips) -

Fresh nashis	132 kg	
Waste (peel/core)	34 kg	(26% waste)
Cut up pieces for dehydration	98 kg	
Final dried chips	14.5 kg	

Drying Ratio = 98/14.5 = 6.8/1
Recovery Ratio = 132/14.5 = 156/18 = 9.1/1

OTHER CONSIDERATIONS

STAND ALONE VS INTEGRATED

This system will require less set-up cost if incorporated into an existing processing facility. Also, when this facility is not being used, other summer fruits will be in season, extending the use of the facility for the full year.

No considerations have been made regarding retail packaging.

PROCESS SAFETY

Sulphur dips are being used. Some people have had reactions to sulphur, so some exhaust fans may be required, or at least, employees need to be made aware of this hazard.

Peeling machinery will require safe operation, as they move fast and have many moving parts. They will also need a competent maintenance person at fairly close call.

Disposal of used chemicals. These are non-toxic, but may require some liquid waste disposal method. Solutions, if reused, will need microbiological testing to ensure product safety.
Disposal of cores and skins will be required. For the larger operation, approximately 600 kg of waste will be generated from a processing run of 2,000 kg of fresh fruit.

SECTION C

6.0 SENSORY EVALUATION OF VALUE-ADDED NASHI PRODUCTS

Prepared by: Rachel Marsh et al, Food Science Australia

EXECUTIVE SUMMARY

Food Science Australia has developed three "concept" value added nashi products :

- **Nashi "chips" –** dried thin slices to be marketed as a shelf stable snack food;
- **Nashi "slices" –** intermediate moisture slices, which could be consumed as snackfood or used as an ingredient for confectionery purposes.
- **Nashi "juices"** – beverages based on nashi.

To assess the commercial viability of the products, it was necessary to determine the consumer acceptability of the value-added nashi in relation to appearance, odour, texture and flavour characteristics. This report detailed the sensory evaluation of two of the three products, nashi chips and slices.

A total of 201 school children (6-17 year olds) and 195 adults (17 to 60 year olds) from four different locations (schools and shopping centres) across Melbourne were selected to evaluate the two products. All panellists were consumers of fresh fruit with most panellists eating fresh fruit several times a week. The majority of panellists were also consumers of dried fruit products.

The consumers were given the products and a questionnaire with a series of questions ranging from the acceptability of the products to their purchase preferences. Consumers were first asked a series of demographic and consumption questions followed by questions in relation to the appearance, odour, texture and flavour of the value-added nashi products. Several comment sections were also included in the questionnaire.

Both children and adults found each nashi product acceptable, with around 84% of consumers rating the overall acceptability on the liking side of the scale. It was difficult to make exact comparisons between the children and adults mean rating score for each attribute, as the category scales were not identical across the two groups. The results found in this study however, conclude that both products could be marketed to children and/or adults at either demographic location since liking and acceptability levels of the odour, texture, flavour and taste of the products, were positive.

The role of packaging, price and marketing of the nashi products should also be considered since such factors could play a large role in determining sales and repurchasing of the nashi products. One recommendation is that some additional resources be allocated to promoting these products to increase consumer awareness of their availability. As well as the nashi products being positioned as a snack food or a dried fruit product, there may also be some scope for expanding into the cereals and baked product line.

Only one locational effect was found with the Heathdale children rating the overall acceptability of the nashi slice as significantly more acceptable than the nashi chip. Heathdale children's overall acceptability rating of the slice was also significantly higher than the Waverley children's rating of the chip and the slice. The exact reason for this difference is not apparent as no significant differences were found for each sensory attribute. No locational effects were found between the two supermarket (adult) locations.

There was an inconsistency noted in the homogeneity of the product colour and appearance. This may therefore need some further development in order to improve the consistency of the products. These attributes could be especially important with children, since appearance can influence whether a child will eat a product. If any modifications are made to the nashi products it is recommended that further consumer evaluations be carried out as such changes to specific attributes may impact on other aspects of the product, which contribute to consumer acceptability.

Studies to determine the shelf-life of these products are also recommended since this study did not take into account how the sensory characteristics of a product may change over a period of time.

6.1 PROJECT AIM

- To determine the overall consumer acceptability by children and adults of both the value-added nashi chip and the semi moist nashi slice in relation to appearance, odour, texture and flavour attributes. Other information such as purchase intent and consumption data was also collected.
- To determine if there was any locational/ social effect between two demographic areas with regard to liking of the two value-added nashi products.

6.2 METHODS

6.2.1 Samples Production

- Pilot scale production of both nashi chips and slices was conducted at the premises of A.A. Magarey & Sons in Adelaide, South Australia.
- Nashis were peeled, cored (using single hand rotating peeler and corer) and sliced into the desired thickness before soaking in 0.5% sodium metabisulphite solution. The chips and slices were placed in their respective osmotic solution for a period of time before putting on trays to be dried in a heat pump dryer.
- 18kg of dried slices and 14kg of dried chips were produced and sealed in aluminium foil bags and sent to Werribee for sampling.

6.2.2 Testing Environment

- The consumer evaluation sessions were conducted at four locations around Melbourne, Victoria.
- 12th October 2001- Southland Westfield Shopping Complex, Melbourne.
- 16th October 2001-Northcote Shopping Centre, Melbourne.
- 25th October 2001-Heathdale Christian College, Hoppers Crossing, Melbourne.
- 26th October 2001-Waverley Christian College, Waverley, Melbourne.

- Consumers aged over 12 years at all locations were seated in individual booths and completed independent evaluations. However, children under the age of 12 years old were seated in a one-on-one interview situation and interviewed by Food Science Australia staff members.

6.2.3 Samples Preparation and Serving

- Two value-added nashi products were evaluated: dried nashi chip and semi moist nashi slice.
- Samples were presented to consumers in a random order, one at a time.
- Two pieces of each of the value-added nashi products were presented at room temperature to each consumer on a 3-digit coded white plate. Consumers were told whether it was a chip or a slice sample.
- Plain water cracker biscuits and filtered water were used as palate cleansers.

6.2.4 Demographics of Consumer Panel

(see Section C, Appendices 6.8 for specific demographics)

- A panel of 396 consumers completed the evaluations. There were 201 children and teenagers (aged between 6 and 17) and 195 adults (aged between 17 and 60).
- Consumers were divided into the following age groups:

  Children - Split into years ranging from 6-17 years old.
  Adults - 17-20, 21-30, 31-40, 41-50, 51-60, 60^{+}
- Approximately equal numbers of males and females were recruited in each group.
- All panellists were consumers of fresh fruit with most panellists eating fresh fruit several times a week (over 87%).
- The majority of panellists were also consumers of dried fruit products (over 93% adults and over 88% children).

6.2.5 Questionnaires Design

<u>Adult's questionnaire:</u>

- The questionnaire consisted of a series of demographic and consumption questions. The appearance, odour, texture, flavour and overall acceptability of the value-added nashi products were then rated on a nine-point hedonic category scale where 1=Like Extremely and 9= Dislike Extremely. Rating for intensity of sweetness, chewiness, overall odour, overall flavour and gritty/grainy strength were also collected using a 5-point hedonic scale where 3 was equal to "Just Right". (see Section C, Appendices 6.8 for questionnaires).
- A purchase intent question was also included in the questionnaire with 1 = Definitely would buy and 5= Definitely would not buy.
- After evaluating the attributes of the value-added nashi sample, consumers were presented with three different sized packets.
- The sizes of the packets were as follows:

  Slices
  - Packet A consisted of 100g slices.
  - Packet B consisted of 250g slices.
  - Packet C consisted of 375g slices.

  Chips
  - Packet A consisted of 40g chips.

- Packet B consisted of 80g chips.
- Packet C consisted of 150g chips.
- Several comment sections were also included in the questionnaire.

Children's questionnaire:

- The questionnaire consisted of a series of demographic and consumption questions. The appearance, odour, texture and flavour of the value-added nashi products were then rated on a seven-point hedonic category scale where 1=Like A lot/ Heaps and 7= Dislike A lot/ Heaps. Rating for intensity of sweetness, chewiness, overall odour, overall flavour and gritty/grainy strength were also collected using a 3-point scale in which 2 was equal to "no change" (see Attachment 2 for questionnaire).
- Several comment sections were also included in the questionnaire.

6.2.6 Data Entry and Analyses

- The sensory software Compusense Paper was used for the development of the questionnaire.
- The analysis of variance, or where necessary, the REMEL method was used to compare the means, and the least significant difference (LSD) test was used for pairwise comparisons of the means.
- All pairwise comparisons were at the 5% level of significance. Only specific attributes were graphed. All other data can be found in the Appendix of this report.
- All children's preference scores were analysed using ANOVA statistical techniques to determine means (5% level of significance).

6.3 PHOTO GALLERY

Semi Moist Nashi Slice Product

Dried Nashi Chip Product

Northcote Shopping Centre

Northcote Shopping Centre

Southland Shopping Centre

Different Packet Sizes –Nashi Chips

Individual Booth Set-up

Children 12 years old and over

Location: Waverley School

One-on-One Interviewing

Children under 12 years old

Location: Heathdale School

Appearance Assessment

Odour Assessment

Texture and Flavour Assessment

Overall Acceptability

6.4 RESULTS

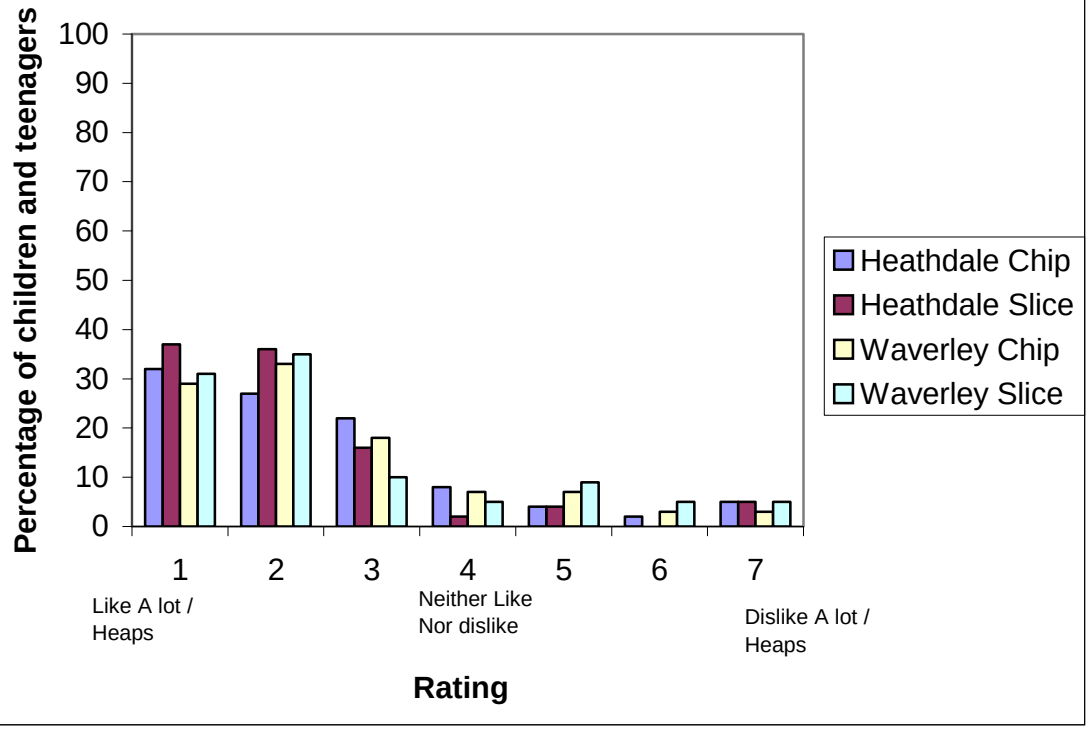
6.4.1 Overall Acceptability Scores

84% of those surveyed liked the value-added nashi products and 16% either had no opinion or did not like them. This did not vary significantly with age (child vs adult), socio economic status/location (lower vs higher) and product type (chip vs slice), or their two-way interactions or three-way interaction. Please note 'like' equals a mean score less than 5 for adults and less than 4 for children and 'dislike' equals a mean score greater than 5 for adults and greater than 4 for children on the overall acceptability rating scales.

(Please refer to Table 9a in Section C, Appendices 6.8.1 for percentages of responses)

Figure 1 presents the distribution of overall acceptability scores for the children and teenager evaluations of the value-added nashi products.

Figure 1: Distribution of Overall Acceptablity Scores for Children and Teenagers Evaluation of Value-Added Nashi Products.

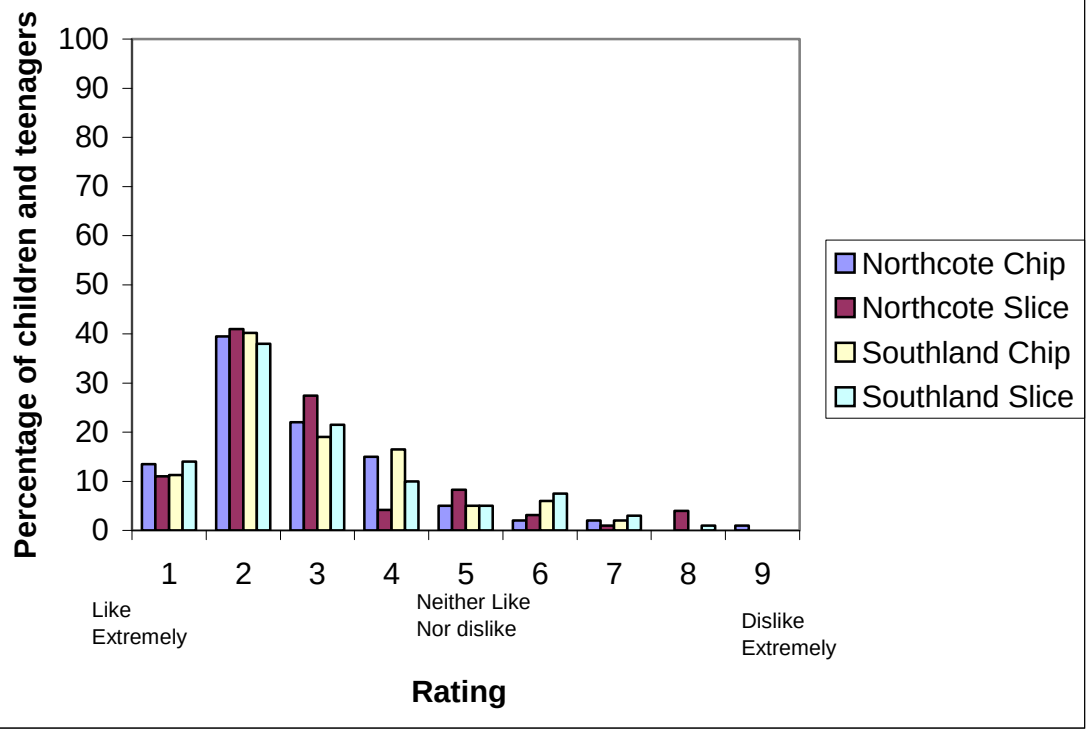


Nb. A score of 3 or less is considered acceptable.

- The majority of school children and teenagers rated the nashi products as acceptable.
- Over 80% of the children and teenagers found the nashi chip acceptable at both school locations (score of 3 or less).
- At Heathdale School 89% of the children found the nashi slice acceptable in comparison to 77% at Waverley School.

Figure 2 presents the distribution of overall acceptability scores for the adult evaluations of the value-added nashi products.

Figure 2: Distribution of Overall Acceptablity Scores for Adults Evaluation of Value-Added Nashi Products.



* A score of 4 or less is considered acceptable.

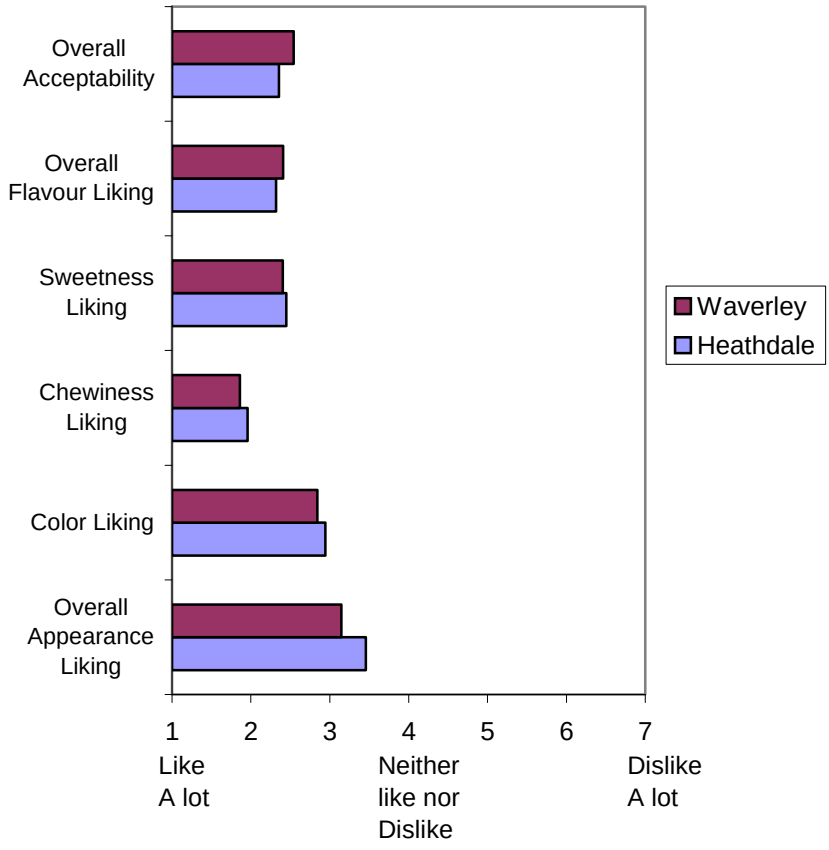
KEY POINTS

- The majority of adults at both locations rated the nashi products as acceptable.
- 83% of the adults found the nashi slice acceptable at both supermarket locations (score of 4 or less).
- A higher percentage of Southland consumers found the nashi chip acceptable; Southland 90% compared to Northcote 87%.

6.4.2 Main School Locational Effect – School Children And Teenagers

Figure 3 presents the mean scores for attributes on liking for the main school locational effect (analyses of both products combined). Please note, the lower the mean score the higher the liking level.

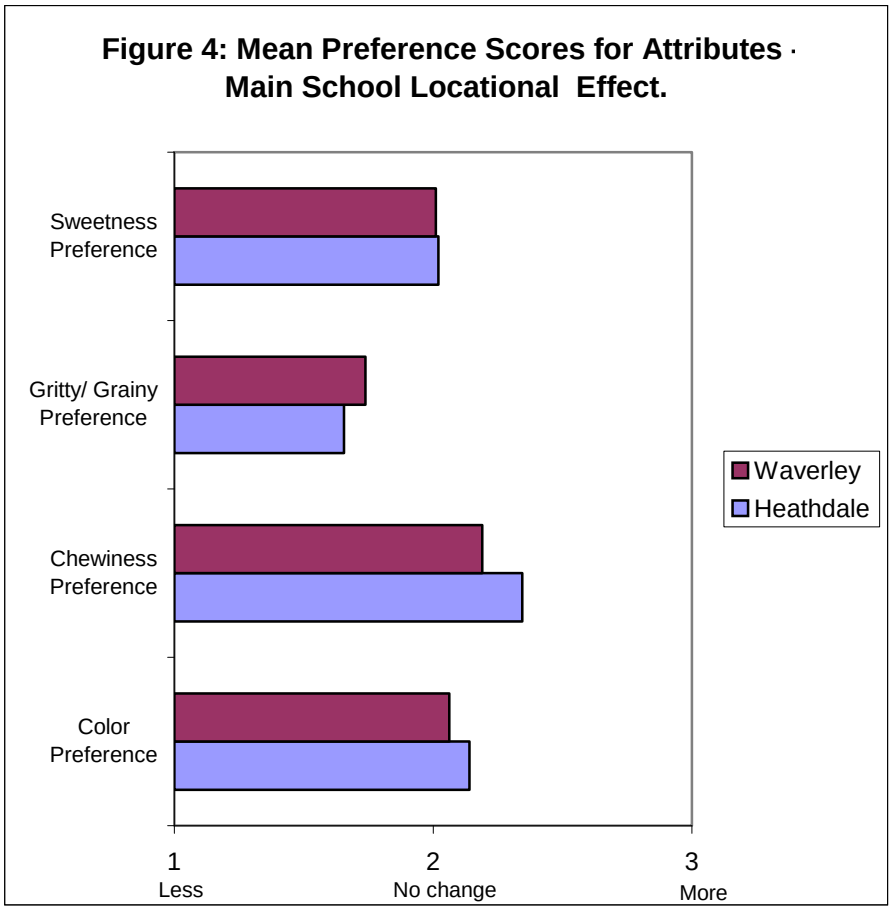
Figure 3: Mean Scores for Attributes on liking - Main School Locational Effect



KEY POINTS

- When combining the two products together and comparing the two demographic locations as a whole, there were no significant differences found between the two different locations in terms of liking levels of each attribute.
- All mean liking attribute scores are on the liking side of the scale.
- Please refer to Table 1a in Section C, Appendices 6.8 for all other mean scores of attributes.

Figure 4 presents the mean scores for attributes on preference for the main school locational effect.



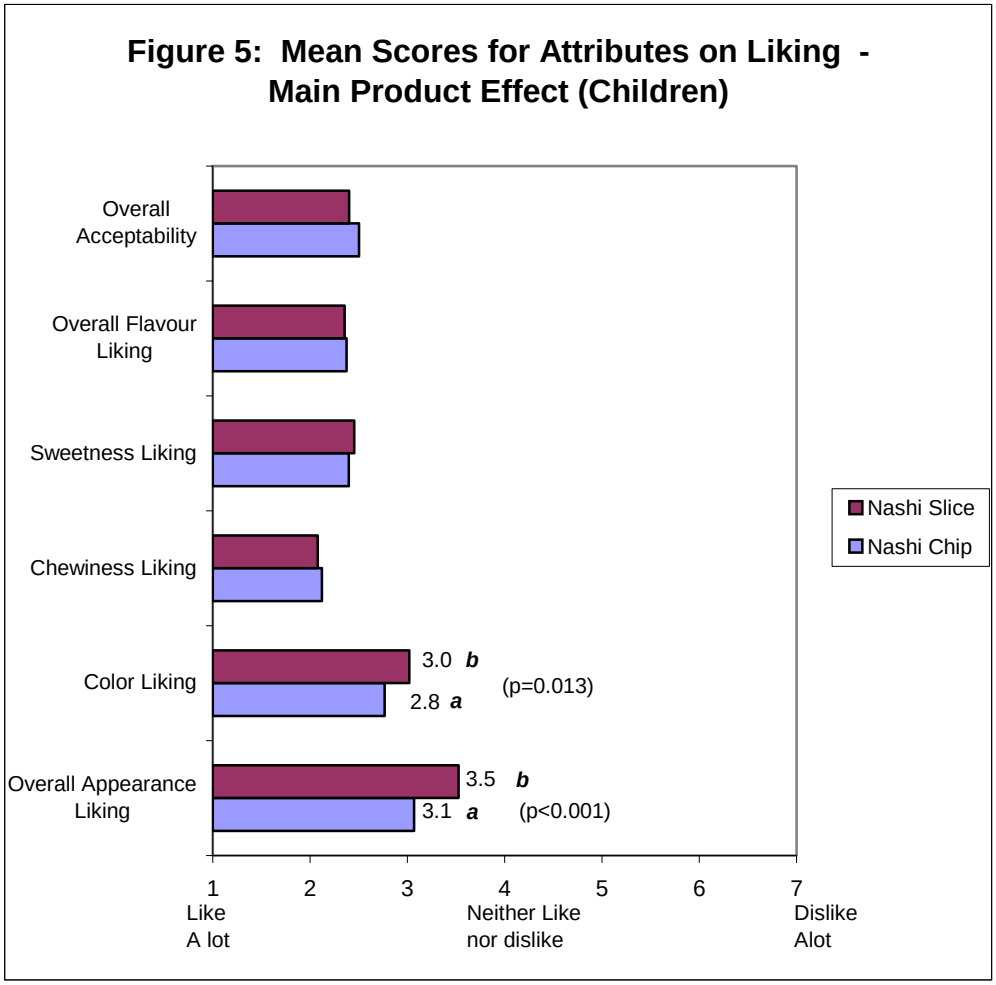
KEY POINTS

- When combining the two products together and comparing the two demographic locations, there were no significant differences in preference scores between the two locations.
- All mean scores were close to 2.0 except for gritty/grainy and chewiness preference scores. This may suggest that at each location the children would prefer a product that is less gritty/ grainy. As the products are naturally gritty/grainy it would be difficult to suggest ways of improving this attribute. There may be some scope for increasing the chewy texture of the products, however it is not an essential requirement as consumers already like the chewiness of products. Also in changing this attribute it does not necessarily mean that the overall acceptability of the product will increase.
- Please refer to Table 1a in Section C, Appendices 6.8 for all other mean scores of attributes.

6.4.3 Main Product Effect – School Children And Teenage Consumers.

Figure 5 presents the mean scores for attributes on liking for the main product effect. Please note, the lower the mean score the higher the liking level.

Figure 5: Mean Scores for Attributes on Liking - Main Product Effect (Children)



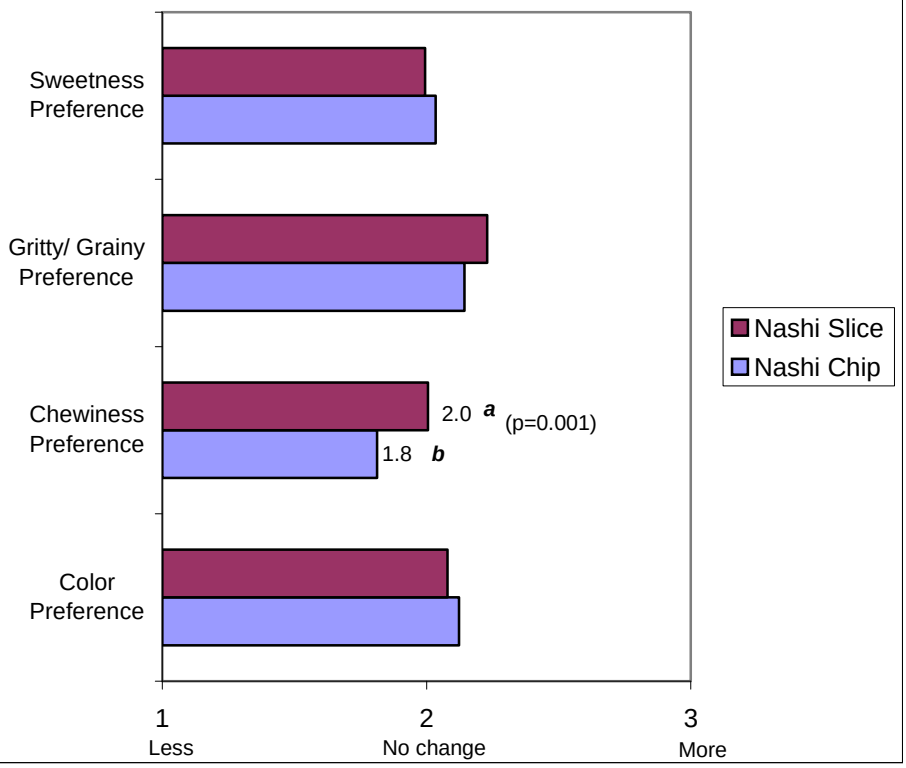
NB. Any two means followed by a different letter are significantly different at the 5% level. Absence of letters after means indicates that there are no significant differences.

KEY POINTS

- When combining all children's responses, significant differences were found between the nashi chip and nashi slice samples for overall appearance and colour liking with the nashi chip being liked significantly more for both attributes.
- Some children's comments could suggest that changing the shape of the nashi slice and making it less shrivelled could improve the appearance. The thickness of the slice may also be of interest as some children commented that they like the thickness of the chip better (see Appendix – Attachment 2 for children's comments).
- Comments on colour and appearance varied slightly, suggesting that there was some variability in the consistency of the product. Overall, comments may suggest that the slice needs to be a little lighter in colour although this modification was not apparent in the colour preference scores.
- Please refer to Table 2a in Section C, Appendices 6.8 for all other mean scores of attributes.

Figure 6 presents the mean scores for attributes on preference for the main product effect (children).

Figure 6: Mean Preference Scores for Attributes - Main Product Effect (children).



* Any two means followed by a different letter are significantly different at the 5% level. Absence of letters after means indicates that there are no significant differences.

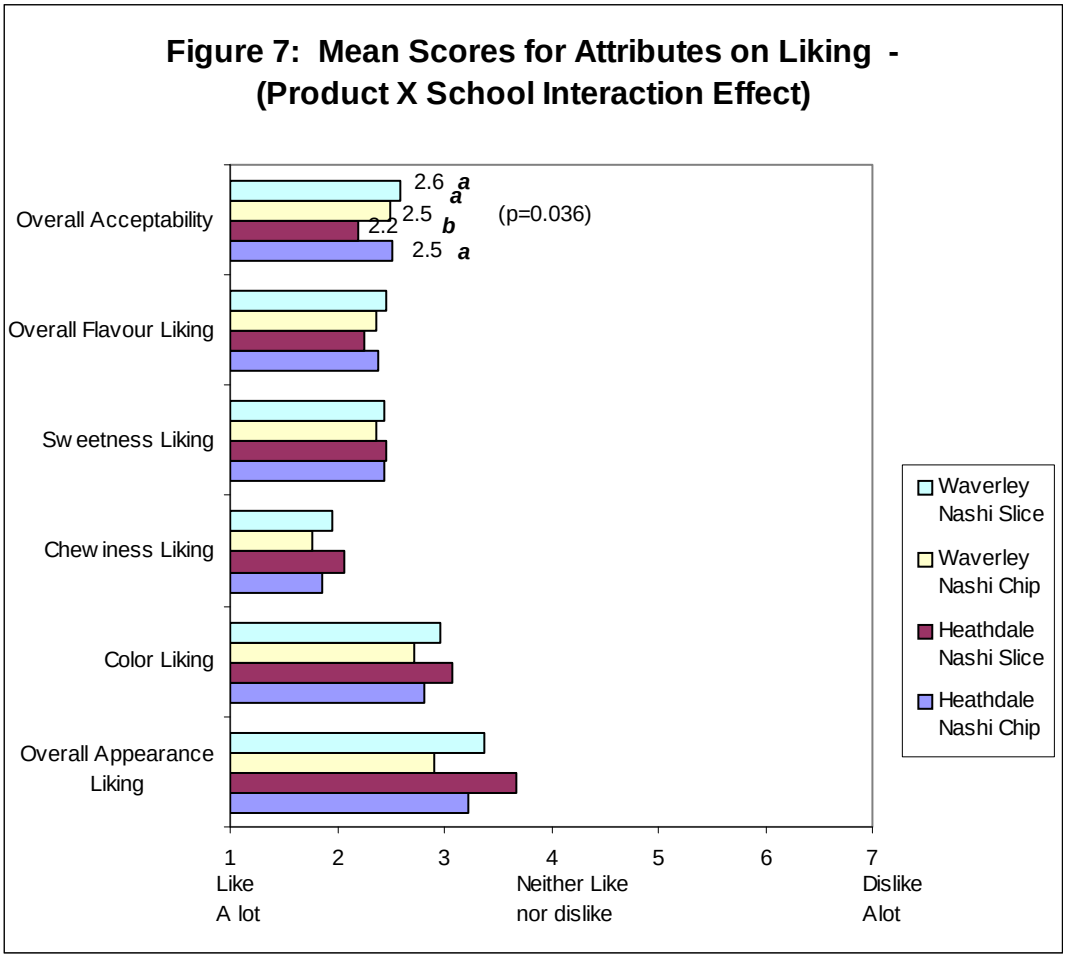
KEY POINTS

- When combining all children's responses, a significant difference was found between the two products for chewiness preference with the nashi slice being perceived as closer to the children's 'ideal' chewy texture than the nashi chip.
- As the mean chewiness preference score for the nashi chip was lower than 2.0, there may be a preference to produce a nashi chip that is less chewy than the current product. It should however be noted that chewiness liking scores were on the liking side of the scale and that changes to the texture may therefore not necessarily result in an increase in overall acceptability scores.
- Please refer to Table 2a in Section C, Appendices 6.8 for all other mean scores of attributes.

6.4.4 Product-By-School Interaction Effect– School Children And Teenage Consumers

Figure 7 presents the mean product scores for attributes on liking for each school location (product-by-school interaction effect). Please note, the lower the mean score the higher the liking level.

Figure 7: Mean Scores for Attributes on Liking - (Product X School Interaction Effect)



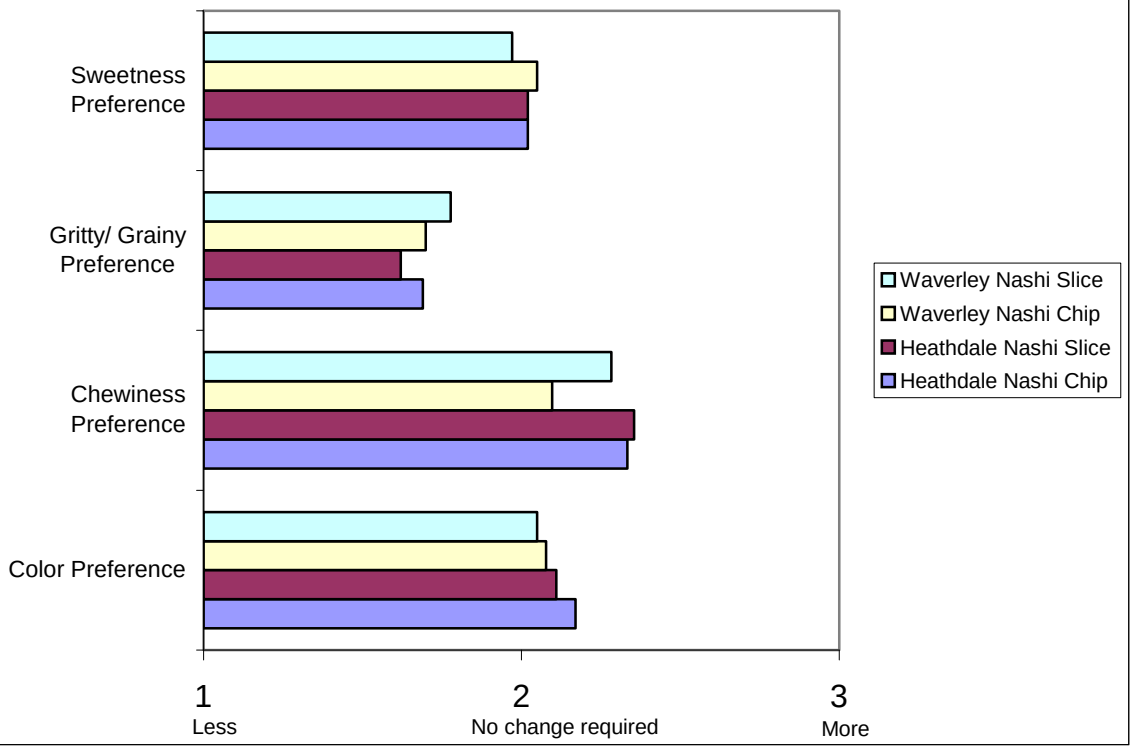
* Any two means followed by a different letter are significantly different at the 5% level. Absence of letters after means indicates that there are no significant differences.

KEY POINTS

- When comparing each of the products at each location, there was a significant difference between products and locations for overall acceptability.
- The nashi slice at Heathdale School was rated the most acceptable (p=0.036).
- All scores were on the liking side of the scale with the appearance and colour scores rating the least liked attributes.
- Comments from the children may suggest that the colour and the appearance could be improved especially in relation to the shape of the product, however further work in this area may not necessarily mean that the overall acceptability scores would increase.
- Please refer to Table 3a in Section C, Appendices 6.8 in Appendix for all other mean scores of attributes.
- Please refer to Section C, Appendices 6.8 for children's comments.

Figure 8 presents the mean product scores for attributes on preference for each school location (product-by-school interaction effect).

Figure 8: Mean Preference Scores for Attributes - (Product-By-School Inteaction Effect)

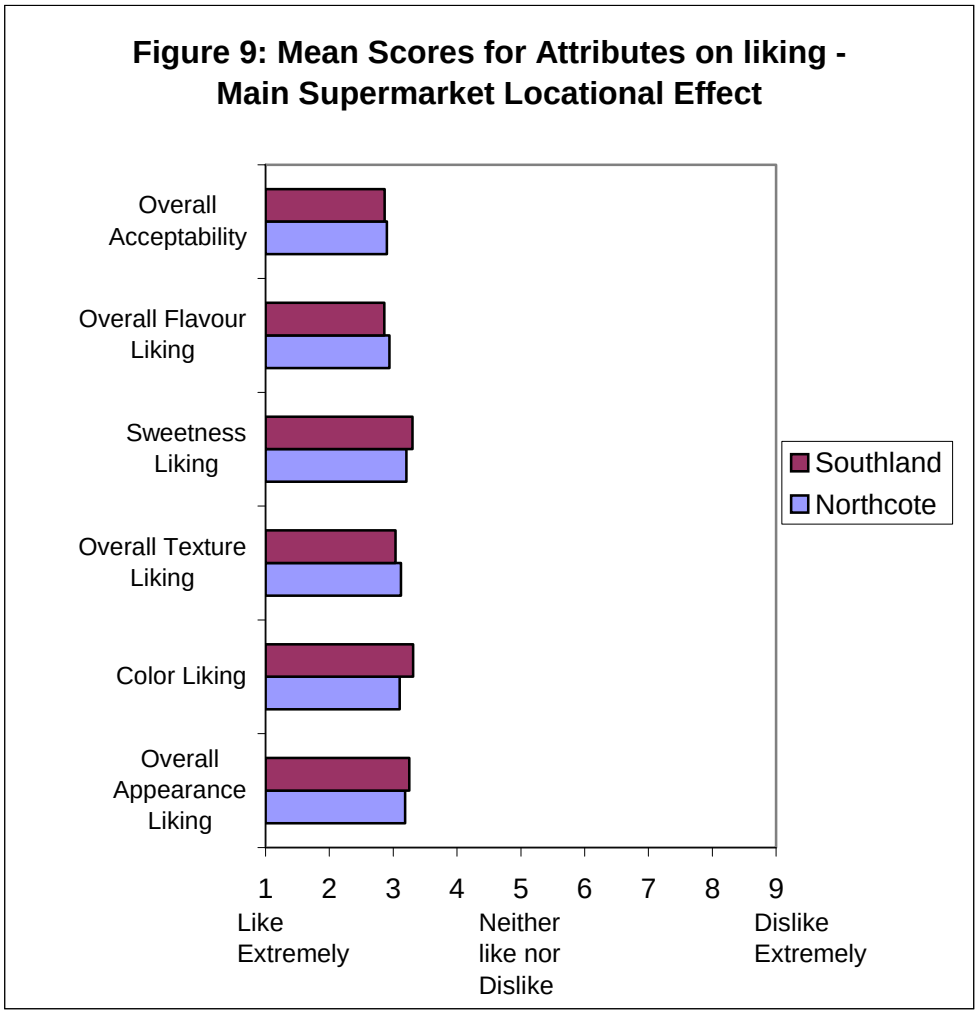


KEY POINTS

- When comparing each of the products at each location, all preference scores were close to 2.0 except for the gritty/grainy and chewiness preference mean scores.
- At both locations the children and teenagers show some trend towards wanting a less gritty/ grainy product.
- With reference to chewiness, Waverley school children found the nashi chip closest to their 'ideal' chewiness.
- At both schools, the children suggested that the nashi slice needed to be chewier.
- Please refer to Table 3a in Section C, Appendices 6.8 for all other mean preference scores of attributes.

6.4.5 Main Supermarket Locational Effect - Adult Evaluations At Supermarket

Figure 9 presents the mean scores for attributes on liking for the main supermarket locational effect. Please note, the lower the mean score the higher the liking level.

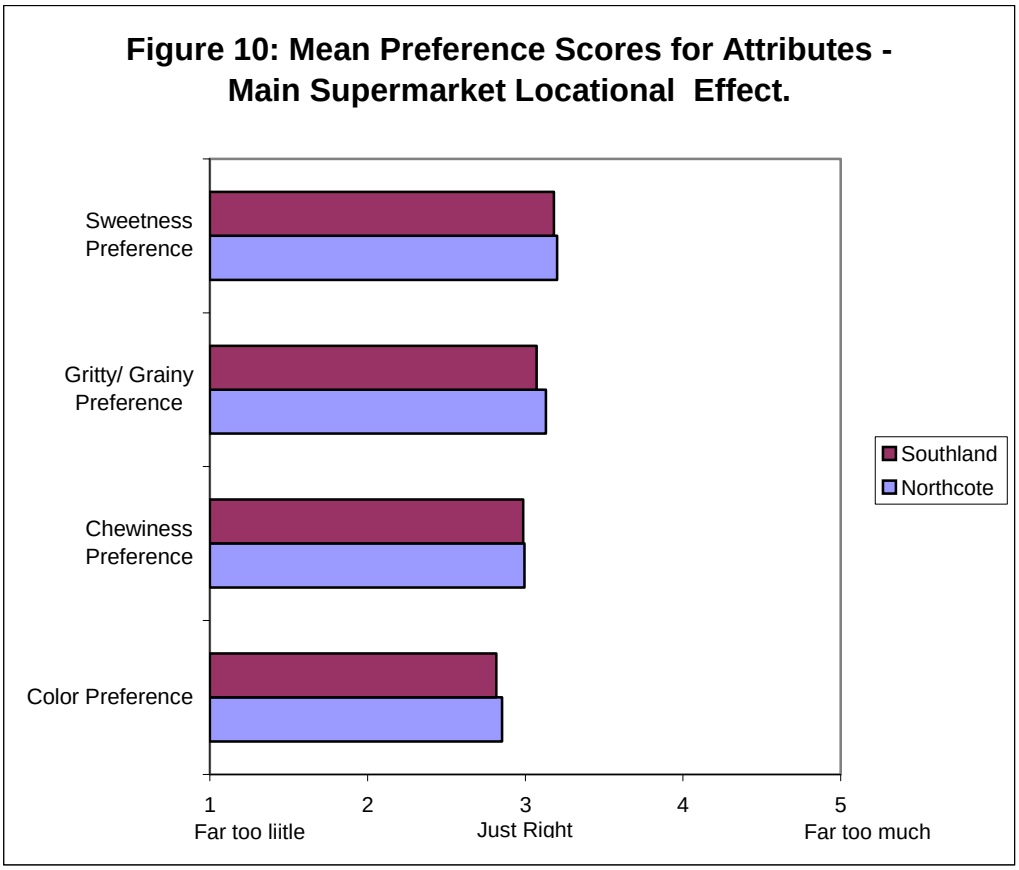


KEY POINTS

- When considering the two products together and comparing the two demographic locations as a whole, no significant differences were found between the two different locations in terms of liking levels of each attribute.
- All mean liking attribute scores are on the liking side of the scale.
- Please refer to Table 4a in Section C, Appendices 6.8 for all other mean scores of attributes.

Figure 10 presents the mean scores for attributes on preference for the main supermarket locational effect.

Figure 10: Mean Preference Scores for Attributes - Main Supermarket Locational Effect.



KEY POINTS

- When combining the two products together and comparing the two demographic locations, no significant differences were found between the two different locations in terms of preference levels of each attribute except for odour preference (please see the table below).
- All preference scores were close to 3.0 suggesting that all attributes are perceived as "Just Right".
- Adults at each location believed that the chewiness levels were 'just right' for both products as a whole.
- Please refer to Table 4a in Section C for all other mean preference scores of attributes.

Table 1 presents the only significant difference for mean preference scores for main supermarket locational effect ($p<0.05$).

Table 1. Nashi product - Mean scores for sensory attributes with significant main effect for supermarket.

Attribute	Northcote	Southland	p-value
Odour Preference	2.549	3.036	0.016

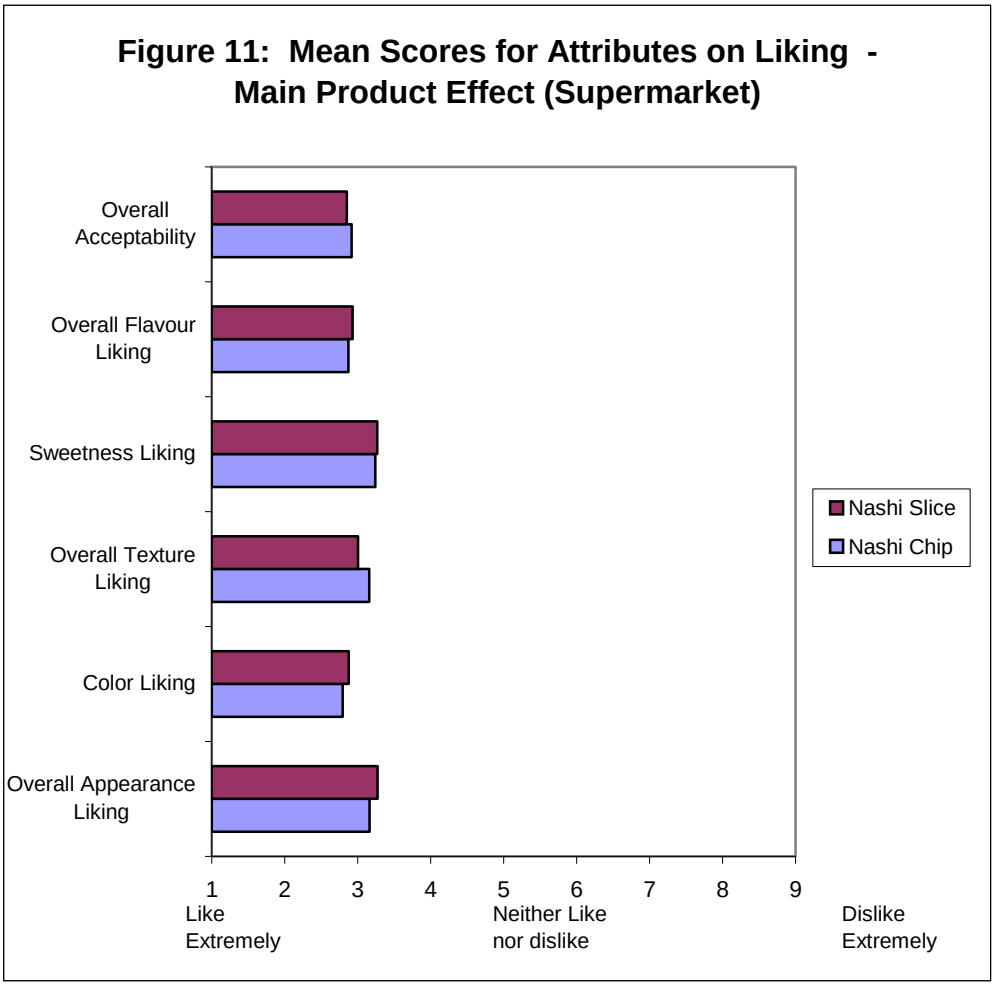
KEY PONTS

- There was a significant difference between Northcote and Southland adults odour preference score with Southland consumers perceiving the samples as closer to "just right" than the Northcote consumers.
- Considering both products together, Northcote consumers would have preferred that the odour of the products to be stronger.
- Please refer to Table 4a in Section C, Appendices 6.8 for all other mean preference scores.

6.4.6 Main Product Effect – Adult Evaluations At Supermarket

Figure 11 presents the mean scores for attributes on liking for the main product effect for the adults' evaluations. Please note, the lower the mean score the higher the liking level.

Figure 11: Mean Scores for Attributes on Liking - Main Product Effect (Supermarket)

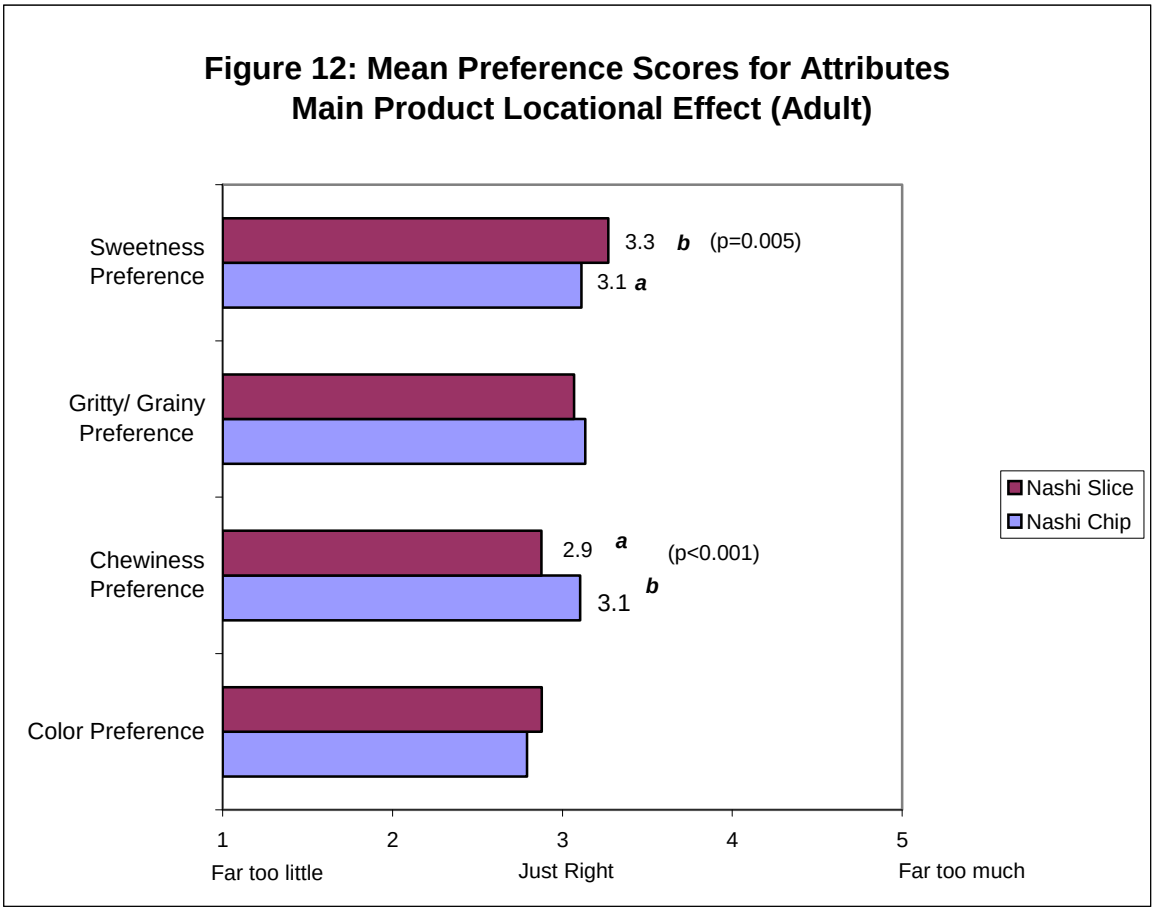


KEY POINTS

- When combining adult responses at both locations together, there were no significant differences found between the nashi chip and nashi slice samples for liking attributes.
- All mean scores are on the liking side of the scale and many positive comments were made about both products.
- Please refer to Table 2a in Section C, Appendices 6.8 for all other mean scores of attributes.
- Please refer to Section C, Appendices 6.8 for adult's comments.

Figure 12 presents the mean scores for attributes on preference for the main product effect (adult evaluation).

Figure 12: Mean Preference Scores for Attributes Main Product Locational Effect (Adult)



NB.

* Any two means followed by a different letter are significantly different at the 5% level. Absence of letters after means indicates that there are no significant differences.

KEY POINTS

- When combining all adult responses at both locations, there were significant differences between the nashi chip and nashi slice samples for chewiness preference and sweetness preference mean scores.
- The nashi slice was perceived as being a little too sweet, however, the slice was closer to panellists 'ideal' chewy level when compared with the nashi chip.
- All preference scores were close to 3.0 with the exception of the nashi slice sweetness level suggesting that most attributes are perceived as "Just Right".
- Possible modifications could be considered for sweetness. As the product was soaked in a sugar solution it may be of interest to review the concentration of this solution. An alternative way of decreasing the sweetness intensity may be to combine the nashi slice with other products such as dry nuts and other fruit or the addition into cereals and baking products.
- Please refer to Table 2a in Section C, Appendices 6.8 for all other mean scores of attributes.

Table 2 presents the suggested mean prices for the nashi chip and nashi slice packets ($p<0.05$).

Table 2. Nashi product - Mean scores for Pricing with Significant Main Effect for Products.

Attribute	Nashi Chip	Nashi Slice	p-value
Packet A Pricing*	$2.51 per 12 packets of 40g	$2.87 per 6 packets of 100g	<0.001
Packet B Pricing*	$2.30 / 80g	$2.80 / 250g	<0.001
Packet C Pricing*	$3.30 / 150g	$3.72 / 375g	<0.001

KEY POINTS

- There were significant differences in pricing between the nashi chip and nashi slice packets with consumers prepared to pay different prices for each size packets.
- As a whole, consumers may be prepared to pay more for the slice than the chip; however, it is difficult to determine whether the significant differences are due to the consumers judging price on the amount of grams or the specific size of the packet.
- Packet C was valued at $1.00 more than packet B for both products.
- There may be opportunity to price the nashi products according to what section they are displayed at within the store. The slice may be more appropriate in the dried fruit section, while the chip may be displayed with the snackfoods. Products within these categories may influence pricing.
- Choice of store location may also influence price. It may be found that the value-added nashi products may sell for a higher price if sold in a health store.

Table 3 presents the distribution of responses for packets size preference for the nashi chip and nashi slice products.

Table 3. Nashi products – Distribution of Responses for Packet Size Preference.

	Nashi Chip	Nashi Slice
Packet A	27.2%	28.7%
Packet B	44.0%	48.6%
Packet C	28.8%	22.6%

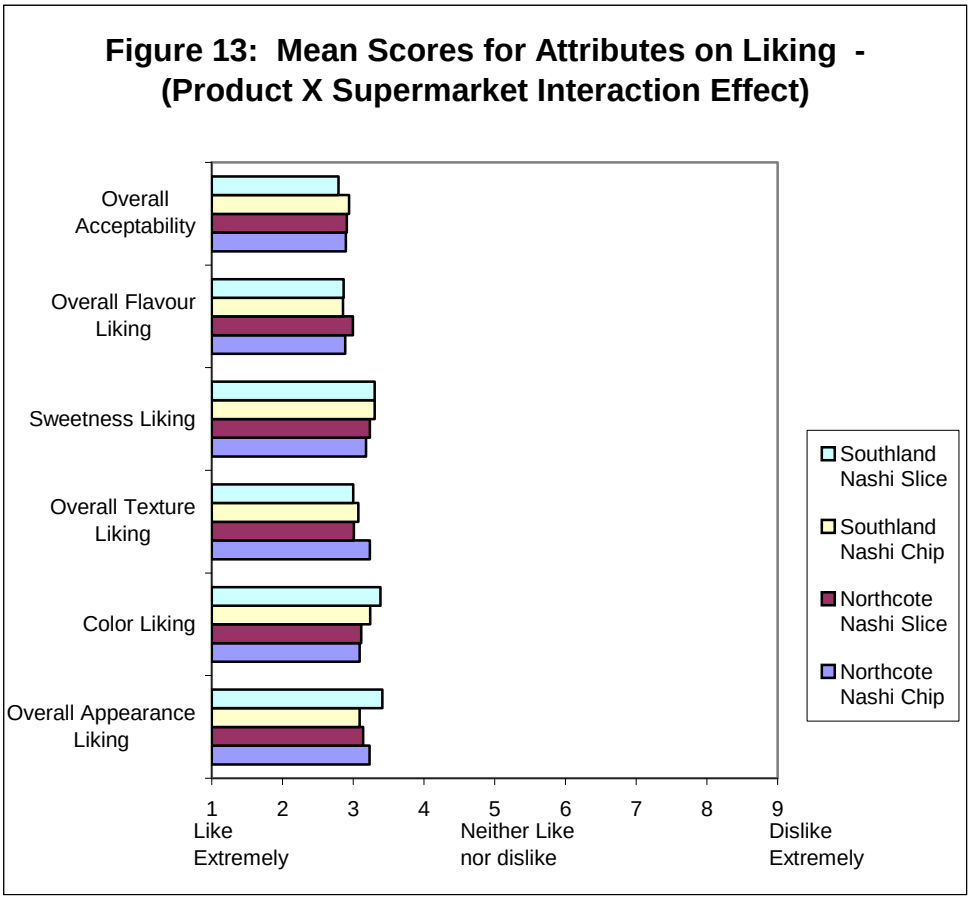
KEY POINTS

- For both products, Packet B was the preferred size. (Nashi Chip, 44.0% compared to Nashi Slice 48.6%).
- There was no locational effect for packet size preference.

6.4.7 Product-By-Supermarket Interaction Effect – Adult Consumers

Figure 13 presents the mean product scores for attributes on liking for each supermarket location (product-by-supermarket interaction effect). Please note, the lower the mean score the higher the liking level.

Figure 13: Mean Scores for Attributes on Liking - (Product X Supermarket Interaction Effect)

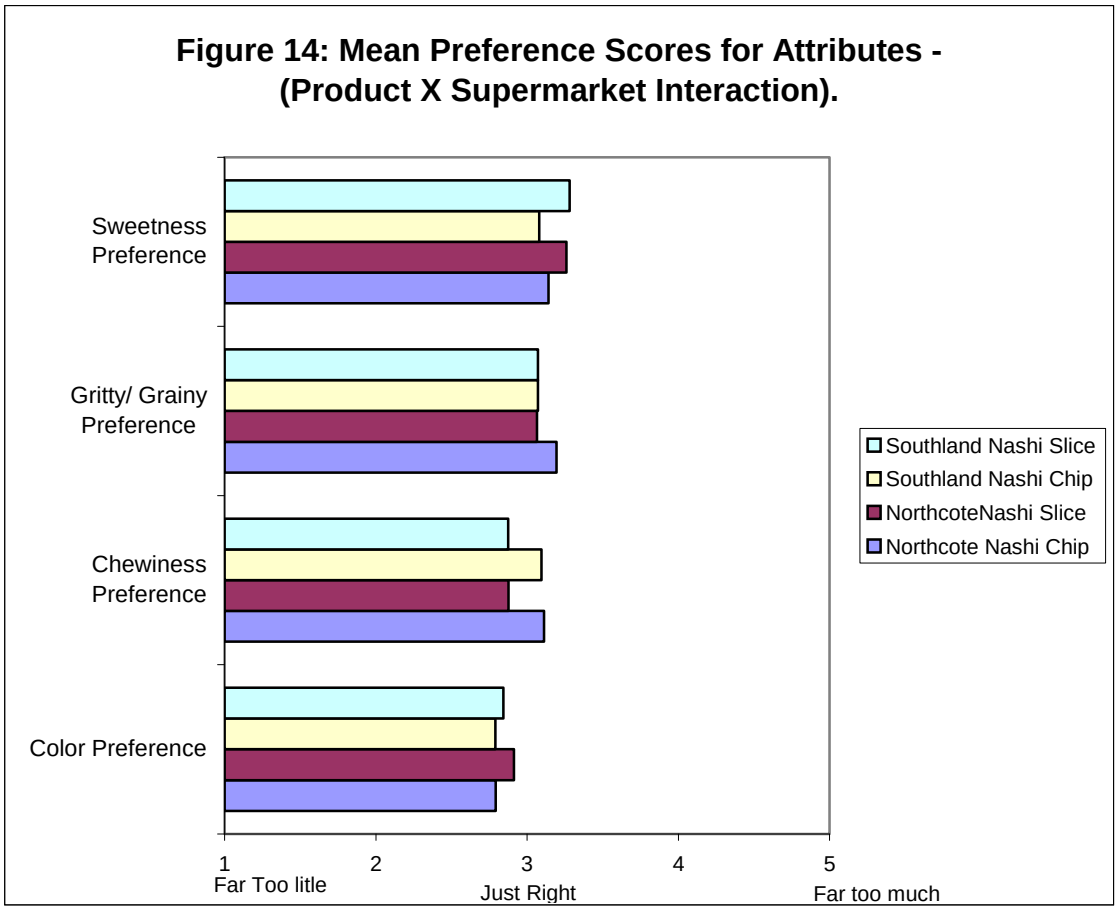


KEY POINTS

- When comparing each product individually at each supermarket location, there were no significant differences for any attributes. This suggests that at each location panellists liked each attribute of the nashi products in the same way.
- All scores were rated on the liking side of the scale with many positive comments being made about each product at both locations.
- Please refer to Table 6a in Section C, Appendices 6.8 for all other mean scores of attributes.

Figure 14 presents the mean product scores for attributes on preference for each supermarket location (product-by-supermarket interaction effect).

Figure 14: Mean Preference Scores for Attributes - (Product X Supermarket Interaction).



KEY

KEY POINTS

- When comparing each product individually at each supermarket location, there were no significant differences between preference levels for each attribute.
- Most preference scores were close to 3.0 suggesting that the consumers perceived the attributes close to their perception of 'just right'.
- The sweetness preference scores indicate that the products may have been perceived as slightly too sweet. With the products being soaked in a sugar solution there may be some scope to measure the effect of varying this solution to change sweetness levels of the product. Alternative ways of decreasing sweetness intensity may be to combine the nashi products such as dry nuts, other dried fruit, adding the nashi product to cereals and baking products.
- Please refer to Table 6a in Section C, Appendices 6.8 for all other mean scores of attributes.

6.4.8 Product -By-Years In Australia Interaction

Extra analyses were conducted on the supermarket data in relation to the number of years a consumer had been living in Australia vs sensory attribute mean scores. Two attributes were found to have significant product-by-years in Australia interaction, namely, colour preference (p=0.019) and price expectation for Packet C (p=0.025).

6.4.9 Product-By-Age Interaction

Extra analyses were carried out in relation to age distribution. There were product-by-age interactions for three attributes: overall appearance (P=0.016), colour preference (P=0.042) and "How Often Would You Eat the Nashi Product?" (P=0.020).

For overall appearance, there was a significant difference between age groups for the slice product, with ages 51^+ years liking the overall appearance more than the 17-30 and 41-50 age group. Ages 60^+ years also liked the appearance significantly more than the 31-40 age group. There were no significant differences between age groups for the chip product.

There was a significant difference between age groups for colour preference. For the chip product, the significantly higher score for adults aged 17-20 and 41-50 years old (2.88 and 2.91 respectively) showed that they perceived the colour of the nashi products as closer to their “just right” than the 60^+ years olds (mean score 2.62). For the slice product adults aged 17-20 years gave a significantly higher score (3.22) than all other age groups except the 41-50 year olds (2.96). This reflects that the 17-20 year olds perceived the nashi products as being darker than their perception of “just right”.

With regards to "How Often Would You Eat the Nashi Product?”, there were no significant differences between age groups for the chip product. There were significant differences found for the slice product with 17-20 and 51^+ year olds likely to eat the slice product more frequently than the 21-40 year olds. The 51^+ year olds were also likely to eat the nashi slice more frequently than the 41-50 year olds.

Please see Table 10a, 11a and 12a in Section C, Appendices 6.8 for mean scores.

6.4.10 Products-By-Supermarket Location- By-Age Interaction

There was a three-way interaction, supermarket-by-product-by-age for responses to the "How likely would you be to buy the nashi product for your child's school lunchbox?" question (P=0.050).

The purchase intent of the nashi chip for a child’s lunch box by Northcote adults aged 60^+ years was significantly lower than treatments 12,18 and 23. The mean score was 4.82 which represents a response of probably/definitely would not buy.

The Southland adults aged 51-60 years had the lowest mean score for intended purchase of the slice for a child’s lunch box (2.43). This score corresponded to "may buy" and was significantly lower than treatment 2, 5, 6, 8, 13, 14, 15, 17, 20 and 21.

(Please refer to Section C, Appendices 6.8 - Table 10a- 13a for treatment categories)

The mean score for Southland adults aged 60 years intended purchase of the chip for a child's lunch box was the second lowest (3.00). This score corresponded to "may or may not buy" and was significantly lower than treatment 14, 15 and 20.

6.4.11 Purchase Intent Of School Children

QUESTION 11: "Would you ask your mum/dad to buy these products?"

Table 8 presents the distribution of responses for Question 11: "Would you ask your mum/dad to buy these products?"

Table 8: Distribution of Responses to Question 11.

	YES	MAYBE	NO
SCHOOL CHILDREN	**46.2%**	**31.1%**	**22.7%**

There was no school effect, no product effect and no school-by-product interaction, thereby safely confirming that 46.2% of the children would ask their parents to buy the nashi products.

QUESTION 12: "Would you buy the products from the canteen?"

Table 9 presents the distribution of responses for Question 11: "Would you buy the products from the canteen?"

Table 9: Distribution of responses to Question 12.

SCHOOL	YES	MAYBE	NO
HEATHDALE	**29.7%**	**46.2%**	**24.1%**
WAVERLEY	**46.1%**	**29.6%**	**24.3%**

There was a significant school effect (p=0.021) with more "YES" responses and fewer "MAYBE" responses at the Waverley School.

6.5 DISCUSSION

It was difficult to make exact comparisons between the children and adult mean rating scores for each attribute, as the category scales were not identical across the two groups. As a result of the positive liking and acceptability levels of odour, texture, taste, and flavour it can be concluded that both products could be marketed to children and/or adults at either demographic location.

The role of packaging, price and marketing of the nashi products should also be considered, as such factors could play a significant role in determining sales and repurchasing of the nashi products. As well as the nashi products being positioned as a snack food or a dried fruit product, there may also be some scope for expanding into the cereals and baked products line. It is recommended that some additional resources be allocated to promoting these products to increase consumer awareness of their availability.

Limiting the addition of other ingredients such as additives, may also be important to consumers. Results from this study along with some comments from consumers suggested

the desire for products to be kept as natural as possible (refer to Attachment 1 –Tables 30a-h and Attachment 2 – comments in appendix).

With an inconsistency noted in the homogeneity of the product colour and appearance, there may be some need to further improve the consistency in these areas. Such attributes could be especially important with the children, since appearance may be more likely to determine the child's willingness to consume a product.

6.6 CONCLUSION

In conclusion both products could be marketed to children and adults at either demographic location as liking and acceptability levels of the sensory properties of the nashi products are positive.

Both the children and adults found each nashi product acceptable, with around 84% of consumers rating the overall acceptability on the liking side of the scale.

Only one locational effect was found with the Heathdale children rating the overall acceptability of the nashi slice as significantly more acceptable than the nashi chip. Heathdale children's overall acceptability rating of the slice was also significantly higher than the Waverley children's rating of the chip and the slice. The exact reason for this difference is not apparent as no significant differences were found for each sensory attribute.

No locational effects were found for the comparison of the two supermarket (adult) locations with regards to liking levels.

Some preference scores deviated a little from the consumers 'ideal, however, if changes were to be made to the product it is recommended that there be further development in improving the consistency of the colour and appearance of the product. This may subsequently enhance the appeal to children.

Pricing, packaging and product concepts may vary between consumers and such factors should be considered in the promotional strategy.

6.7 FURTHER WORK and RECCOMMENDATIONS

If any modifications are made to the nashi products it is recommended that further consumer evaluations be carried out so that the impact of these changes on specific sensory attributes of the product can be measured.

Marketing, price and packaging may also play a crucial role in consumer acceptability and some time should be spent in developing an advertising campaign and suitable packaging if this product is to be sold individually or as a snack food product.

Studies to determine the shelf-life of these products is also recommended as this study did not take into account how the sensory characteristics of a product may change over a period of time.

6.8 APPENDICES

6.8.1 Results Tables/Demographics

Table 1a. Value-added nashi product - Mean scores for sensory attributes with significant main effect for school location.

Attribute	Heathdale	Waverley	p-value
Overall Appearance	3.455	3.146	0.090
Colour Liking	2.945	2.845	0.543
Colour Preference	2.140	2.063	0.287
Odour Liking	3.425	3.180	0.125
Chewiness Liking	1.96	1.859	0.096
Chewiness Preference	2.344	2.190	0.203
Gritty/ Graininess Liking	3.152	3.261	0.563
Gritty/ Graininess Preference	1.655	1.738	0.268
Sweetness Liking	2.450	2.403	0.802
Sweetness Preference	2.020	2.010	0.886
Overall Flavour Liking	2.320	2.408	0.661
Overall Acceptability	2.357	2.544	0.356

Table 2a. Nashi product – Children's mean scores for sensory attributes with significant main effect for products.

Attribute	Nashi Chip	Nashi Slice	p-value
Overall Appearance	3.069	3.527	<0.001
Colour Liking	2.768	3.020	0.013
Colour Preference	2.123	2.079	0.400
Odour Liking	3.320	3.281	0.694
Chewiness Liking	2.727	2.638	0.458
Chewiness Preference	1.813	2.005	0.001
Gritty/ Graininess Liking	1.695	1.700	0.923
Gritty/ Graininess Preference	2.143	2.229	0.270
Sweetness Liking	2.399	2.453	0.631
Sweetness Preference	2.034	1.995	0.478
Overall Flavour Liking	2.375	2.354	0.824
Overall Acceptability	2.502	2.401	0.296

Table 3a: Nashi product- Mean scores for each nashi product at each demographic with significant differences.

Attribute	Heathdale School		Waverley School		p-value
	Nashi Chip	Nashi Slice	Nashi Chip	Nashi Slice	
Overall Appearance	3.230	3.680	2.913	3.379	0.945
Colour Liking	2.810	3.080	2.728	2.961	0.854
Colour Preference	2.170	2.110	2.078	2.049	0.769
Odour Liking	3.48	3.370	3.165	3.194	0.488
Chewiness Liking	1.86	2.06	1.767	1.951	0.893
Chewiness Preference	2.333	2.354	2.097	2.283	0.296
Gritty/ Graininess Liking	3.152	3.151	3.359	3.163	0.364
Gritty/ Graininess Preference	1.690	1.620	1.699	1.777	0.149
Sweetness Liking	2.440	2.460	2.359	2.447	0.766
Sweetness Preference	2.020	2.020	2.049	1.971	0.484
Overall Flavour Liking	2.391	2.249	2.359	2.457	0.194
Overall Acceptability	2.510	2.204	2.495	2.592	0.039

Table 4a. Nashi product –Mean scores for sensory attributes with significant main effect for supermarket.

Attribute	Northcote	Southland	p-value
Overall Appearance	3.186	3.250	0.723
Colour Preference	2.853	2.817	0.525
Colour Liking	3.102	3.312	0.213
Odour Preference	2.549	3.036	0.016
Odour Liking	3.794	3.969	0.328
Chewiness Preference	2.995	2.986	0.884
Gritty/ Graininess Preference	3.130	3.073	0.357
Overall Texture Acceptability	3.123	3.037	0.631
Sweetness Preference	3.201	3.181	0.771
Sweetness Liking	3.208	3.302	0.631
Overall Flavour Liking	2.941	2.859	0.648
Aftertaste Liking	3.158	3.167	0.96
Overall Acceptability	2.903	2.865	0.828
Overall Purchase Intent	2.359	2.438	0.539
Purchase intent for Child's Lunch box	3.96	4.005	0.865
Packet A Pricing*	$2.66	$2.71	0.821
Packet B Pricing*	$2.59	$2.52	0.593
Packet C Pricing*	$3.50	$3.53	0.821
Intended Frequency of Consumption	3.295	3.422	0.548
Perception as a Healthy Snackfood	1.242	1.297	0.387

* Packaging prices were converted to $ values using the upper value of each category with the assumption that the top category ranged from $5.00 to $6.00. Analysed as continuous scales variables and adjusted to the mid-point of the category.

Table 5a. Nashi product – Supermarket- Mean scores for sensory attributes with significant main effect for products.

Attribute	Nashi Chip	Nashi Slice	p-value
Overall Appearance	3.163	3.272	0.351
Colour Preference	2.792	2.879	0.021
Colour Liking	3.163	3.247	0.321
Odour Preference	2.705	2.872	0.129
Odour Liking	3.959	3.802	0.083
Chewiness Preference	3.105	2.876	<0.001
Gritty/ Graininess Preference	3.134	3.069	0.247
Overall Texture Acceptability	3.156	3.006	0.292
Sweetness Preference	3.112	3.270	0.005
Sweetness Liking	3.241	3.268	0.855
Overall Flavour Liking	2.871	2.931	0.632
Aftertaste Liking	3.164	3.161	0.975
Overall Acceptability	2.918	2.851	0.636
Overall Purchase Intent	2.469	2.326	0.099
Purchase intent for Child's Lunch box	4.045	3.920	0.226
Packet A Pricing*	$2.51 per 12 packets of 40g	$2.87 per 6 packets of 100g	<0.001
Packet B Pricing*	$2.30 / 80g	$2.80 / 250g	<0.001
Packet C Pricing*	$3.30 / 150g	$3.72 / 375g	<0.001
Intended Frequency of Consumption	3.422	3.294	0.305
Perception as a Healthy Snackfood	1.294	1.244	0.103

*** Packaging prices were converted to $ values using the upper value of each category with the assumption that the top category ranged from $5.00 to $6.00. Analysed as continuous scales variables and adjusted to the mid-point of the category.**

Table 6a. Nashi product- Supermarket - Treatment mean scores for interaction of appearance, odour, texture and flavour attributes with significant differences.

Attribute	Northcote		Southland		p-value
	Nashi Chip	Nashi Slice	Nashi Chip	Nashi Slice	
Overall Appearance	3.233	3.139	3.090	3.410	0.078
Colour Preference	2.793	2.913	2.791	2.844	0.369
Colour Liking	3.091	3.112	3.238	3.385	0.453
Odour Preference	2.442	2.655	2.976	3.095	0.670
Odour Liking	3.928	3.660	3.991	3.947	0.215
Chewiness Preference	3.113	2.877	3.096	2.875	0.891
Gritty/ Graininess Preference	3.194	3.066	3.073	3.073	0.254
Overall Texture Acceptability	3.235	3.011	3.074	3.000	0.601
Sweetness Preference	3.141	3.260	3.081	3.281	0.465
Sweetness Liking	3.181	3.234	3.302	3.302	0.858
Overall Flavour Liking	2.887	2.995	2.854	2.865	0.697
Aftertaste Liking	3.12	3.195	3.209	3.125	0.497
Overall Acceptability	2.898	2.909	2.939	2.792	0.574
Overall Purchase Intent	2.459	2.259	2.480	2.396	0.504
Purchase intent for Child's Lunch	4.047	3.874	4.043	3.967	0.639
Packet A Pricing*	$2.508	$2.817	$2.502	$2.921	0.506
Packet B Pricing*	$2.344	$2.828	$2.257	$2.774	0.803
Packet C Pricing*	$3.298	$3.695	$3.306	$3.752	0.750
Intended Frequency of Consumption	3.365	3.226	3.480	3.363	0.932
Perception as a Healthy Snackfood	1.275	1.208	1.313	1.281	0.563

*** Packaging prices were converted to $ values using the upper value of each category with the assumption that the top category ranged from $5.00 to $6.00. Analysed as continuous scales variables and adjusted to the mid-point of the category**

Table 7a. Nashi product - % of people that would use Nashi Chip in this way:

% of panellists that would use product this way.	Northcote	Southland	p-value
By itself	64.95	65.26	1.000
Mixed with Other dried fruits	34.02	24.47	0.156
In muesli	29.90	22.34	0.253
Ingredient in muffins/biscuits/ cakes	21.65	15.96	0.358
As a snackfood	49.48	46.81	0.773
Ingredient in muffins/biscuits/ cakes	15.46	6.38	0.063
Other	6.19	1.06	0.118

Table 8a. Nashi product - % of people that would use Nashi Slice in this way.

% of panellists that would use product this way:	Northcote	Southland	p-value
By itself	69.15	72.63	0.633
Mixed with other dried fruits	38.30	26.32	0.088
In muesli	23.40	21.05	0.729
Ingredient in muffins/biscuits/ cakes	26.60	12.63	0.018
As a snackfood	47.87	44.21	0.663
Ingredient in muffins/biscuits/ cakes	13.83	7.37	0.164
Other	2.13	4.21	0.682

Table 9a: Percentages of Responses for the Overall Acceptability Ratings.

AGE	Socio-economic	Product	Like	Dislike
Child	**Lower**	Chip	81.00	19.00
		Slice	88.78	11.22
		Mean	**84.85**	**15.15**
	Higher	Chip	80.58	19.42
		Slice	76.70	23.30
		Mean	**78.64**	**21.36**
	Both Locations	Chip	80.79	19.21
		Slice	82.59	17.41
		Mean	**81.68**	**18.32**
Adult	**Lower**	Chip	86.60	13.40
		Slice	82.80	17.20
		Mean	84.74	15.26
	Higher	Chip	83.16	16.84
		Slice	89.58	10.42
		Mean	**86.39**	**13.61**
	Both Locations	Chip	84.90	15.10
		Slice	86.24	13.76
		Mean	85.56	14.44
Combined	**Lower**	Chip	83.76	16.24
		Slice	85.86	14.14
		Mean	**84.79**	**15.21**
	Higher	Chip	81.82	18.18
		Slice	82.91	17.09
		Mean	**82.37**	**17.63**
Mean of both socio locations		Chip	82.78	17.22
		Slice	84.36	15.64
		Mean	**83.57**	**16.43**

Table 10a presents the treatment combinations and mean scores for overall appearance for the Product-by-Age interaction.

Table 10a: Treatment combinations and mean scores for the overall appearance for the product-by-age interaction.

Treatment	Product	Age group	MEAN
1	Chip	17-20y	3.45
2	Chip	21-30y	3.12
3	Chip	31-40y	2.93
4	Chip	41-50y	3.37
5	Chip	51-60y	3.42
6	Chip	>60y	3.05
7	Slice	17-20y	3.73
8	Slice	21-30y	3.41
9	Slice	31-40y	3.35
10	Slice	41-50y	3.58
11	Slice	51-60y	2.47
12	Slice	>60y	2.41

KEY POINT

- For Overall Appearance, there was a significant difference between age groups for the slice product. Ages 51^{+} years liked the overall appearance more than the 17-30 and 41-50 age group. Ages 60^{+} years also liked the appearance significantly more than the 31-40 age group. There were no significant differences between age groups for the chip product.

Table 11a presents the treatment combinations and mean scores for colour preference for the product-by-age interaction.

Table 11a: Treatment combinations and mean scores for the colour preference for the product by age interaction.

Treatment	Product	Age group	MEAN
1	Chip	17-20y	2.89
2	Chip	21-30y	2.77
3	Chip	31-40y	2.83
4	Chip	41-50y	2.92
5	Chip	51-60y	2.81
6	Chip	>60y	2.61
7	Slice	17-20y	3.22
8	Slice	21-30y	2.76
9	Slice	31-40y	2.87
10	Slice	41-50y	2.96
11	Slice	51-60y	2.93
12	Slice	>60y	2.68

KEY POINTS

- There was significant difference between age groups for colour preference.
- For the chip product, the significantly higher score for adults aged 17-20 and 41-50 years (2.88 and 2.91 respectively) showed that they perceived the colour of the nashi products as closer to their "just right" than the 60^{+} years (mean score 2.62).
- For the slice product, ages 17-20 years gave a significantly higher score (3.22) than all other age groups except the 41-50 years (2.96). This reflects that the 17-20 years perceived the nashi products as being darker than their perception of "just right".

Table 12a presents the treatment combinations and mean scores for intended frequency of consumption for the Product-by-Age interaction.

Table 12a: Treatment combinations and mean scores for the intended frequency of consumption for the product-by-age interaction.

Treatment	Product	Age group	MEAN
1	Chip	17-20y	3.22
2	Chip	21-30y	3.51
3	Chip	31-40y	3.73
4	Chip	41-50y	3.71
5	Chip	51-60y	3.96
6	Chip	60y	2.94
7	Slice	17-20y	2.93
8	Slice	21-30y	3.69
9	Slice	31-40y	3.96
10	Slice	41-50y	3.67
11	Slice	51-60y	2.47
12	Slice	>60y	2.43

KEY POINTS

- With regards to "How Often Would You Eat the Nashi Product?", there were no significant differences between age groups for the chip product.
- There were significant differences found for the slice product, with the adults aged 17-20 and 51^{+} years likely to eat the slice product more frequently than the 21-40 year olds.
- Those aged 51^{+} years were likely to eat the nashi slice more frequently than the 41-50 year olds.

Table 13a presents the treatment combinations and purchase intent mean scores for product-by-shop-age interaction.

Table 13a: Treatment combinations and mean scores for the product-by-Shop Location-by- age interaction.

TREATMENT	LOCATION	PRODUCT	AGE GROUP	MEAN
1	Northcote	Chip	17-20	3.53
2	Northcote	Chip	21-30	4.25
3	Northcote	Chip	31-40	3.67
4	Northcote	Chip	41-50	3.58
5	Northcote	Chip	51-60	4.35
6	Northcote	Chip	>60	4.82
7	Northcote	Slice	17-20	3.58
8	Northcote	Slice	21-30	4.06
9	Northcote	Slice	31-40	4.04
10	Northcote	Slice	41-50	3.73
11	Northcote	Slice	51-60	3.62
12	Northcote	Slice	>60	3.52
13	Southland	Chip	17-20	4.14
14	Southland	Chip	21-30	4.28
15	Southland	Chip	31-40	4.78
16	Southland	Chip	41-50	3.50
17	Southland	Chip	51-60	3.57
18	Southland	Chip	>60	3.00
19	Southland	Slice	17-20	3.72
20	Southland	Slice	21-30	4.53
21	Southland	Slice	31-40	4.43
22	Southland	Slice	41-50	3.83
23	Southland	Slice	51-60	2.43
24	Southland	Slice	>60	3.39

KEY POINTS

There was a three-way interaction, shop-by-product-by-age for responses to the "How likely would you be to buy the nashi product for your child's school lunchbox?" question (P=0.050).

- The purchase intent of the nashi chip for a child's lunch box by Northcote adults aged 60^{+} years old was significantly lower than treatments 12,18 and 23. The mean score was 4.818 which represents a response of probably/definitely would not buy. The lower the mean score the more likely the product will be purchased.
- The Southland adults aged 51-60 years had the lowest mean score for intended purchase of the slice for a child's lunch box (2.429). This score corresponded to "may buy" and was significantly lower than treatment 2, 5, 6, 8, 13, 14, 15, 17, 20 and 21.
- The mean score of Southland adults aged 60+ years for intended purchase of the chip for a child's lunch box, was the second lowest (3.00). This score corresponded to "may or may not buy" and it was significantly lower than treatment 14, 15 and 20.

6.8.2 Demographics

Table 14a. Age Group of Adult Respondents.

Age Group	17- 20 years	21- 30 years	31 - 40 years	41 – 50 years	51 – 60 years	Over 60 years
Northcote	12.12	31.31	19.20	12.12	11.11	14.14
Southland	21.90	36.50	14.60	6.20	7.30	13.5

Table 14b. Age Group of Children Respondents.

Age Group	6 years	7 years	8 years	9 years	10 years	11 years	12 years	13 years	14 years	15 years	16 years	17 years
Heathdale	9.0	8.0	8.0	9.0	8.0	8.0	8.0	8.0	9.0	8.0	11.0	6.0
Waverley	7.77	7.77	8.74	12.62	11.65	6.80	8.74	10.68	4.85	7.77	8.74	3.88

Table 15a. Gender of Respondents.

Gender	**Male**	**Female**
Northcote	**41.4**	**58.6**
Southland	**41.7**	**58.3**
Heathdale	**51.0**	**49.0**
Waverley	**56.3**	**41.7**

Table 16a. Adults-Frequency of Fresh Fruit Consumption.

Frequency of consumption	**Daily**	**Several Times a Week**	**Weekly**	**Fortnightly**	**Monthly**	**Less than once a month**	**Never**
Northcote	**50.0**	**37.76**	**8.16**	**2.04**	**1.02**	**0**	**1.02**
Southland	**55.21**	**33.33**	**7.29**	**1.04**	**3.12**	**0**	**0**

Table 16b. Children-Frequency of Fresh Fruit Consumption.

Frequency of consumption	**Daily**	**Several Times a Week**	**Once a week**	**Once a Fortnight**	**Once a Month**	**Once a Year**
Heathdale	**64.00**	**27.00**	**5.00**	**1.00**	**3.00**	**0**
Waverley	**61.17**	**30.10**	**4.85**	**2.91**	**0**	**0.97**

Table 17a. Consumption of Fresh fruit Types.

%	Apples	Oranges	Pears	Bananas	Pineapple	Plums	Nectarines	Peaches	Nashi	Other
Northcote	**85.86**	**76.77**	**59.60**	**90.91**	**73.74**	**47.47**	**64.65**	**72.73**	**39.39**	**37.37**
Southland	**89.58**	**80.21**	**64.58**	**87.50**	**66.67**	**37.50**	**45.83**	**53.13**	**28.12**	**17.71**

Table 17b. Consumption of Fresh fruit Types.

	Apples	Oranges	Pears	Bananas	Nashi	Other
Heathdale	**95.00**	**85.00**	**67.0**	**81.0**	**29.00**	**69.0**
Waverley	**95.15**	**85.44**	**63.11**	**78.64**	**30.10**	**46.60**

Table 18a. Adults- Frequency of Dried Fruit Consumption.

Frequency of consumption	Daily	Several Times a Week	Weekly	Fortnightly	Monthly	Less than once a month	Never
Northcote	**7.29**	**18.75**	**27.08**	**18.75**	**19.79**	**2.08**	**6.25**
Southland	**9.68**	**18.28**	**20.43**	**21.51**	**21.51**	**2.15**	**6.45**

Table 18b. Children's- Frequency of Dried Fruit Consumption.

Frequency of consumption	Daily	Several Times a Week	Once a week	Once a Fortnight	Once a Month	Once a Year	Less than once a year
Heathdale	**6.00**	**14.00**	**23.00**	**15.00**	**28.00**	**2.00**	**12.00**
Waverley	**4.95**	**18.81**	**22.77**	**17.82**	**24.75**	**3.96**	**6.93**

Table 19a. Adults-Consumption of Dried fruit Types.

%	Sultanas/ Raisins/ Currants	Pears	Cherries	Apricots	Cranberries	Paw Paw	Dates/Figs	Other
Northcote	**80.41**	**21.65**	**11.34**	**73.20**	**4.12**	**18.56**	**42.27**	**26.80**
Southland	**77.66**	**13.98**	**9.57**	**59.57**	**1.06**	**12.77**	**25.53**	**17.02**

Table 19b. Children-Consumption of Dried fruit Types.

%	Sultanas/ Raisins/ Currants	Apple	Banana Chips	Apricots	Other
Heathdale	**70.0**	**22.0**	**31.0**	**50.0**	**19.0**
Waverley	**75.73**	**23.30**	**33.98**	**52.43**	**17.48**

Table 20a. Adults- Consumption of Dried fruit.

	By Itself	Ingredient in baked product	As a snackfood	In a mixture of dried fruit and/or nuts	In Muesli/ Breakfast Cereal	As part of mixed fruit in a muesli bar	Other
Northcote	**65.98**	**32.99**	**43.30**	**30.93**	**51.55**	**24.74**	**0**
Southland	**55.91**	**33.33**	**44.09**	**18.28**	**45.16**	**17.20**	**0**

Table 20b. Children- How/When do you eat Dried fruit?

	By Itself	In Muesli/ Breakfast Cereal	In a Muesli Bar	In a Biscuit/ Cake or Bun.	As a Snackfood	Other
Heathdale	**75.00**	**49.00**	**50.00**	**42.00**	**39.00**	**1.00**
Waverley	**78.64**	**35.92**	**39.81**	**37.86**	**32.04**	**0.97**

Table 21a. Consumption of Nashi Pears

	Yes	No
Northcote	**51.04**	**48.96**
Southland	**42.39**	**57.61**
Heathdale	**37.00**	**63.00**
Waverley	**33.33**	**66.67**

Table 22a. Adults- Frequency of Nashi Consumption

Frequency of consumption	Daily	Several Times a Week	Weekly	Fortnightly	Monthly	Less than once a month	Never
Northcote	**3.19**	**6.38**	**3.19**	**7.45**	**19.15**	**12.77**	**47.87**
Southland	**1.10**	**7.69**	**6.59**	**5.49**	**13.19**	**8.79**	**57.14**

Table 23a. Adults- Consumption of Snack foods

	Potato Chips	Rice Crackers/ other plain biscuits	Muesli Bars/ Fruit Bars	Chocolate	Corn Chips	Other Flavoured Snacks (eg cheezles)	Nuts	Other
Northcote	**42.86**	**59.18**	**43.88**	**68.37**	**36.73**	**25.51**	**66.33**	**11.22**
Southland	**59.38**	**62.50**	**48.96**	**66.67**	**48.96**	**27.08**	**59.38**	**10.53**

Table 24a. Adults -Frequency of Snack food Consumption

Frequency of consumption	Daily	Several Times a Week	Weekly	Fortnightly	Monthly	Less than once a month	Never
Northcote	**23.66**	**40.86**	**20.43**	**8.60**	**5.38**	**0**	**1.08**
Southland	**29.79**	**44.68**	**18.09**	**4.26**	**3.19**	**0**	**0**

Table 25a. Primary Shopper in Household

	Yes	No
Northcote	**70.1**	**29.9**
Southland	**50.0**	**50.0**

Table 26a. Household Composition

	Single	Couple	Family	Shared
Northcote	**17.53**	**18.56**	**39.18**	**24.74**
Southland	**7.37**	**23.16**	**30.53**	**38.95**

Table 27a. Number of Children In Household

	0	1	2	3	4	5+
Northcote	**52.58**	**14.43**	**20.62**	**10.31**	**1.03**	**1.03**
Southland	**61.70**	**13.83**	**14.89**	**6.38**	**2.13**	**1.06**

Table 28a. Length of Time in Australia

	<1yr	1-5yrs	5-10yrs	10-15yrs	>15yrs
Northcote	**2.06**	**7.22**	**3.09**	**1.03**	**86.60**
Southland	**9.38**	**8.33**	**7.29**	**10.42**	**64.58**

Table 29a. Frequency of Reading Ingredients Lists on Food Packets

	Yes	Sometimes	Never
Northcote	53.33	40.0	6.67
Southland	52.22	38.89	8.89

Table 30a. Purchase intent with health promoting ingredients

	Yes	Maybe	No
Northcote	81.05	16.84	2.11
Southland	78.72	21.28	0

Table 30b. Purchase intent with Preservatives present

	Yes	Maybe	No
Northcote	20.0	58.95	21.05
Southland	23.91	60.87	15.22

Table 30c. Purchase intent with Vit C/ Ascorbic Acid (preservative 300) present

	Yes	Maybe	No
Northcote	65.26	29.47	5.26
Southland	73.12	23.66	3.23

Table 30d. Purchase intent with Citric Acid (preservative 330) present

	Yes	Maybe	No
Northcote	32.26	54.84	12.90
Southland	42.70	49.44	7.87

Table 30e. Purchase intent with Sulphur Dioxide (preservative 220) present

	Yes	Maybe	No
Northcote	11.70	55.32	32.98
Southland	14.13	59.78	26.09

Table 30f. Purchase intent with Flavours present

	Yes	Maybe	No
Northcote	32.26	45.16	22.58
Southland	41.49	39.36	19.15

Table 30g. Purchase intent with Colours present

	Yes	Maybe	No
Northcote	**26.32**	**40.0**	**33.68**
Southland	**36.17**	**39.36**	**24.47**

Table 30h. Purchase intent with Sugar present

	Yes	Maybe	No
Northcote	**34.74**	**42.11**	**23.16**
Southland	**38.30**	**41.49**	**20.21**

6.8.3 Comments Made By Consumers

6.8.3.1 Comments Made By Panellists

The Heathdale Children's' comments in relation to appearance, odour, texture and flavour characteristics of the value-added nashi products are presented in Table 1.0. A variety of comments, both positive and negative, were made.

Table 1.0: Heathdale Children's comments on the sensory characteristics of the value-added nashi products.

QUESTION	CHIP	SLICE
Q9. What did you LIKE and why?	**Flavour** Sweet flavour. (22) Not too sweet. Not as strong in taste as slice. Taste. (38) Tastes different. Flavour apart from sweetness. Definitely the taste. It has a burst of flavour. Lots of taste. Tasted like juice. Tastes minty and crunchy. Texture Very chewy. Chewiness. (22) Chewiness, keeps mouth busy. Chewiness is different and appealing. Initial chewiness. Chewy and nice. Not hard. Crispy but soft.	Flavour Sweet like dried apples. Sweet but also healthy. Sweetness. (24) It did not look sweet but when I tasted it, it was sweet. A lot of flavour. Taste. (31) Tasty. (7) Great taste. (2) Tasted like a fresh Nashi. Tasted like apple/pear. Taste like fruit toothpaste. Retains the fruit flavour. (2) Tastes a bit like apricot. Tastes like a healthy snack. Leaves a good aftertaste. Texture Great texture. (2) Not too chewy. (2) Chewiness. (15) Not as chewy as the chip. Softer and easier to eat. (3)

QUESTION	CHIP	SLICE
	Crunchy bits. (5) <u>Appearance</u> Shape. (3) Appearance. (2) Colour. (3) Pretty colour. Looks nice so I want to taste it. Appearance, looks nice and crunchy. It looks strange but I like the look of it. The lighter texture of the appearance. **<u>Odour</u>** Smell. Smelt like pineapple. **<u>Other</u>** It is fruit; it is healthy and tasty at the same time. It is easier to carry than fruit because you can carry in your pocket. Apples, and other fruit get squashed. The fizz of it. Nothing. (2) Healthy. (2) It was just nice. I like dried apples and this is similar. Everything. (2) Something different to what I normally eat.	Dry, not messy. Not grainy. Not as gritty as the chip. Grittiness. (5) Graininess – it's good when it's soft. Moistness. It is not runny. Personally I like squishy things and this is squishy **<u>Appearance</u>** Appearance. (2) Shape. (2) Inviting colour. Colour. (3) Colour is cheerful. Looks like potato chips. Could trick kids to eat them and they may like them. **<u>Odour</u>** Smell. (2) Smelt like peaches and I like peaches. **<u>Other</u>** Juicy. It's different, never seen anything like this, thicker than dried apples. Nothing. (3) It was filling. OK. Bite size pieces. It's different. Healthy.
Q10. What did you DISLIKE and why?	<u>Flavour</u> Taste. (5) Odd taste. Taste is not as good as the slice. Overall flavour. Disgusting taste. Dried, not much flavour. Too sweet. (8) It is less sweet than the slice. Doesn't retain a lot of the real flavour of fresh fruit. A tad sour.	<u>Flavour</u> Not enough flavour. (2) Taste. (5) Too sweet. (6) Sour taste at first. Strange Sour/bitter taste. **<u>Texture</u>** Too grainy. (11) Graininess felt like sand. Didn't trust the crunchy core. Not chewy enough. (2) A bit too chewy. (2)

QUESTION	CHIP	SLICE
	Texture Too grainy. (4) Too gritty. (6) The crunchy texture. Texture a bit rough. Gritty, hurt my tongue. Bumps are annoying. Grainy bits. Looks too dry. Too tough to bite. Chewiness. (6) Too chewy. Too hard. (2) The chewiness became annoying. (2) **Appearance** Appearance. Thin. (3) Too small. Colour. The colour green. The brown colour in the middle around the core. **Odour** Smell. (3) Had no smell. **Other** It is different to what I normally eat. Should be natural. I don't like sugar added. The after effect. Nothing, it's all good.	Chewiness. It was not dry enough. Too dry. (2) Squeezes up all the time. The dryness on the outside but softness inside. **Appearance** Appearance. (5) Too thick. Colour, prefer green. (2) Colour. (3) Colour too brown. Make colour darker. Looks like 'plate' (teeth) Looks too wrinkly. Wrinkly and dry appearance. Looks yuk cos it's all mangled up sort of. Soft and shrivelled. Didn't look too appetising at first. It looks like a banana. **Odour** Smell. (5) **Other** All of it. (3) Too much would be sickening. Gets stuck in my teeth bands.
Q13. Product Name?	Dried nashi chips (6) Dried Nashi. (4) Nashi chip. (111) Nashi Chip Chews. Nashi chew. (2) Nashi Mashi Nashi Yum Chewy chips. Chewy Nashi Dried. Apple stew. Silly. Nashi Crisps. Chewy Nashi Snack. Chewy Sweet Pear Chips. Sweet Bites.	Dried Nashi. (2) Nashi Slice. (10) Nashis. Nashi Mashi. Nashi Pears.(2) Greenie (2) Yellow squiggles. Sweet Grit. Dried Chewier Nashi. Fat Food. Tasty. Nachi C's Sweet pear. Nashitastic. Nashi strips.

QUESTION	CHIP	SLICE
	Sweet and Dry. The Chewy Nashi Fruit. Dried Nashi Pears. (4) Dried Nashi snacks. Dried Nashitrific Pears. Nashi Pear Chip. New Nashi Chips. Very very nice fruit. Lemon Lime. Nice Nashis. Brent Chip. Yummy Nashi. Nashi thinned. The name doesn't matter. Smashy Nashy Dry. Tasty flavour-filled dried Nashi treats. Fruit-in-a-chip – Nashi. Full-flavour Nashi Chips. Sweet Apple. Crunchy Fruit.	Nashi Bites. Smashi Nashi Slices. Nashi Chews. Sweet Bites. Sweet Slice Yellow Dried Nashi Fruit. Yummy Fruit. Yummi Nashi. New generation of Apple. Crunchy Teeth. Big Dried Nashirific Pears. Nice Nashis. Brent Slice. Nashi Delight. Chewy Nashi Slice. (2) Nashi Rings. Nashi Pieces. Chewy Sweet Nashi Delights. Nashi Snack. Nashi Apple Nice 'n' sweet Nashi Slice. Apple chips. Juicy pears /dried first. Chewies.
Q14. Changes?	<u>Flavour</u> Make sweeter. (3) Make it less sweet. (4) Make a fraction sweeter. Maybe add sugar or flavour. Needs more flavour, freshness. More flavour. Make less bland taste Taste. (5) Taste more like apple. More salt. **<u>Texture</u>** Make it softer. (2) Make it smoother. Not as hard and grainy. Less gritty. (7) Grittiness Make it crunchier. (2) Make it more crispy. It looks crispy but when you eat it, it is not what you expect. Make less chewy. (2) Make more juicy. **<u>Appearance</u>** Prefer it bigger, thicker. (5)	<u>Flavour</u> Make it sweeter. (3) Make it less sweet. (2) Make less sour. Increase flavour or sugar. **<u>Texture</u>** Make less grainy. (9) Make a more consistent texture. Make more chewy. (5) Make less chewy. (3) Chewiness. Make crispier. Dry it more. Put juice in it. (2) **<u>Appearance</u>** Make thinner. Make thicker. Make a bit bigger. Make it smaller. (2) Make darker green. Make dark yellow. Make darker colour. Need more colour. Make it a funky colour like purple or red.

QUESTION	CHIP	SLICE
	Make thinner. Make it a bit smaller. (3) Colour. (4) Make darker in colour. Make it green. Make colour darker. Make colour a darker yellow. Shape **Odour** Make it smell sweeter. **Other** No change. (21) Put juice in it. Change it to red and make it taste like strawberries.	Make less brown. Make it darker brown. Shape. (3) Make it round. Too wrinkly, make it round like a do-nut. Make less wrinkled. Appearance. (3) Cut it as a straight 'finger' rather than a slice. **Odour** Smell. **Other** No change. (20) Everything.
Q15. Other comments?	I liked the slice better. (4) I liked it better than the slice. It has no smell. Way to go! I like it because it is healthy and nice. It is strange because I haven't tasted it before. Overall it was really nice. I've never had dried Nashi before. Stick to the normal nashi pear. It would be good in strips. It's not too bad mate! It is very nice, I like it a lot. Good job, well done, but it makes you very thirsty. Really nice, you should try it. Yum! Yum! Yum! Quite Yum. Not enough to eat. Though it was dried it still had flavour. It Rocks! Not too crunchy but not too soft! Delicious. Overall it was ok. Overall it was very good. I like it. It was very nice. (3) I would recommend it to others to try.	It does not smell. Nice. (5) Tastes yummy. I liked it. Yummy. I preferred the chip. It was nicer than the chip. (2) I like the way it appears like an apple. I've never heard of it before but it is nice. It's all good. Yummy for my Tummy. I really like it. This is the first time I have eaten it. Yum! Yum! Yum! I would buy it from the canteen if it didn't cost too much. Little bag-60c, large bag –90c. It was pretty good. It was very nice of you to select me to try this wonderful product-thankyou. Should have a variety of shapes. It was ok. I would eat it again. I have not seen it before. Where can I buy it? I really liked it and there is nothing bad I could say about it-delicious. Tastes beautiful. A really good idea.

The Waverley childrens' comments in relation to appearance odour, texture and flavour characteristics of the value-added nashi products are presented in Table 2.0. A variety of comments, both positive and negative, were made.

Table 2.0. Waverley Children's comments on the sensory characteristics of the value-added nashi products.

QUESTION	CHIP	SLICE
Q9. What did you LIKE and why?	Flavour Taste (31) Good Flavour. (3) Very tasty. (2) Had a kick to it in the mouth. Sweetness. (16) Very sweet. (3) Not too sweet (3) Natural sweetness, less sugar sweetness. Sweeter than the slice. Tastes like apples. (2) Tasted like pear. Nearly tasted like a nashi pear. (2) Tasted better than the slice. A bit like a sultana. (2) Nice aftertaste. Freshness. Flavour stays in the mouth after eating. Not boring. It was food and I was hungry and it didn't taste too bad. **Texture** Chewiness. (15) Chewier than the slice It was not too chewy. Crunchy. (2) Not too crunchy. (2) Not as crunchy as it looked. Not hard. (3) Hard like nuts. Feels nice in my mouth. Grittiness made it different. Feels nice. **Appearance** Appearance (7) Thinner than the slice. (2) Colour. (3) Colour looks like apple. Colour looks like fresh nashi. Shape. It looked crunchy.	Flavour Taste was ok. Taste. (29) Tasty. Good flavour. (3) A little sour. Sweetness. (24) Like pineapple and I like pineapple. Tastes just like nashi pear without the hassle of the dripping juice. Tasted like apple. (3) Tasted like apple danish. Tastes like real fruit- no artificial flavour. **Texture** Chewiness (12) More chewy than the chip Grittiness. (3) Not very grainy. Soft. (5) Soft and mushy. Overall texture Thicker that the chip. Not tough. Juiciness. (2) Moistness when chewing. Thickness Feel. **Appearance** Looks nice. (6) Thicker than the chips. (2) Colour. (3) Oval shape It was bigger and thicker. Not too big to eat. Size. Looks healthy (2) **Odour** Odour (4) Like pineapple. Smelt like apples.

QUESTION	CHIP	SLICE
	Looks like dried banana. Looks like a potato chip. **Odour** Smells good (2) **Other** Everything It is different to other snacks. Nothing (2)	**Other** It is healthy. (2) Easy to carry around. No core. Different to other snacks. Everything. Nothing. (6) Yummy. (2) Very Good. A general afternoon snack. Fruit. Great! Yum! Yummy. It was edible
Q10. What did you DISLIKE and why?	Flavour Taste Tasted weird. A bit too sweet. (5) Too sweet. (4) Sweetness. Not sweet enough. It was a bit off. Different It looked better than it tasted. **Texture** Grittiness (11) Too chewy. (8) Too hard. (2) Dried. Rough on my tongue at first. Made mouth feel dry afterwards Stickiness. **Appearance** Appearance (3) Colour. Colour too light (2) Shape Too small. **Other** A bit hard to swallow	Flavour Taste (10) I don't like dried fruit. Not really like a nashi pear. A bit sweeter than the chip Too sweet. (5) Bit too sweet. (4) Not sweet enough. A funny aftertaste. It's fruitiness **Texture** Too gritty. (7) Slightly too soft. Chewiness (3) Too chewy. (2) Bit too dry. (2) Too moist **Appearance** Appearance. Shape Shape –looks like a C Appearance. (5) Curliness in the shape Thickness – too chunky. **Odour** Smells bad. No smell
Q13. Product Name?	Soft Chips Nashi chips (13) Semi Moist Nashi Slice (2) Dried Nashi Chip (5)	Nippies Yuchy Chewy Nashi Slices. Nashi Slice. (4)

QUESTION	CHIP	SLICE
	Dried Nashi Fruit. Dried Nashi. Nashi Pear. Dried Sweet Nashi. Pear Chips Dried Pear. (2) Dried flat Nashi Pear. Tweety chips. Yummy chips Nashi Flakes. Crunchy Pear Sweetie pears. Sweet pears. Chewy Chip. (2) Nashi Potato. Sultana Chips. Chewy Nashi Pear. Chew Nashi. Sweet Dried Nashi Pears. Nashi Crunch. Nashed. Shape Nashi chips Pale Chew. Nashi Nice-as-Chips Nashi Toughs. Tasty Chips. Dried McApple. Fruity Fruits Nashi Fruit bite. Pear and Apple Fruit Chips Apple Chips Nutritious Nashi Chip Nashi Ness Yum Yum Snack.	Nashi Nice Slice Dried Pear. (2) Semi Moist Nashi Slice. (2) Dried Nashi Pear. (6) Dried Nashi. (2) Dried Nashi Fruit. Nashi Snacks. (2) Nashi Chip Happy pineapple Pineapple Chew. Golden Pear. Dried Crunchy Nashi Pears Apple Chews. Apple Pear Nasty Nashi Squishy Cewy Chips. Nashi Apple Slice. Sweetie. Sweet Chew Slice Sweet snacks. Chewy Pear. Curly Fruit. Oval Shaped Chip. Sun Showers Soft Nashi Pear. Chip Bananas. Sweet Nashi Pears Sweet Nashi Pear Slices. Sweet and Sour Nashi Slice. Nashed? Slices of Nashi Nashi chew Softened Nashi Dried Chewy Nashi Sweetie Chew. Light ‘n’ Nice McApple Floppy Joe Nashi Wedges. Tangy Delicious Nashi Nashi Slice Bites Chewy Nashi Chewy chips Nutritious Nashi. Nummie Nashi Tasty Yum Food.
Q14. Changes?	<u>Flavour</u> Make a little sweeter. (3)	<u>Flavour</u> Flavour. (2)

QUESTION	CHIP	SLICE
	Make less sweet. (6) Aftertaste is a bit funny. Taste. Make it like chocolate. **Texture** Make more crunchy (2) Make less crunchy. Make a bit smoother. Make less gritty (6) Make more mushy. Make less chewy. (3) Make more chewy. Chewiness. Chewiness needs to be crisp like a potato chip. Make it softer. The flexibility. **Appearance** Appearance To look more like mandarin Make more like a potato ship. Colour (3) Make different colours. Change colour to red. Shape, to make it more attractive. Make it round. (3) Make it a triangle. Make it a bit bigger. (2) Make it flatter. Make the shape uniform –circles or squares. **Other** The name No change (16) Packaging.	Increase flavour. Make less sweet. (8) Make sweeter. (5) Make it a little sour. Make it taste more like a pear and less like apple. **Texture** Texture. (2) The inside had good texture but outside was gritty. Make it like an apple - less gritty. Soften the texture to be more like dried apple. More moisture. Less moisture Make less chewy. (3) Chewiness. (2) Make less gritty. Less mushy. Make a little bit juicer. **Appearance** Appearance. (2) Make it not yellow Make it into a J shape. Make it less crinkly. Make it a circle. (4) Make it not so round. Make less curly. Make it a bit thicker. Make it look fresher. Make it bigger. (2) **Other** Nothing (14) Cover it in chocolate. Everything The packet. (2)
Q15. Other comments?	Tastes like pears. Another good product but the slice was juicier. I liked the flavour better than the slice. This was better than the slice. (2) Yummy. Nashis still taste better fresh than dried. It could come in sour, sweet and super sweet.	Chip tasted nicer but slice texture was better. Can you give me some more? A good product to pursue. Reminds me of alphabet letters. Smells like pineapple. The smell reminded me of watermelon and I like watermelon. I thought they would have been crunchier from the appearance. Looks appealing.

QUESTION	CHIP	SLICE
	Beautiful! It is good for me. Healthy, makes people strong. Healthy for babies. Everyone would like it. It is beautiful. Totally delicious. The packaging looks dodgy. Change it so that it does not look so cheap. Smelt like apple. Should have a bright package to sell it. People would eat as dried fruit but not if there was chocolate around. It was very nice.	It is yummy. Yummo! Well done. Thanks. Not keen on dried fruits but I like this. Totally delicious. Can't eat too much at a time because it's too sweet and tastes artificial.

The Southland panellists' comments in relation to appearance odour, texture and flavour characteristics of the value-added nashi products are presented in Table 3.0. A variety of comments, both positive and negative, were.

Table 3.0: Southland Comments on the sensory characteristics of the value-added nashi samples.

QUESTION	CHIP	SLICE
Describe what you LIKED about this product.	<u>Flavour</u> Flavour (39) Heaps of flavour. Tasty (4) Not too strong. Not too sweet. Sweetness. (9) Not as sweet as the slice. Just like fresh fruit but dried. (4) A lot like the slice. Natural. (3) Like dried apples. Tangy Aftertaste. (3) Unique. **<u>Texture</u>** Texture (8) Flesh feel. Easy to eat. (2) Not too chewy. (2) Chewiness (12) Not greasy. Harder. Good to digest.	<u>Flavour</u> Flavour (26) Fresh flavour (4) Moderate flavour. Initial flavour. Really delicious flavour. A lot of flavour from a small slice. Tastier than chip. Almost like it was not dried makes me think it is more healthy. Subtle Sweet aftertaste. Not too sweet. (3) Sweet enough to replace chocolate or lollies. Sweetness. (10) Fruitiness (2) Real nashi flavour. (2) Initial flavour was a pleasant surprise given the lack of odour. Very long lasting taste. Aftertaste. (2) No aftertaste. No oily aftertaste. Clean refreshing aftertaste.

QUESTION	CHIP	SLICE
	Drier and lighter. Drier than the slice. **Appearance** Looks good. (4) Appearance more appealing than slice. Colour Size. (3) **Odour** Odour. (2) Better than the slice. **Other** Nothing Everything. Convenient bite size pieces. Convenient. Healthy food. (6) Can be eaten with cereal or as a snack. Good for a snack. Different. Refreshing. (2) Would take on trips of shopping rather than sweets or sandwiches. Texture allowed me to experience the flavour for longer.	Aftertaste was amenable, not like some dried fruits. Much nicer than dried apples. Better than the chip. (2) Tangy **Texture** Texture. (8) Pleasantly moist on the inside. Not too chewy. Chewiness. (5) Easy to chew. Easy to chew with false teeth. Thicker slices. (2) Softer than chip. Softness. (3) Not too hard. Juicier than chip. (5) Nicer than the chip. Not sticky in the mouth. A little sticky. **Appearance** Appearance. (2) Looks fresh. (3) Size. (5) Colour. (2) **Odour** Smells nice and light. Not overpowering. Other Light on the tongue. Healthy food. (4) Convenient. (2) Easy storage. Different. (2) Good for snacks. (2) It can be eaten with cereal for breakfast. Everything. (3) Not much. (2) Pleasant to eat. It is fruit.

Consumer Comments on Value-added Nashi……Southland		
QUESTION	**CHIP**	**SLICE**
Describe what you DISLIKED about this product.	Flavour Flavour (4) Aftertaste (2) Too sweet. (8) Sweetness. A bit too sweet. (2) Too sweet to snack on large amounts. Strange taste once chewing begins. Aftertaste leaves a coating of heavy sugar. Aftertaste a bit 'fishy.' A bit like chemicals. **Texture** Texture Grittiness. (5) A bit too grainy. (3) Too chewy. (5) A bit too chewy. (2) Got stuck in my teeth. (3) Too dry. (4) For older people –a bit too dry. Moist and sticky- as a chip you expect it to be crispier. (2) A little tacky. Sticky in the hand. **Appearance** Appearance. Colour. Yellow colour. Colour did not look healthy. Too pale in the middle. Colour too pale. More definite colour. (2) The green bits on the sides. (2) **Odour** Maybe a bit 'pungy'. Lack of smell. (3) **Other** Not quite as nice as the slice.	Flavour Flavour (3) Lacks overall flavour. Stronger flavour. Too sweet. (8) A little too sweet. (5) Diabetes sufferer – a little too sweet. A little bitter. Sweet aftertaste. Aftertaste. Different taste. **Texture** Texture (2) Too moist. (3) A bit too soft. (2) A bit too grainy. (3) Very grainy. (2) Sticky to touch. (2) Not chewy enough to be dried fruit. Not chewy. Gets stuck in the teeth. Pips. Appearance Appearance. (3) Looks a bit like worms. Shrivelled –even though it is expected from dried food. Colour too light. Colour too dark. Colour weird. **Odour** The aroma does not stimulate the senses. No smell. (2) **Other** Packaging. Couldn't eat a lot.

Consumer Comments on Value-added Nashi……Southland		
QUESTION	**CHIP**	**SLICE**
Would you consider this a HEALTHY snack food?	Yes Because it is real fruit. A good snack for busy people. **Maybe** Depends on sugar content and preservatives. Print nutritional details onpack. **No**	Yes Because it is dried fruit. It is fruit and not artificially sweetened. How much sugar? (2) If there are no additives. While it is a healthy snack-food, I think it is concentrated sugar, so I'd try not to over indulge – very tempting to do so. Maybe Put info on the package. Depends on sugar content and preservatives **No** Dried fruit contains too much sugar.
What suggestions can you provide to IMPROVE this product?	Flavour Make it sweeter. (2) Increase flavour Make it less sweet. (2) Keep it less sweet than the slice. **Texture** More texture. Remove some of the grit. (6) Make less sticky. (2) A bit drier. (2) Needs to be easier to chew, especially for kids or they will lose interest. Make less chewy. (3) Make more chewy. Make it crisp like a chip, less moist and less sticky.- the name is misleading because it is not crisp. (2) Make it thicker. **Appearance** Appearance. Colour. (3) Less green/yellow. Don't include broken pieces. Change shapes to animal shapes to attract kids.	Flavour Increase flavour. Reduce sweetness. (8) Increase sourness. **Texture** Make a little harder. Make drier. (3) Less grainy (2) Make less sticky. Make more chewy. **Appearance** Different colour. Colour. Add colour. (3) Brighten the colour. Colour more natural, less yellow. Make it less squishy looking in the packet. **Other** Packaging and presentation to relate to healthy and/or happy overweight people. Packaging (6) Package for 150 gm.

Consumer Comments on Value-added Nashi……Southland		
QUESTION	**CHIP**	**SLICE**
	Make larger pieces and whole circles. Smaller pieces to put on cereal. Take off the green peel. Add colour. **Odour** Give it odour. **Other** Mix it with other dried fruits. Don't use preservatives. Dehydrate naturally. Improve the packaging. (4) Put nutrition on pack.	Package it as a single item, as per sample. Put recipes on the pack, which includes the product. Kids would like the sweetness. Promote healthiness. Organic would be great. To be naturally rather than artificially de-hydrated.
Other comments?	Very capable staff to demonstrate your fruit. This is like comparing Australian dried apricots to Turkish. I know the Aussie ones are better value for money, because they are more dehydrated, but the Turkish ones are softer and easier to eat, so the kids prefer them. Delicious. (2) Good with peanuts and beer. A great product. Don't make it too expensive. People are looking for healthy food, not too much sugar. Organically grown would be a big selling point at the moment. Packaging – associate different animals and colours with different size packets. Overall nice. I like the chip better –it is more like dried fruit. Thanks for the special treat at the end. Advertise it. Nice in chocolate bars. Perfect. A good experience. Slice and chip could be marketed as one product, they are so similar. No sulfur for the environment. (2)	It's delicious. I'd certainly buy it, depending on price. Sweetness may limit how much you eat. Include dried strawberry. It's fantastic. Knowing how healthy it is (or isn't) would weigh heavily on it's appeal. Not as tasty as the chip. Get it on the market soon. Lovely genuine nashi flavour. Should sell well. Nice to have something different other than the usual dried fruits. Don't make it too expensive. (2) Very enjoyable. It's perfect. This is delicious as well. I love it! Delicious. (2) Very delicious. I am happy with the product. Very appealing. Very nice indeed. I could see myself eating it with peanuts and a beer.

Consumer Comments on Value-added Nashi……Southland		
QUESTION	**CHIP**	**SLICE**
	Keep it natural.	

The Northcote panellists' comments in relation to appearance odour, texture and flavour characteristics of the value-added nashi products are presented in Table 4.0. A variety of comments, both positive and negative, were made.

Table 4.0: Northcote panellists' comments on the sensory characteristics of the value-added nashi products.

Consumer Comments on Value-added Nashi		**Northcote**
QUESTION	**CHIP**	**SLICE**
Describe what you LIKED about this product.	Flavour Flavour (35) Tasty (5) Not too sweet. (5) Sweetness (11) Aftertaste. (3) Fresh. Very accurate. Moderate sweetness. Different. (4) Fruitiness. (2) Tasted very like nashi. The bit of tang. (3) Tingly. A little sourness. **Texture** Texture (11) Gritty/grainy. Easy to eat. (2) Not as chewy as the slice. Chewiness. (7) Not too grainy. Not too hard. Not too dry. Just right for a dry product. Texture says it is real fruit – very important. **Appearance** Attractive. (2) Appearance. (2) Fresh appearance. Fresh colour. Colour. (3) Looks like apple chips.	Flavour Flavour. (27) Tasty. (5) Better flavour than chip. Clean. Sourness. Interesting. Different. (2) Simple. Sweetness (12) Fruitiness. Strong nashi flavour. Fresh fruity that hinted of juiciness. Almost like fresh nashi. (2) Natural flavour. (4) Not too sweet or sour. No aftertaste. Aftertaste (2) Made me want more. Better than I expected. Fresh. **Texture** Texture. (10) Flexibility. Better texture than chip. Chewiness (7) Crunchiness. Seemed quite fresh, not as dry as chip. Lovely soft moist texture. Softness. Combination of softness and grittiness. Moisture content. (2) Not too dry. (5)

Consumer Comments on Value-added Nashi		**Northcote**
QUESTION	**CHIP**	**SLICE**
	Looks delicious. Reasonably appealing. Looks healthy. A small piece if green rind looked attractive. Served on a white plate made it look insipid. Size of pieces. (2) **Other** Everything. Has the sweetness and gritty texture that makes fresh nashi appealing. Better than potato chips. Would mix well with nibbles. Snackable. I've never tried anything like this and enjoyed it. Healthy snack. (3) Healthy, didn't feel like I was eating something with added sugar and preservatives, natural. Feels healthy. Convenience. (2) Don't have to peel it. Versatile snack. Nutritional. Easy to digest. The fact that it is fruit. Refreshing. Tangy. Uplifting. Surprising that it is classed as a chip. Prefer the dried fruit to the fresh.	Not too sticky. Thicker than chip. (3) Felt good. Not hard to swallow. Wasn't chewy and easy to eat. Didn't get stuck in the teeth. The way it softens in the mouth. **Appearance** Appearance (4) Appealing. Colour. (6) Fresh colour Not too dark Size (3) Still looks like fruit. Plump. **Odour** Like fresh nashi. Other Nothing. Not much. Everything. A pleasant change from dried apples and mango. Healthy Snack. (4) Fresh and great for a snack food. Healthy alternative to greasy snacks. A good snack. (3) Bite size pieces. Easy to handle as a food snack. Don't need to peel it. Convenient snack. Flavour ok but not as good as chip. Very snackable.

Consumer Comments on Value-added Nashi		**Northcote**
QUESTION	**CHIP**	**SLICE**
Describe what you DISLIKED about this product.	Flavour Flavour. Aftertaste. (3) A bit too sweet. (4) Too sweet. (4) Too plain. (2) Too plain to eat a whole packet. Not sweet enough. (2) Slightly chemical artificial taste. A bit too much like confectionary. **Texture** Grittiness. (7) A little too grainy. (3) If this is a chip, why does it bend? -fried chips should be brittle and able to break. This is just like the slice only thinner. Too dry. (4) Too thin Too coarse. Very sticky. (2) Sticky on fingers. The chips don't taste like chips. Too chewy. (7) Not chewy enough. Sour aftertaste. Too hard. (2) Feels hideous in the hand, like plastic fruit. Gets stuck in the teeth. Not real good for people with no teeth. **Appearance** Appearance. It doesn't look as it tastes. Shrivelled. Too thin. Looks too grainy. Colour too pale. **Odour** No odour. (2) **Other** Is it a chip or dried fruit? Tastes like fruit so 'nashi chip' name is misleading. The packaging. Fried.	Flavour Flavour. Aftertaste. (3) Sweetness. A bit too sweet. (8) Too sweet. (8) Far too sweet. Could get sickly. (2) Not enough flavour. Initial taste seemed like over ripe fruit. Maybe too fruity. **Texture** Texture. Texture really put me off. Feel. Initially gritty before the flavour came through. Too gritty/grainy. (5) Far too grainy. Too chewy. (2) Far too chewy. Chewiness. Not chewy enough. Sugary coating. Too squishy. Too fleshy. A bit sticky to touch. Wanted to wash hands. (2) Too thick. Too tough for people like me with no teeth. Too tough. Appearance Appearance really put me off. Looked like shrivelled up baby ears. Too small. (2) Looks like banana. Colour. (2) The colour green. Does not look very appealing. (2) Lack of colour. **Odour** Too little. (2) **Other** Nothing. ~~Nothing really, would not like it~~ any sweeter. Not enough of it!

Consumer Comments on Value-added Nashi		**Northcote**
QUESTION	**CHIP**	**SLICE**
Would you consider this a HEALTHY snack food?	Yes If not artificially sweetened. Not as sweet as the slice. If organic, no pesticides/herbicides and free from GM. **Maybe** If it is not fried like potato chips. Depends on how it is made. Don't know how it was produced and cured. **No** Too dry with substantial sugar, which makes it, seem unhealthy. Too much sugar.	Yes Depending on the drying process, but more so than processed foods. If no added sugar. If free from preservatives and artificial colours. I am a diabetic and need to know what goes into the sweetness and ingredients. A healthy alternative. **Maybe** Sugar? Don't know how it was produced / cured.- preservatives etc. Too sweet. If organic and free from genetic modification. **No** Too much sugar.
What suggestions can you provide to IMPROVE this product?	Flavour Needs more flavour. (2) Could they be salty? Make less sweet. (5) Make sweeter. Improve aftertaste and flavour. **T** **exture** Make it moister. (3) Make it dryer. Give it more body. Slightly less grainy. (3) Get rid of the grit. Expected it to be crisper because they were called chips. (2) Dry it till crisp…there is little difference from the slice. (2) Maybe coat it with something to prevent sticking together. Make less sticky. Make less chewy. (2) Make it chewier. Make it harder, crunchier. Make not so rough. Make thinner. Not so many little crumbly bits in	Flavour Less sweet. (10) If the sugar was added, cut it out. **Texture** Make less sticky to touch. Decrease grit and grain. Easier on the teeth if there was no grit. Make it softer to chew for people with no teeth. Make a bit chewier. Less chewy. More chewy. Slightly more chewy. Smoother. Make crispier. (2) Make less squishy. Make it more like the chip, drier. Cut it thinner. **Appearance** Add colour (2) Improve colour Lose the shrivelled look. Make it bigger. (2)

Consumer Comments on Value-added Nashi		**Northcote**
QUESTION	**CHIP**	**SLICE**
	the bag. Make it crunchier like a potato chip. **Appearance** Overall appearance. Cut thicker. Add a tinge of green. Colour needs to be darker, more attractive Odour Increase smell. **Other** More accurate naming. Some people expecting a chip might be put off by lack of crunchy and crisp texture. Packaging. (12) Packaging looks cheap. Needs an 'image' for kids. Change the name. Better name brand. Use by date. Company name and address. Groovy packaging. Vacuum sealed. Picture of the fruit on the packet. Add nutritional information. (4) Add ingredient details. (3) Calories on the pack. Preferred the slice. Environmentally sound packaging. Have it available as organic and free from GM. Good idea to sell in snack pack size and in chip aisle for kids, but needs to be crunchier so they will buy it.	Make it thinner. **Odour** Increase. (3) **Other** Nutritional information. (3) Indicate calories on the packaging. Ingredient listing. Better packaging. (7) Don't turn it into a normal product / the healthy market you are aiming for is a conscious one. Groovy print on packet / vacuum sealed / retro market /yuppie image. Have the option to be organic and free from GM. Powder it for sprinkling on cereal.
Other comments?	Very palatable. Prefer the slice. (3) Don't make it too expensive. They should be called Tasty Nashi Chips as these are not chips. Target the teenagers. It is a 'product' instead of a food type.	Nice innovation. Would use it quite a lot if cost was reasonable. Package should be a different colour to the product –darker – plum, maroon. Excellent. Perfect. Quite impressed.

Consumer Comments on Value-added Nashi		**Northcote**
QUESTION	**CHIP**	**SLICE**
	Quite lovely. Don't put artificial ingredients in it. Aim at the young people and kids. Would be nice in muesli or cereal. Fabulous product. Overall fantastic. It's a winner. It is perfect. Good idea. Get into other fruits too and make it 97% fat free for the ladies. Would be good added to cereal in the mornings. Good product. (2) I loved it. Keep prices cheap.	Did not really taste of Nashi- much too sweet. Much better than the chip. Chip was much better. Nice but not for me. Develop a commercial generated toward young people and kids. Acceptable product. Healthy. Extremely yummy and delicious. I could have had more. Nice taste, shame about the ears (appearance). I want to trial it on the family. Need to have a cool picture(cartoon) to sell it to kids. Excellent product. No complaints, everything is perfect. I'm not a parent but I think not having any smell would be an advantage with kids. Put it in LeSnack, muesli bars and dried fruit section of supermarket. I believe it will be fantastic on the market. Loved the see through packaging, can see any flaws in the product. Keep prices in check, no need for greed. Prefer the orange packaging to the green. Seems like a useful product. Put a picture of the whole fruit on the packet. Better than other products. Good. I'd buy it! More flavour-some than the chip, nicer.

6.8.4 Questionnaires

6.8.4.1 Adult Questionnaire

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CSIRO AFISC Australian Food Industry Science Centre

SENSORY EVALUATION OF NASHI PRODUCTS

NAME: _____**(optional)** **POSTCODE:**_____

DATE: _____ **TIME:** _____

Please ensure that you answer all questions by colouring in the box completely.

1. GENDER:

☐ Male ☐ Female

2. AGE:

☐ 17-20 years ☐ 21-30 years ☐ 31-40 years
☐ 41-50 years ☐ 51-60 years ☐ Over 60 years

3. What types of FRESH fruit do you eat? (can select more than one)

☐ Apples ☐ Oranges ☐ Pears
☐ Bananas ☐ Pineapple ☐ Mango, Melon
☐ Plums ☐ Nectarines ☐ Peaches
☐ Nashi ☐ Other (please state)_____

4. How often do you eat FRESH fruit?

☐ Every day ☐ Several times a week ☐ Once a week
☐ Once a fortnight ☐ Once a month ☐ Once a year
☐ Do not eat

5. What types of DRIED fruit do you eat? (can select more than one)

☐ Sultanas/Raisins/ Currants ☐ Pears ☐ Cherries
☐ Apricots ☐ Cranberries ☐ Paw Paw
☐ Dates/ Figs ☐ Other (please state)_____

6. How often do you eat DRIED fruit?

☐ Every day ☐ Several times a week ☐ Once a week
☐ Once a fortnight ☐ Once a month ☐ Once a year
☐ Do not eat

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7. How do you eat DRIED fruit? (can select more than one)

☐ By itself ☐ Ingredient in baked products.
☐ As a snackfood ☐ In a mixture of dried fruits and/or nuts
☐ In muesli/ breakfast cereals ☐ As part of a mixed fruit in a muesli bar
☐ Other (please state)_____

8. Do you eat FRESH and/or DRIED nashi?

☐ Yes ☐ No

9. If you eat nashi, how often do you eat them?

☐ Every day ☐ Several times a week ☐ Once a week
☐ Once a fortnight ☐ Once a month ☐ Once a year
☐ Do not eat

10. What types of SNACK FOODS do you eat? (can select more than one)

☐ Potato Chips ☐ Rice Crackers and Other Plain Biscuits
☐ Muesli Bars / Fruit Bars ☐ Chocolate
☐ Corn Chips ☐ Other Flavoured Snacks eg. Cheezles
☐ Nuts ☐ Other (please state)_____

11. How often do you eat SNACK FOODS?

☐ Every day ☐ Several times a week ☐ Once a week
☐ Once a fortnight ☐ Once a month ☐ Once a year
☐ Do not eat

12. Are you the Primary Grocery Shopper in your household?

☐ Yes ☐ No

13. What type of household do you live in?

☐ Single person ☐ Couple
☐ Parent(s) with children ☐ Shared household

14. How many children live in your household?

☐ 0 ☐ 1 ☐ 2
☐ 3 ☐ 4 ☐ 5 or more

15. What is your cultural background? _____

16. Where were you born? _____

17. How long have you been living in Australia?

☐ Less than one year ☐ 1-5 years ☐ 5-10 years
☐ 10-15 years ☐ Over 15 years

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FOOD SCIENCE AUSTRALIA
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CSIRO AFISC Australian Food Industry Science Centre

CONSUMER EVALUATION OF DRIED NASHI CHIP PRODUCT

SAMPLE 001

Instructions

Please have some water before you start.

You will be presented with a Dried Nashi Chip sample. Evaluate the sample presented by smelling, examining and tasting it as appropriate. Please ensure that you answer all questions by colouring in the box completely.

Please examine the Dried Nashi Chip and evaluate the following characteristics:

OVERALL APPEARANCE

1. How much do you like the OVERALL APPEARANCE?

- ☐ Like Extremely
- ☐ Like Very Much
- ☐ Like Moderately
- ☐ Like Slightly
- ☐ Neither Like nor Dislike
- ☐ Dislike Slightly
- ☐ Dislike Moderately
- ☐ Dislike Very Much
- ☐ Dislike Extremely

COLOUR

2. How dark is this sample?

- ☐ Far too Pale
- ☐ Too Pale
- ☐ Just Right
- ☐ Too Dark
- ☐ Far Too Dark

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3. How much do you like the COLOUR?

☐ Like Extremely
☐ Like Very Much
☐ Like Moderately
☐ Like Slightly
☐ Neither Like nor Dislike
☐ Dislike Slightly
☐ Dislike Moderately
☐ Dislike Very Much
☐ Dislike Extremely

Please smell the Dried Nashi Chip and answer the following questions:

ODOUR

4. How strong is the ODOUR?

☐ Extremely Weak
☐ Very Weak
☐ Moderately Weak
☐ Slightly Weak
☐ Just Right
☐ Slightly Strong
☐ Moderately Strong
☐ Very Strong
☐ Extremely Strong

5. How much do you like the ODOUR?

☐ Like Extremely
☐ Like Very Much
☐ Like Moderately
☐ Like Slightly
☐ Neither Like nor Dislike
☐ Dislike Slightly
☐ Dislike Moderately
☐ Dislike Very Much
☐ Dislike Extremely

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Now please eat ALL of the Dried Nashi Chip and answer the following questions:

TEXTURE

6. How CHEWY is this sample?

☐ Nowhere Near Chewy Enough
☐ Not Chewy Enough
☐ Just Right
☐ Too Chewy
☐ Far Too Chewy

7. How GRITTY/GRAINY is this sample?

☐ Nowhere Near Gritty/ Grainy Enough
☐ Not Gritty/Grainy Enough
☐ Just Right
☐ Too Gritty/Grainy
☐ Far Too Gritty/Grainy

8. How much do you like the OVERALL TEXTURE?

☐ Like Extremely
☐ Like Very Much
☐ Like Moderately
☐ Like Slightly
☐ Neither Like nor Dislike
☐ Dislike Slightly
☐ Dislike Moderately
☐ Dislike Very Much
☐ Dislike Extremely

SWEETNESS

9. How SWEET is this sample?

☐ Nowhere Near Sweet Enough
☐ Not Sweet Enough
☐ Just Right
☐ Too Sweet
☐ Far Too Sweet

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10. How much do you like the SWEETNESS?

- ☐ Like Extremely
- ☐ Like Very Much
- ☐ Like Moderately
- ☐ Like Slightly
- ☐ Neither Like nor Dislike
- ☐ Dislike Slightly
- ☐ Dislike Moderately
- ☐ Dislike Very Much
- ☐ Dislike Extremely

OVERALL FLAVOUR

11. How much do you like the OVERALL FLAVOUR?

- ☐ Like Extremely
- ☐ Like Very Much
- ☐ Like Moderately
- ☐ Like Slightly
- ☐ Neither Like nor Dislike
- ☐ Dislike Slightly
- ☐ Dislike Moderately
- ☐ Dislike Very Much
- ☐ Dislike Extremely

AFTERTASTE

12. How much do you like the AFTERTASTE?

- ☐ Like Extremely
- ☐ Like Very Much
- ☐ Like Moderately
- ☐ Like Slightly
- ☐ Neither Like nor Dislike
- ☐ Dislike Slightly
- ☐ Dislike Moderately
- ☐ Dislike Very Much
- ☐ Dislike Extremely

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OVERALL ACCEPTABILITY

13. Overall, how ACCEPTABLE do you find the Dried Nashi Chip?

- ☐ Like Extremely
- ☐ Like Very Much
- ☐ Like Moderately
- ☐ Like Slightly
- ☐ Neither Like nor Dislike
- ☐ Dislike Slightly
- ☐ Dislike Moderately
- ☐ Dislike Very Much
- ☐ Dislike Extremely

14. Please describe what you LIKED about this product?

_____
_____
_____
_____

15. Please describe what you DISLIKED about this product?

_____
_____
_____
_____

PURCHASE INTENT

16. Having evaluated the Dried Nashi Chip how likely are you to buy this sample?

- ☐ Definitely would buy
- ☐ Probably would buy
- ☐ May or may not buy
- ☐ Probably would not buy
- ☐ Definitely would not buy

17. How likely would you be to buy the Dried Nashi Chip for your child's school lunch box?

- ☐ Definitely would buy
- ☐ Probably would buy
- ☐ May or may not buy
- ☐ Probably would not buy
- ☐ Definitely would not buy
- ☐ Do not have children

MASTER BALLOT 130-0- 5

■

18. How much would you expect to pay for the following different size packets?

Packet A (12 packets X 40g each)

☐ Under $1.00 ☐ $1.00-$2.00 ☐ $2.00-$3.00
☐ $3.00-$4.00 ☐ $4.00-$5.00 ☐ Over $5.00

Packet B (80g)

☐ Under $1.00 ☐ $1.00-$2.00 ☐ $2.00-$3.00
☐ $3.00-$4.00 ☐ $4.00-$5.00 ☐ Over $5.00

Packet C (150g)

☐ Under $1.00 ☐ $1.00-$2.00 ☐ $2.00-$3.00
☐ $3.00-$4.00 ☐ $4.00-$5.00 ☐ Over $5.00

19. Which size packet would you prefer to purchase?

☐ Packet A ☐ Packet B ☐ Packet C

20. How often would you eat the Nashi Chip?

☐ Every day ☐ Several times a week ☐ Once a week
☐ Once a fortnight ☐ Once a month ☐ Once a year
☐ Would not eat

21. How would you eat the Dried Nashi Chip? (can select more than one)

☐ By itself ☐ Mixed with other dried fruits
☐ In muesli ☐ Ingredient in muffins/ biscuits / cakes
☐ As a snackfood ☐ As part of a mixed fruit in a muesli bar
☐ Other (please state)_____

22. Would you consider the Dried Nashi Chip to be a healthy snack food?

☐ Yes ☐ Maybe ☐ No

_____
_____

23. What suggestions can you provide to improve this product?

_____
_____
_____

24. Please write any other comments here.

_____
_____

MASTER BALLOT 130-0- 6

FOOD SCIENCE AUSTRALIA
A JOINT VENTURE OF CSIRO AND AFISC

CSIRO AFISC Australian Food Industry Science Centre

CONSUMER EVALUATION OF NASHI SLICE PRODUCT

SAMPLE 001

Instructions

Please have some water before you start.

You will be presented with a Nashi Slice sample. Evaluate the sample presented by smelling, examining and tasting it as appropriate. Please ensure that you answer all questions by colouring in the box completely.

Please examine the Nashi Slice and evaluate the following characteristics:

OVERALL APPEARANCE

1. How much do you like the OVERALL APPEARANCE?

☐ Like Extremely
☐ Like Very Much
☐ Like Moderately
☐ Like Slightly
☐ Neither Like nor Dislike
☐ Dislike Slightly
☐ Dislike Moderately
☐ Dislike Very Much
☐ Dislike Extremely

COLOUR

2. How dark is this sample?

☐ Far too Pale
☐ Too Pale
☐ Just Right
☐ Too Dark
☐ Far Too Dark

SOUTHLAND

MASTER BALLOT 127-0- 1

■

3. How much do you like the COLOUR?

☐ Like Extremely
☐ Like Very Much
☐ Like Moderately
☐ Like Slightly
☐ Neither Like nor Dislike
☐ Dislike Slightly
☐ Dislike Moderately
☐ Dislike Very Much
☐ Dislike Extremely

Please smell the Nashi Slice and answer the following questions:

ODOUR

4. How strong is the ODOUR?

☐ Extremely Weak
☐ Very Weak
☐ Moderately Weak
☐ Slightly Weak
☐ Just Right
☐ Slightly Strong
☐ Moderately Strong
☐ Very Strong
☐ Extremely Strong

5. How much do you like the ODOUR?

☐ Like Extremely
☐ Like Very Much
☐ Like Moderately
☐ Like Slightly
☐ Neither Like nor Dislike
☐ Dislike Slightly
☐ Dislike Moderately
☐ Dislike Very Much
☐ Dislike Extremely

MASTER BALLOT 127-0- 2

■

Now please eat ALL of the Nashi Slice and answer the following questions:

TEXTURE

6. How CHEWY is this sample?

☐ Nowhere Near Chewy Enough
☐ Not Chewy Enough
☐ Just Right
☐ Too Chewy
☐ Far Too Chewy

7. How GRITTY/GRAINY is this sample?

☐ Nowhere Near Gritty/ Grainy Enough
☐ Not Gritty/Grainy Enough
☐ Just Right
☐ Too Gritty/Grainy
☐ Far Too Gritty/Grainy

8. How much do you like the OVERALL TEXTURE?

☐ Like Extremely
☐ Like Very Much
☐ Like Moderately
☐ Like Slightly
☐ Neither Like nor Dislike
☐ Dislike Slightly
☐ Dislike Moderately
☐ Dislike Very Much
☐ Dislike Extremely

SWEETNESS

9. How SWEET is this sample?

☐ Nowhere Near Sweet Enough
☐ Not Sweet Enough
☐ Just Right
☐ Too Sweet
☐ Far Too Sweet

MASTER BALLOT 127-0- 3

■

10. How much do you like the SWEETNESS?

☐ Like Extremely
☐ Like Very Much
☐ Like Moderately
☐ Like Slightly
☐ Neither Like nor Dislike
☐ Dislike Slightly
☐ Dislike Moderately
☐ Dislike Very Much
☐ Dislike Extremely

OVERALL FLAVOUR

11. How much do you like the OVERALL FLAVOUR?

☐ Like Extremely
☐ Like Very Much
☐ Like Moderately
☐ Like Slightly
☐ Neither Like nor Dislike
☐ Dislike Slightly
☐ Dislike Moderately
☐ Dislike Very Much
☐ Dislike Extremely

AFTERTASTE

12. How much do you like the AFTERTASTE?

☐ Like Extremely
☐ Like Very Much
☐ Like Moderately
☐ Like Slightly
☐ Neither Like nor Dislike
☐ Dislike Slightly
☐ Dislike Moderately
☐ Dislike Very Much
☐ Dislike Extremely

MASTER BALLOT 127-0- 4

■

OVERALL ACCEPTABILITY

13. Overall, how ACCEPTABLE do you find the Nashi Slice?

☐ Like Extremely
☐ Like Very Much
☐ Like Moderately
☐ Like Slightly
☐ Neither Like nor Dislike
☐ Dislike Slightly
☐ Dislike Moderately
☐ Dislike Very Much
☐ Dislike Extremely

14. Please describe what you LIKED about this product?

_____
_____
_____
_____

15. Please describe what you DISLIKED about this product?

_____
_____
_____
_____

PURCHASE INTENT

16. Having evaluated the Nashi Slice how likely are you to buy this sample?

☐ Definitely would buy
☐ Probably would buy
☐ May or may not buy
☐ Probably would not buy
☐ Definitely would not buy

17. How likely would you be to buy the Nashi Slice for your child's school lunch box?

☐ Definitely would buy
☐ Probably would buy
☐ May or may not buy
☐ Probably would not buy
☐ Definitely would not buy
☐ Do not have children

MASTER BALLOT 127-0- 5

■

18. How much would you expect to pay for the following different size packets?

Packet A (6 packets X 100g each)

☐ Under $1.00 ☐ $1.00-$2.00 ☐ $2.00-$3.00
☐ $3.00-$4.00 ☐ $4.00-$5.00 ☐ Over $5.00

Packet B (250g)

☐ Under $1.00 ☐ $1.00-$2.00 ☐ $2.00-$3.00
☐ $3.00-$4.00 ☐ $4.00-$5.00 ☐ Over $5.00

Packet C (375g)

☐ Under $1.00 ☐ $1.00-$2.00 ☐ $2.00-$3.00
☐ $3.00-$4.00 ☐ $4.00-$5.00 ☐ Over $5.00

19. Which size packet would you prefer to purchase?

☐ Packet A ☐ Packet B ☐ Packet C

20. How often would you eat the Nashi Slice?

☐ Every day ☐ Several times a week ☐ Once a week
☐ Once a fortnight ☐ Once a month ☐ Once a year
☐ Would not eat

21. How would you eat the Nashi Slice? (can select more than one)

☐ By itself ☐ Mixed with other dried fruits
☐ In muesli ☐ Ingredient in muffins/ biscuits / cakes
☐ As a snackfood ☐ As part of a mixed fruit in a muesli bar
☐ Other (please state)_____

22. Would you consider the Nashi Slice to be a healthy snack food?

☐ Yes ☐ Maybe ☐ No

_____
_____

23. What suggestions can you provide to improve this product?

_____
_____
_____

24. Please write any other comments here.

_____
_____

MASTER BALLOT 127-0- 6

6.8.4.2 School Children Questionnaire

■

SENSORY EVALUATION OF NASHI PRODUCTS

NAME:_____

DATE: _____ **TIME:** _____

Question 1: Gender

☐ Male ☐ Female

Question 2: How old are you?

☐ 6 years old ☐ 12 years old
☐ 7 years old ☐ 13 years old
☐ 8 years old ☐ 14 years old
☐ 9 years old ☐ 15 years old
☐ 10 years old ☐ 16 years old
☐ 11 years old ☐ 17 years old

Question 3: What types of FRESH fruit do you eat? (can select more than one)

☐ Apples ☐ Bananas ☐ Pears
☐ Oranges ☐ Nashi
☐ Other (please state)_____

Question 4: How often do you eat FRESH fruit?

☐ Every day ☐ Several times a week ☐ Once a week
☐ Once a fortnight ☐ Once a month ☐ Once a year
☐ Do not eat

Question 5: What types of DRIED fruit do you eat? (can select more than one)

☐ Apple ☐ Apricots ☐ Sultanas/ Raisins,Currants
☐ Banana Chips ☐ Other (please state)_____

Question 6: How often do you eat DRIED fruit?

☐ Every day ☐ Several times a week ☐ Once a week
☐ Once a fortnight ☐ Once a month ☐ Once a year
☐ Do not eat

WAVERELY

MASTER BALLOT 116-0- 1

Question 7: How do you eat DRIED fruit? (can select more than one)

☐ By itself ☐ In muesli/ breakfast cereal ☐ In a muesli bar
☐ In a biscuit/cake/bun ☐ As a snackfood ☐ Other (please state)_____

Question 8: Do you eat nashi? (showing the nashi to the child)

☐ Yes ☐ No

Question 9: How often do you eat nashi?

☐ Every day ☐ Several times a week ☐ Once a week
☐ Once a fortnight ☐ Once a month ☐ Once a year
☐ Do not eat

Question 10: What types of SNACK FOODS do you eat? (can select more than one)

☐ Potato Chips ☐ Muesli Bars ☐ Flavoured Snacks eg. Cheezles
☐ Chocolate ☐ Fruit Roll Ups ☐ Fruit Twists/ Bars
☐ Nuts ☐ Corn Chips ☐ Breakfast Bars
☐ Other (please state) _____

Question 11: How often do you eat SNACK FOODS?

☐ Every day ☐ Several times a week ☐ Once a week
☐ Once a fortnight ☐ Once a month ☐ Once a year
☐ Do not eat

Question 12: : When do you eat SNACK FOODS? (can select more than one)

☐ Lunch ☐ After School ☐ Morning / Afternoon Break
☐ Weekends ☐ Other (please state)_____
☐ Do not eat

Question 13: How often does mum/dad pack SNACKFOOD into your lunch box?

☐ Every day ☐ Several times a week ☐ Once a week
☐ Once a fortnight ☐ Less than once a fortnight ☐ Do not eat

MASTER BALLOT 116-0- 2

■

DRIED NASHI CHIP - Sample 001

Please look at the Dried Nashi Chip and answer the following questions:

OVERALL APPEARANCE

Question 1. How much do you like the look of the Dried Nashi Chip?

☐ Like A Lot / Heaps
☐ Like Very Much
☐ Like A Little
☐ Neither Like nor Dislike
☐ Dislike A Little
☐ Dislike Very Much
☐ Dislike A Lot / Heaps

COLOUR

Question 2a. How much do you like the COLOUR?

☐ Like A Lot / Heaps
☐ Like Very Much
☐ Like A Little
☐ Neither Like nor Dislike
☐ Dislike A Little
☐ Dislike Very Much
☐ Dislike A Lot / Heaps

Question 2b. Would you prefer it to be:

☐ Lighter
☐ Darker
☐ No Change

Please smell the Dried Nashi Chip and answer the following question:

ODOUR

Question 3. How much do you like the SMELL?

☐ Like A Lot / Heaps
☐ Like Very Much
☐ Like A Little
☐ Neither Like nor Dislike
☐ Dislike A Little
☐ Dislike Very Much
☐ Dislike A Lot / Heaps

WAVERELY

MASTER BALLOT 110-0- 1

■

Please eat ALL of the Dried Nashi Chip and answer the following questions:

CHEWINESS

Question 4a. How much do you like the CHEWINESS?

☐ Like A Lot / Heaps
☐ Like Very Much
☐ Like A Little
☐ Neither Like nor Dislike
☐ Dislike A Little
☐ Dislike Very Much
☐ Dislike A Lot / Heaps

Question 4b. Would you prefer it to be:

☐ Less Chewy
☐ More Chewy
☐ No Change

GRITTY/GRAININESS

Question 5a. How much do you like the GRITTY/GRAININESS?

☐ Like A Lot / Heaps
☐ Like Very Much
☐ Like A Little
☐ Neither Like nor Dislike
☐ Dislike A Little
☐ Dislike Very Much
☐ Dislike A Lot / Heaps

Question 5b. Would you prefer it to be:

☐ Less Gritty/Grainy
☐ More Gritty/Grainy
☐ No Change

SWEETNESS

Question 6a. How much do you like the SWEETNESS?

☐ Like A Lot / Heaps
☐ Like Very Much
☐ Like A Little
☐ Neither Like nor Dislike
☐ Dislike A Little
☐ Dislike Very Much
☐ Dislike A Lot / Heaps

MASTER BALLOT 110-0- 2

■

Question 6b. Would you prefer it to be:

☐ Less Sweet
☐ More Sweet
☐ No Change

OVERALL FLAVOUR

Question 7. How much do you like the OVERALL FLAVOUR/TASTE?

☐ Like A Lot / Heaps
☐ Like Very Much
☐ Like A Little
☐ Neither Like nor Dislike
☐ Dislike A Little
☐ Dislike Very Much
☐ Dislike A Lot / Heaps

OVERALL ACCEPTABILITY

Question 8. Overall, how much do you like the Dried Nashi Chip?

☐ Like A Lot / Heaps
☐ Like Very Much
☐ Like A Little
☐ Neither Like nor Dislike
☐ Dislike A Little
☐ Dislike Very Much
☐ Dislike A Lot / Heaps

Question 9. What did you LIKE about the Dried Nashi Chip and why?

_____
_____
_____

Question10. What did you DISLIKE about the Dried Nashi Chip and why?

_____
_____
_____

Question 11. Would you ask mum/dad to buy this product?

☐ Yes ☐ Maybe ☐ No

Question 12. If you were allow to buy your lunch would you buy this product?

☐ Yes ☐ Maybe ☐ No

MASTER BALLOT 110-0- 3

■

Question 13. What do you think we should call this product?

_____

Question 14. What would you like changed about the Dried Nashi Chip?

_____

_____

_____

Question 15. What else would you like to tell us?

Please make any other comments about the Dried Nashi Chip here.

_____

_____

_____

MASTER BALLOT 110-0- 4

NASHI SLICE - Sample 001

Please look at the Nashi Slice and answer the following questions:

OVERALL APPEARANCE

Question 1. How much do you like the look of the Nashi Slice?

- ☐ Like A Lot / Heaps
- ☐ Like Very Much
- ☐ Like A Little
- ☐ Neither Like nor Dislike
- ☐ Dislike A Little
- ☐ Dislike Very Much
- ☐ Dislike A Lot / Heaps

COLOUR

Question 2a. How much do you like the COLOUR?

- ☐ Like A Lot / Heaps
- ☐ Like Very Much
- ☐ Like A Little
- ☐ Neither Like nor Dislike
- ☐ Dislike A Little
- ☐ Dislike Very Much
- ☐ Dislike A Lot / Heaps

Question 2b. Would you prefer it to be :

- ☐ Lighter
- ☐ Darker
- ☐ No Change

Please smell the Nashi Slice and answer the following question:

ODOUR

Question 3. How much do you like the SMELL?

- ☐ Like A Lot / Heaps
- ☐ Like Very Much
- ☐ Like A Little
- ☐ Neither Like nor Dislike
- ☐ Dislike A Little
- ☐ Dislike Very Much
- ☐ Dislike A Lot / Heaps

WAVERELY

MASTER BALLOT 98-0- 1

■

Please eat ALL of the Nashi Slice and answer the following questions:

CHEWINESS

Question 4a. How much do you like the CHEWINESS?

☐ Like A Lot / Heaps
☐ Like Very Much
☐ Like A Little
☐ Neither Like nor Dislike
☐ Dislike A Little
☐ Dislike Very Much
☐ Dislike A Lot / Heaps

Question 4b. Would you prefer it to be :

☐ Less Chewy
☐ More Chewy
☐ No Change

GRITTY/ GRAININESS

Question 5a. How much do you like the GRITTY/GRAININESS?

☐ Like A Lot / Heaps
☐ Like Very Much
☐ Like A Little
☐ Neither Like nor Dislike
☐ Dislike A Little
☐ Dislike Very Much
☐ Dislike A Lot / Heaps

Question 5b. Would you prefer it sample to be :

☐ Less Gritty/Grainy
☐ More Gritty/Grainy
☐ No Change

SWEETNESS

Question 6a. How much do you like the SWEETNESS?

☐ Like A Lot / Heaps
☐ Like Very Much
☐ Like A Little
☐ Neither Like nor Dislike
☐ Dislike A Little
☐ Dislike Very Much
☐ Dislike A Lot / Heaps

MASTER BALLOT 98-0- 2

■

Question 6b. Would you prefer it to be :

☐ Less Sweet
☐ More Sweet
☐ No Change

OVERALL FLAVOUR

Question 7. How much do you like the OVERALL FLAVOUR/TASTE?

☐ Like A Lot / Heaps
☐ Like Very Much
☐ Like A Little
☐ Neither Like nor Dislike
☐ Dislike A Little
☐ Dislike Very Much
☐ Dislike A Lot / Heaps

OVERALL ACCEPTABILITY

Question 8. Overall, how much do you like the Nashi Slice?

☐ Like A Lot / Heaps
☐ Like Very Much
☐ Like A Little
☐ Neither Like nor Dislike
☐ Dislike A Little
☐ Dislike Very Much
☐ Dislike A Lot / Heaps

Question 9. What did you LIKE about this product and why?

_____
_____
_____

Question 10. What did you DISLIKE about this product and why?

_____
_____
_____

Question 11. Would you ask mum/dad to buy this product?

☐ Yes ☐ Maybe ☐ No

Question 12. If you were allow to buy your lunch would you buy this product?

☐ Yes ☐ Maybe ☐ No

MASTER BALLOT 98-0- 3

■

Question 13. What do you think we should call this product?

_____

Question 14. What would you like changed about the Nashi Slice?

_____

_____

_____

Question 15. What else would you like to tell us?

Please make any other comments about the Nashi Slice here.

_____

_____

_____

MASTER BALLOT 98-0- 4

SECTION D

7.0 FURTHER DEVELOPMENT OF VALUE-ADDED NASHI PRODUCTS – NASHI JUICE

Prepared by: David O'Beirne et al, Food Science Australia

EXECUTIVE SUMMARY

This part of the study focussed on commercial production and consumer evaluation of a nashi juice prototype developed by Food Science Australia. Nashi juice product was produced by a commercial juice producer, utilising standard apple juice processing conditions and equipment, to ensure ease of commercialisation of such products. Physical, chemical, microbial and storage assessment were conducted on the commercially produced nashi juice.

During shelf life evaluation using storage at refrigerated temperatures, it was found that there was no variation in taste, brix levels, pH and microbial growth throughout the six month storage period for the commercially produced nashi juice product. The product was also judged as microbiologically stable after six months of storage at ambient temperature. Visual and spectrophotometric analysis demonstrated that there were no major quality problems caused by browning of nashi juice products during storage.

A consumer sensory evaluation trial was conducted on samples of the commercially produced juice prototype. The product consumer evaluation trial involved about 100 panellists drawn from the general population and was conducted at a major Melbourne shopping complex. The evaluation provided useful information on the potential acceptance by consumers of a nashi juice product. As an indicator of potential export markets, Asian and Caucasian consumers' acceptability of the nashi juice in relation to appearance, odour and flavour characteristics were determined. However, due to budget constraints this evaluation included a small group of Asian consumers from mixed regions to help determine if Asians, who are more likely to consume nashi pears, would find the juice more acceptable than the Caucasian group. A panel of 100 consumers consisting of 38 Asian and 62 Caucasian, completed the evaluation with approximately an equal number of males and females in each group. All panellists were consumers of fruit juice products with most panellists drinking fruit juice several times a week. The majority of panellists were also consumers of orange and/or apple juice. Consumers were first asked a series of demographic and consumption questions followed by questions in relation to the appearance, odour and flavour of the nashi juice product. Several comment sections were also included in the questionnaire.

Overall, the nashi juice product was found to be well liked by both the Asian and Caucasian consumers tested. The variation in colour acceptability and sweetness intensity scores suggested that the nashi juice may require minor modifications. However, before modifications are carried out, it was judged as important to define the intended target group and consider factors such as serving temperature and packaging. It was recommended that if the juice product is intended for export, it is important to gain an understanding of the expectations of consumers within that region, as product characteristics acceptable to an Australian market, particularly in relation to appearance and flavour, may not be as acceptable to export markets. It was recommended that if industry proceeds with the commercialisation

of nashi juice, then further consumer studies be carried out following product modifications, to confirm whether the product does in fact become more acceptable to target consumers.

7.1 PROJECT AIM

As described in a previous report (Feasibility of Value-adding to Low-grade Nashis, HRDC report NA98001), initial sensory evaluation trials of selected prototype nashi juice products, which exhibited differences through pH adjustment, addition of antioxidant and addition of pear juice concentrate, were carried out. A preferred prototype then underwent shelf life studies as a refrigerated product and as a shelf stable juice product. This part of the study focussed on commercial scale up of nashi juice production and consumer evaluation of a selected nashi juice product.

7.2 METHODS

7.2.1 Background

This part of the project continued to focus on the development of a juice product derived from low grade nashi fruit. A production trial was carried out at the juice manufacturing premises of Bellevue Orchard, a commercial apple juice producer owned by Joe and Robert Russo and located at Officer, Victoria. Nashi fruit was provided by the Australian Nashi Growers Association (ANGA) through the organisation of John Karl, currently chairperson of the Research and Development committee of ANGA. The nashi juice product was produced utilising standard apple juice processing conditions (including juice pH adjustment) and equipment, to ensure ease of commercialisation of nashi juice products. Physical, chemical, microbial and storage assessment were conducted on the nashi juice samples produced by a commercial juice processor. In August, a consumer sensory evaluation trial was conducted on samples of the juice prototype produced at Bellevue Orchard. The product consumer evaluation trial involved about 100 panellists drawn from the general population and was conducted at the Southland shopping centre, a major Melbourne shopping complex. The evaluation provided useful information on the potential acceptance by consumers of a nashi juice product.

A description of the juicing process and potential for commercialisation of nashi juice were also assessed.

7.2.2 Protocol for juice manufacture

One batch of shelf-stable nashi juice product was produced by heating through a pasteuriser to 85^0C for a minimum of 30 seconds. Product was then hot filled into plastic packaging at a minimum fill temperature of 72°C. Samples of each batch were stored at refrigerated (4°C) and ambient temperature (22^0C) and were tested after 0, 1, 2, 4 and 6 months of storage. In anticipation of commercial processing requirements, all nashi juice produced during this study was prepared with skin intact.

7.2.3 Protocol for sensory evaluation of nashi juice products

Analysis of consumer evaluation trials on the selected juice prototype held at a major Melbourne shopping centre. Tasters were recruited from the many visitors to the shopping centre carrying out their various shopping tasks. The evaluation provided useful information on the potential acceptance by consumers of a nashi juice product. The prototype product was

evaluated by an external consumer-type panel consisting of about 100 people who were consumers of fruit juice. For the consumer evaluation study a questionnaire was developed to include 'liking' and 'intensity' questions. The attributes evaluated in the questionnaire included overall acceptability of product (liking), appearance of product (liking), colour of product (liking), aroma of product (liking), flavour of product (liking), sweetness of product (intensity), and acidity of product (intensity). Questions relating to gender, ethnicity, whether tasters were fruit juice drinkers, product buying intentions and suggested improvements were also included.

7.2.4 Protocol for shelf life evaluation

Product (1):	1 prototype (a shelf stable product).
Packaging format (1):	1 type of beverage bottle (2 litre plastic bottle).
Pasteurisation temperature (1):	1 temperature for a shelf stable product.
Storage temperatures (2):	2 temperatures - refrigerated and ambient.
Sampling occasions (4):	1, 4, and 6 months.
Quality Indices:	pH, brix, colour, visual assessment at test times. Microbiological testing for Standard plate count, yeast and mould counts, and lactic acid bacteria were conducted at sampling occasions, whereas tests for *Salmonella*, *E. coli* and *Listeria* were conducted only at initial sampling occasion.

7.2.5 Protocol for microbiological evaluation of shelf life samples

All samples for microbiological testing were tested according to the following Australian Standards microbiological procedural methods: Standard plate count:AS 1766 2.1 – 1991, Yeasts & moulds count:AS 1766 2.2 – 1997, Coliforms and *E. coli* count:AS 1766 2.3 – 1992, Co-agulase positive *Staph.*:AS 1766 2.4 – 1994, *Clostridium perfringens* AS 1766 2.6 – 1991, *Listeria monocytogenes* in food and animal foodstuffs:AS 1766 2.15 – 1998, and *Salmonella* AS 1766 2.5 – 1991.

7.2.6 Protocol for physical and chemical evaluation of shelf life samples

Quality indices measured included pH, visual appearance, taste and brown colour development of the juice. The relative degree of brown colour development of juice samples was measured by absorbance in a 10 mm quartz cell at 420 nm (A_{420}) using a Shimadzu Spectrophotometer model number UV-1201V.

7.3 RESULTS AND DISCUSSION

7.3.1 Manufacturing process

2 bins approximately 450-500kg each of nashi fruit produced 375L juice each for a total of 750L ie an 75-80% juice yield. Nashi fruit was described as yellow in colour, ripe (around 12° brix) but firm, with some scuff marks on fruit surface.

Citric acid added as 20% solution to adjust pH to approximately 3.90.

5 litres of 20% citric acid solution added to 750 L of juice to adjust pH from 4.20 to 3.95.

Pyr-Flo added at 25ml / 1000L of juice.

Optidex L-300 added at 70ml / 1000L of juice.

Bentonite added at 0.2 g/L of juice.

Ascorbic acid added at 100ppm to juice.

Citric acid is added to the nashi juice in order to adjust the pH for microbiological reasons and to impart an acidic flavour balance to the naturally sweet nashi juice. Ascorbic acid is added for its antioxidant abilities to prevent enzymatic reactions causing browning of the juice.

Optidex L-300 is a food grade glucoamylase produced by controlled fermentation of *Aspergillus niger var*., and distributed by Enzyme Solutions Pty Ltd. Heating juices to greater than 71°C will solubilise native starch present and enable the starch to pass through any clarification or filtering steps that are used during processing. During storage or bottling a fine colloidal 'starch haze' may form in the juice. The problem of 'starch haze' can be prevented through the added amylase enzyme hydrolysing the gelatinised starch into soluble glucose units.

Pyr-Flo is a food grade pectic enzyme obtained from *Aspergillus niger var*., also distributed by Enzyme Solutions Pty Ltd. The pectic enzyme hydrolyses both soluble and colloidal pectin substances. The colloids formed by the pectin are therefore destroyed and juice viscosity is reduced. Pry-Flo also contains significant arabinase activity which hydrolyses araban haze in pear and other fruit juices. Depectinisation of single-strength fruit juice accelerates clarification, improves filtration and increases juice extraction.

Bentonite is also used as a fining agent in fruit juices. Bentonite is a naturally occurring clay which is negatively charged and is used to remove suspended material by adsorption and entrapment. Because of its negative charge, bentonite can aid in removing added protein used for pectolytic treatments.

7.3.2 Processing

It was noted that the nashi pears sank while being washed in the washing tank. A system of scooping the fruit from the bottom of a wash tank will need to be considered for commercial processing. The nashi fruit was milled and pressed easily, leaving a relatively dry pomace. After addition of the various additives, the juice was left to settle overnight. Next day juice was racked off settled solids, filtered through 1 micron pad filters, pasteurised by heating to 86°C for 30 seconds and the clear juice filled into 2 litre plastic bottles at 73°C. See Figures 2, 3 and 4 for photographs of processing and the final nashi juice product.

7.3.3 Product Results

A post bottling haze was observed after production of the nashi juice. Tests were carried out on the nashi juice to determine the presence of starch, nitrogen for protein, pectin and catechol. As these tests were all negative, it was concluded that the haze was most likely due to the presence of soluble tannin-like polyphenols or 'procyanidin' material. As with the production of other fruit juices, process techniques involving use of fining agents can be used to eliminate post bottling haze problems. Traditionally gelatin is used as a fining agent in apple juice type products. Gelatin is a protein which carries a positive charge at fruit juice pH of 3.5-4.0. When added in solution it forms an insoluble floc by electrostatic neutralisation of other juice debris which mostly carries a negative charge. The floc slowly sediments thereby clarifying the juice. If the juice contains substantial quantities of tannin-

like polyphenols then hydrogen bonded interactions between gelatin and tannin produce a much denser floc and improves fining efficiency. It is possible to use gelatin in conjunction with bentonite, which is negatively charged and therefore neutralises the added protein, forming a floc which sediments and brings down juice debris from suspension.

7.3.4 Shelf Life Study

In order to simulate storage conditions most commonly available to commercially produced fruit juice products, storage temperatures used were 4°C and 22°C, from which bottled samples were taken for evaluation at regular intervals.

Table 1. Chemical and sensory results for commercially produced shelf stable nashi juice.

Time - months	Brix mean	pH mean	λ420 4°C mean	λ420 20°C mean	Appearance and taste
0	12.8	3.99	0.133	0.133	Product flavour and colour were acceptable in all samples.
2	12.8	3.99	0.195	0.224	Product flavour and colour were acceptable in all samples.
4	12.8	3.99	0.298	0.357	Product flavour and colour were acceptable in all samples.
6	12.8	3.99	0.285	0.376	Product flavour and colour were acceptable in all samples.

Table 1. shows that there was no variation in appearance, taste, brix levels and pH throughout the storage period for the nashi juice product. A slightly greater increase in brown colour was observed in samples stored at ambient storage temperatures compared to product stored at refrigerated temperatures. Figure 1 shows spectrophotometric analysis measured as absorbance (A_{420}) values over time for brown colour development in nashi juice samples. In nashi juice product, significant browning occurred during the first 8 weeks of storage, but beyond that time a further increase in product browning was not observed.

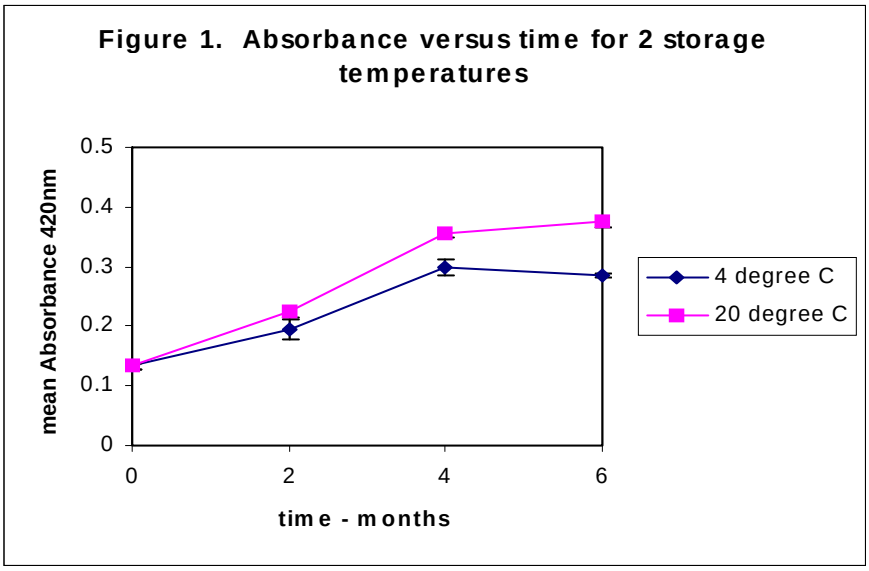


Table 2. Microbiological results for commercially produced shelf stable nashi juice.

Mths	Sample storage description	Total plate count (cfu/ml)	Yeasts & moulds count (cfu/ml)	*Lacto-bacillus* count cfu/ml	Coliforms MPN/ml	*Bacillus cereus* (cfu/ml)	Co-agulase positive *Staph.* (cfu/ml)	*Clostr. Perfring.* (cfu/ml)	*Listeria mn.* and *Salmonella* spp. in 25 ml
1	4°C	< 1 (ND)	< 10 (ND)	NT	<0.3	<10	<10	<1	ND
	20°C	< 1 (ND)	< 10 (ND)	NT	<0.3	<10	<10	<1	ND
4	4°C	< 1 (ND)	< 10 (ND)	< 10 (ND)	NT	NT	NT	NT	NT
	20°C	< 1 (ND)	< 10 (ND)	< 10 (ND)	NT	NT	NT	NT	NT
6	4°C	< 1 (ND)	< 10 (ND)	< 10 (ND)	NT	NT	NT	NT	NT
	20°C	< 1 (ND)	< 10 (ND)	< 10 (ND)	NT	NT	NT	NT	NT

cfu = colony forming units; MPN = most probable number; ND = not detected; NT = not tested; 1 cfu was the detection limit in standard plate count; 10 cfu was the detection limit in co-agulase positive Staphylococci and yeasts & moulds count; 3 MPN was the detection limit in coliforms and E. coli. Test results are based on duplicate samples.

Table 2. shows that there were no spoilage or pathogenic organisms detected, nor was there any microbial growth throughout the storage period of the shelf stable nashi juice product. The growth of tested micro-organisms in all samples was below the level of detection limit. The product was judged as still microbiologically stable after 6 months of storage at ambient temperature.

7.3.5 Conclusion

During shelf life evaluation at refrigerated temperatures, it was found that there was no variation in taste, brix levels, pH and microbial growth throughout the six month storage period for the commercially produced nashi juice product. The product was also judged as microbiologically stable after six months of storage at ambient temperature. Visual and spectrophotometric analysis demonstrated that there were no major quality problems caused by browning of nashi juice products during storage.

7.3.6 References

Ashurst, P.R. (1995) Apple Juice. In Production and Packaging of Non-Carbonated Fruit Juices and Fruit Beverages. Ed P.R.Ashurst. Blackie Academic & Professional

Beveridge, T. Electron Microscopic Characterization of Haze in Apple Juices. Food Technology, Volume 53, No. 1. (1999)

Figure 2. Milling and pressing of nashi fruit being carried out at Bellevue Orchard, a commercial apple juice producer owned by Joe and Robert Russo, located at Officer, Victoria.

Figure 3. Filling pasteurised nashi juice into 2 litre bottles at Bellevue Orchard.

Figure 4. Nashi juice product produced at Bellevue Orchard.

7.4 SENSORY EVALUATION STUDY

For the nashi juice product developed by Food Science Australia, it was necessary to determine Asian and Caucasian consumers' acceptability of the nashi juice in relation to appearance, odour and flavour characteristics. Due to budget constraints this evaluation only included a small group of Asian consumers from mixed regions as a preliminary study to determine if Asians, who are more likely to consume nashi pears, would find the juice more acceptable than the Caucasian group.

The following is a summary of results taken from an internal report titled 'Consumer evaluation of nashi juice product' which was completed by Food Science Australia consumer scientists as part of this HRDC project.

7.4.1 Aim of the Sensory Evaluation

To determine the overall acceptability of the nashi juice product by Asian and Caucasian consumers in relation to appearance, odour and flavour. Other information such as purchase intent and consumption was also collected.

7.4.2 Methods

- The sensory session was conducted at Southland Westfield Shopping Complex, Melbourne. Consumers were seated in individual booths for all the evaluations.
- The sensory session was conducted on Friday 11th of August 2000 commencing at 10am and concluding at 5:30pm.
- 150ml of nashi juice was presented to each panellist in a clear plastic disposable cup at 4°C.
- A panel of 100 consumers consisting of 38 Asian, 62 Caucasian, completed the evaluation with approximately an equal number of males and females in each group. All panellists were consumers of fruit juice products with most panellists drinking fruit juice several times a week. The majority of panellists were also consumers of orange and/or apple juice.
- The questionnaire consisted of a series of demographic and consumption questions. These were followed by rating of appearance, odour and flavour of the nashi juice on a nine point hedonic category scale. A rating for sweetness intensity and sourness intensity was also recorded on a 156mm linescale where the left anchor had a value of 0 and the right anchor had a value of 156. A middle reference ('just right' value of 78) was also provided (see appendix 1 for questionnaire).
- After evaluating the attributes of the nashi juice sample, consumers were presented with a 2L unlabelled transparent bottle and asked to rate the acceptability of the bottled sample. This bottle however was not visible during the taste evaluation.
- Several comment sections were also included in the questionnaire.
- The hedonic category scale for each of the attributes was as follows:

  Like extremely
  Like very much
  Like moderately
  Like slightly
  Neither like nor dislike
  Dislike slightly
  Dislike moderately

Dislike very much
Dislike extremely

- The descriptors for the anchors for sweetness and sourness attributes were as follows:

ATTRIBUTE	**0 anchor**	**78 anchor**	**156 anchor**
Sweetness	Not Sweet Enough	Just Right	Too Sweet
Sourness	Not Sour Enough	Just Right	Too Sour

- The sensory software Compusense Paper was used for the development of the questionnaire.
- Individual group data was totalled. The percentage of responses was graphed and trends were determined.

7.4.3 Results

Figure 5 presents the distribution of ethnic groups with 62 Caucasian and 38 Asian consumers completing the evaluation.

There was an equal distribution of males and females for both the Caucasian and Asian groups of consumers, and that both groups had consumers from a wide variety of age groups. Other information revealed in the study included:

- that the majority of consumers consume fruit juice products at least several times a week with half of them consuming juice everyday.
- that Orange juice and apple juice were the most popular choices for both groups of consumers.
- that the most popular time of day to consume fruit juice in the Caucasian group was at breakfast time and with the Asian group was at dinner time.

Figure 5: Distibution of Ethnic Groups.

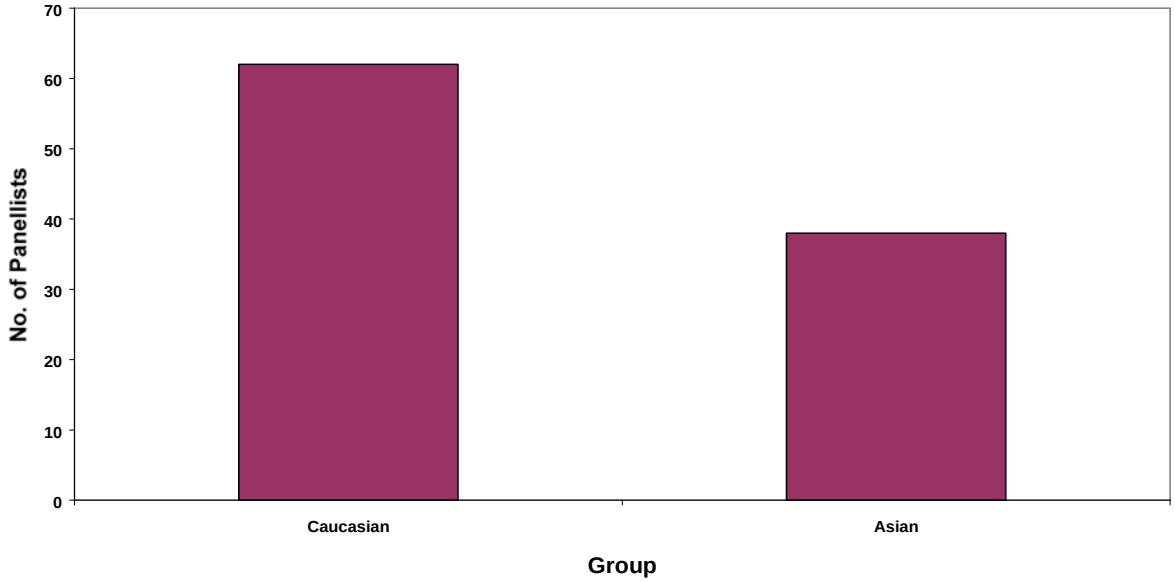


Table 3. presents the mean scores for the Total, Caucasian and Asian groups for each of the attributes.

Table 3. Mean Scores for Total, Caucasian and Asian Samples for each attribute

Attribute	Total Mean Score(mm)	Caucasian Group Mean Score (mm)	Asian Group Mean Score (mm)
Overall Appearance Acceptability	117.8	121.5	111.8
Colour Acceptability	112.8	109.2	115.0
Odour Acceptability	113.2	113.6	112.3
Overall Flavour Acceptability	127.3	130.1	122.8
Sweetness Intensity (JR)*	86.4	89.0	82.4
Sourness Intensity (JR)*	78.2	78.7	77.5
Bottled Appearance Acceptability	99.2	101.6	95.2
Overall Acceptability	123.5	125.7	120.2

NB.Please note that the higher the mean acceptability score the more acceptable consumers found the product for that attribute.

Please note that the scale length for the Just Right (JR)* Scales was 156mm.

For JR scales a score of 78mm indicates that the sample was just right.

KEY POINTS

- Overall, the nashi juice product was found to be very acceptable by both the Asian and Caucasian groups.
- There were no major differences in mean scores between the Caucasian and Asian groups.
- The sweetness intensity mean scores are fairly close to ‘Just Right’ with all mean scores falling towards the ‘too sweet’ side of the scale.
- The sourness intensity mean scores appears to be almost ‘Just Right’.
- The main objective of including the bottled sample in the evaluations was to help determine whether consumers would detect the residue present in the bottled sample. Since the overall appearance acceptability rating of the bottled sample was lower than the cup sample it indicates that the residue may have contributed to the slightly lower rating.

Figure 6 presents the distribution of responses for liking of overall appearance. The majority of responses were rated towards the 'like' side of the scale, however 11% of the Asian consumers compared to 5% of Caucasian consumers rated the overall appearance at the 'dislike' end of the scale.

Figure 6: Distribution of Overall Appearance Acceptability Ratings.

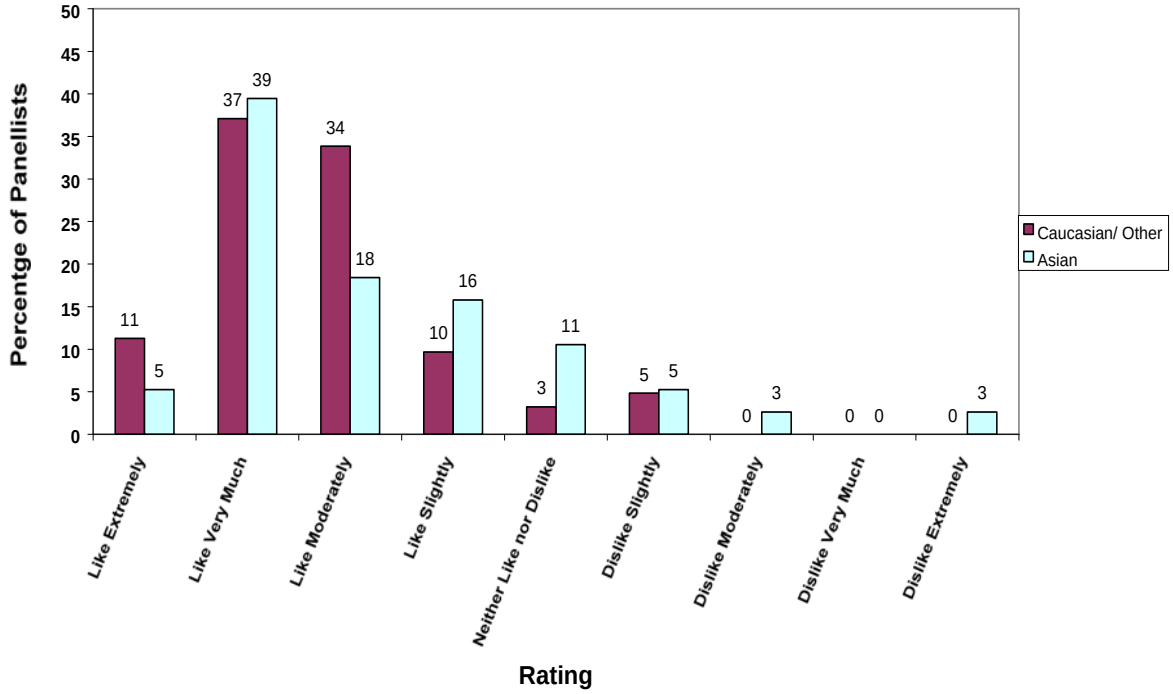


Figure 7 presents the distribution of responses for colour acceptability. Over half the consumers from each group liked the colour of the product.

Figure 7: Distribution of Colour Acceptability Ratings.

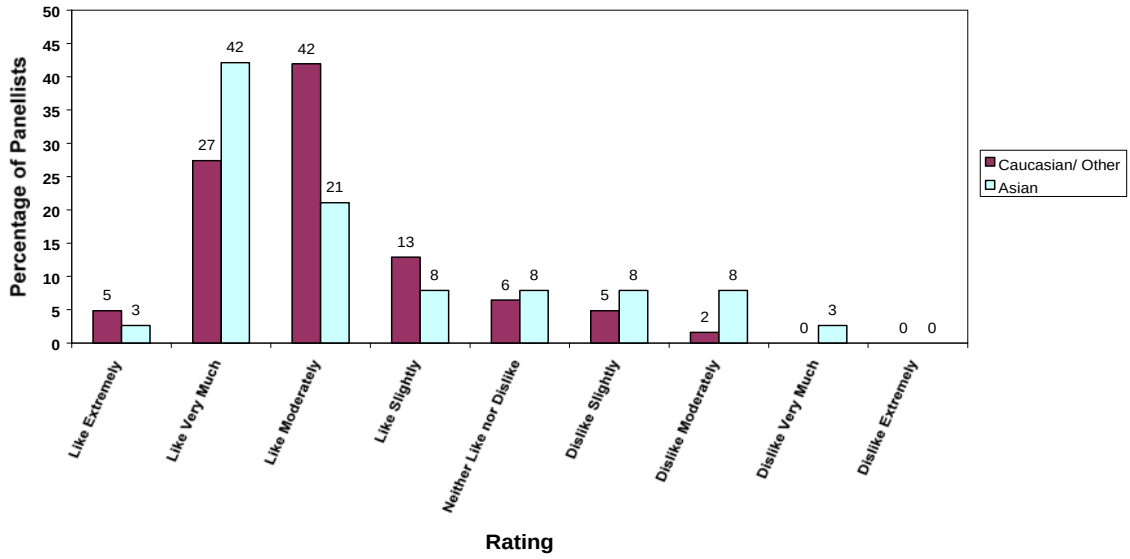


Figure 8 presents the distribution of responses for odour acceptability. Overall the distributions for the two groups appears to be similar, with the majority of consumers rating the odour acceptability to the 'like' side of the scale.

Figure 8: Distribution of Odour Acceptability Ratings.

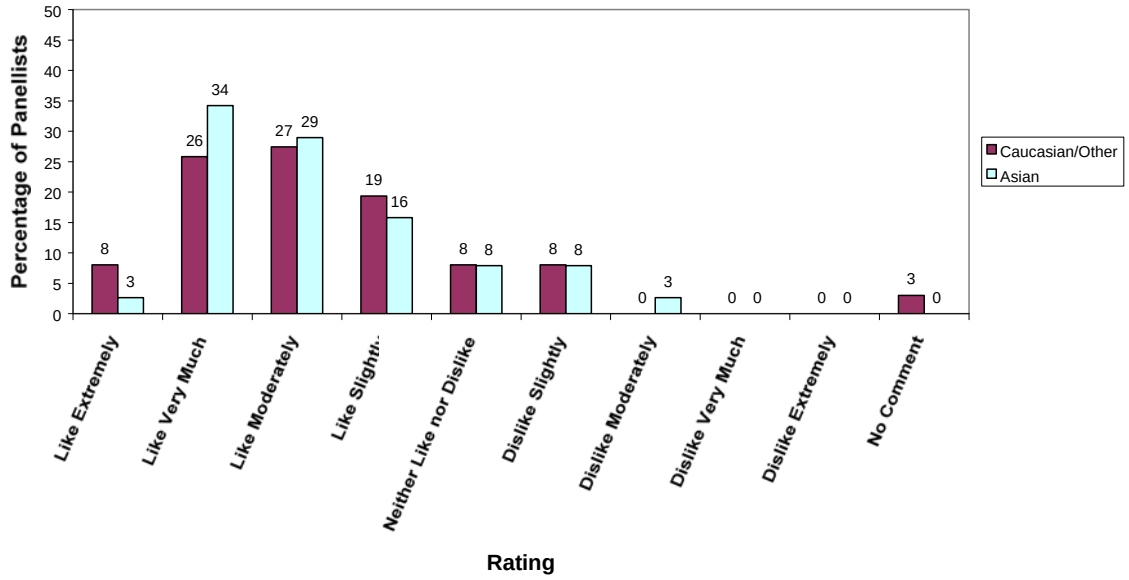


Figure 9 presents the distribution of responses for overall flavour acceptability. Approximately equal number of consumers from each group rated the overall flavour on the 'like' side of the scale. 9% of the Asian consumers rated the overall flavour acceptability on the 'dislike' side of the scale.

Figure 9: Distribution of Overall Flavour Acceptability Ratings.

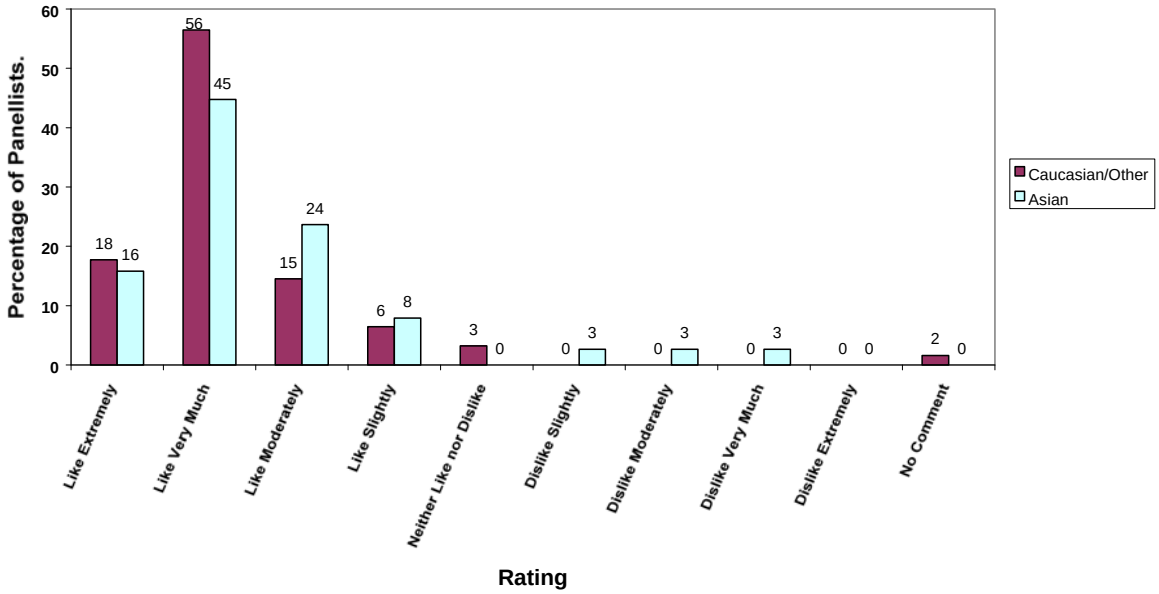


Figure 10 presents the distribution of responses for sweetness intensity. Over half the consumers in each group rated the sweetness as 'Just Right'. There were slightly more consumers who perceived the product towards the 'too sweet' side rather than 'not sweet enough' side.

Figure 10: Distribution of Sweetness Intensity Scores

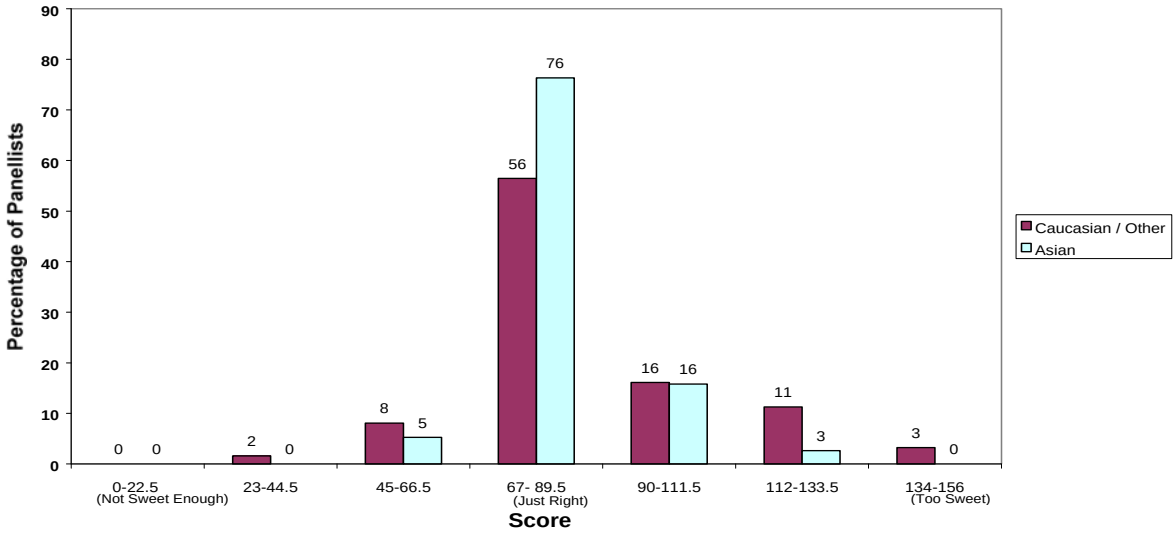


Figure 11 presents the distribution of responses for sourness intensity. Three quarters of the consumers' responses for each group fall within the 'just right' range of 67-89.5.

Figure 11: Distribution of Sourness Intensity Scores.

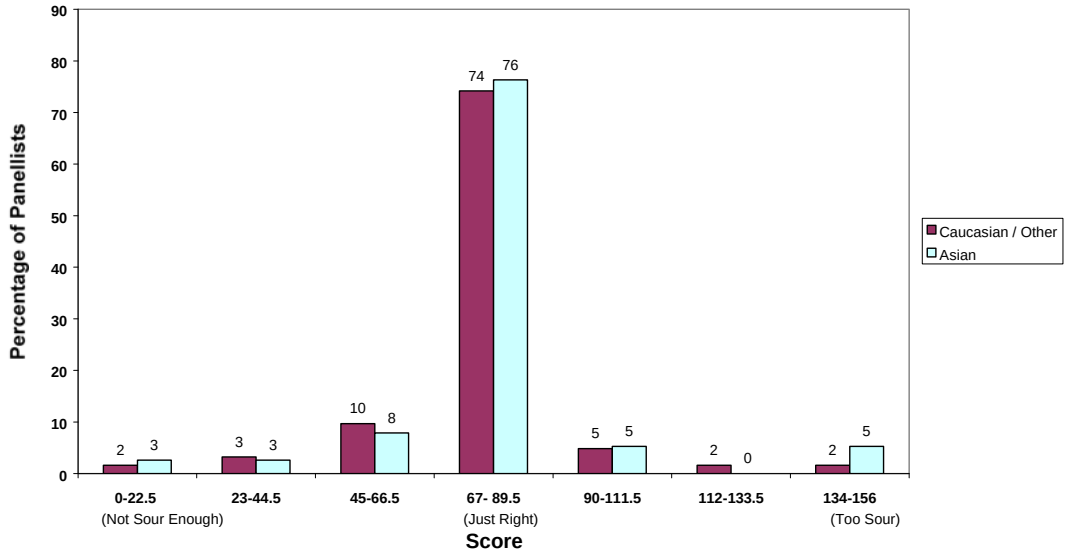


Figure 12 presents the distribution of responses for overall acceptability. The majority of consumers rated the overall acceptability towards the 'like' side of the scale with only 2% of Caucasian and 5% Asian consumers rating it at the 'dislike' end of the scale.

Figure 12: Distribution of Overall Acceptability Ratings.

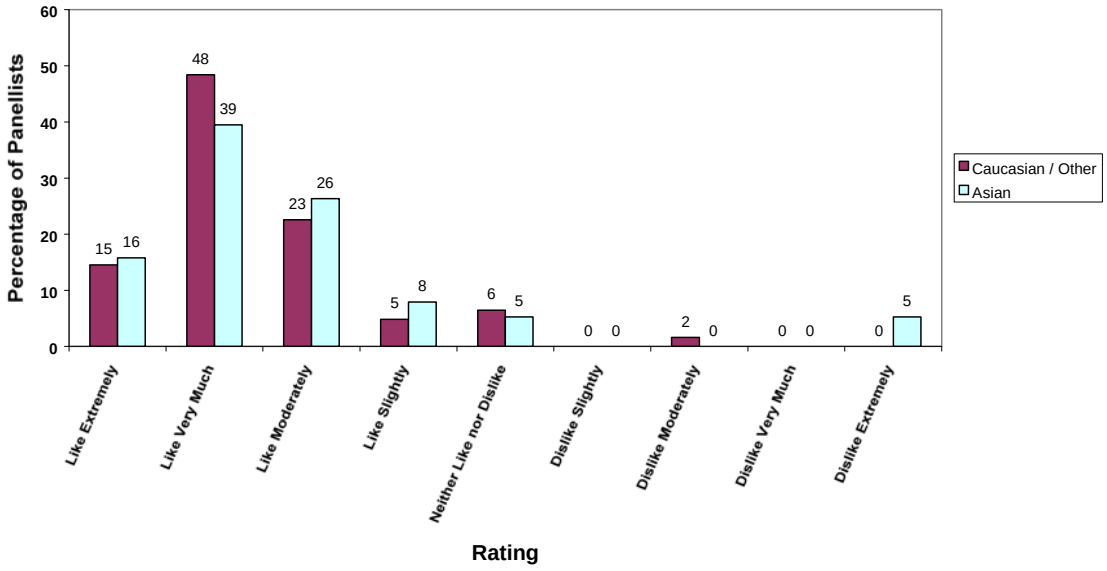


Figure 13 presents the distribution of responses for the overall visual acceptability of the product displayed in the bottle. Both groups of consumers' responses were spread across the scale, with 34% of Asian and 16% of Caucasian 'disliking' the bottled nashi juice.

Figure 13: Distribution of visual acceptability ratings of the Nashi juice as displayed in the unlabelled plastic bottle.

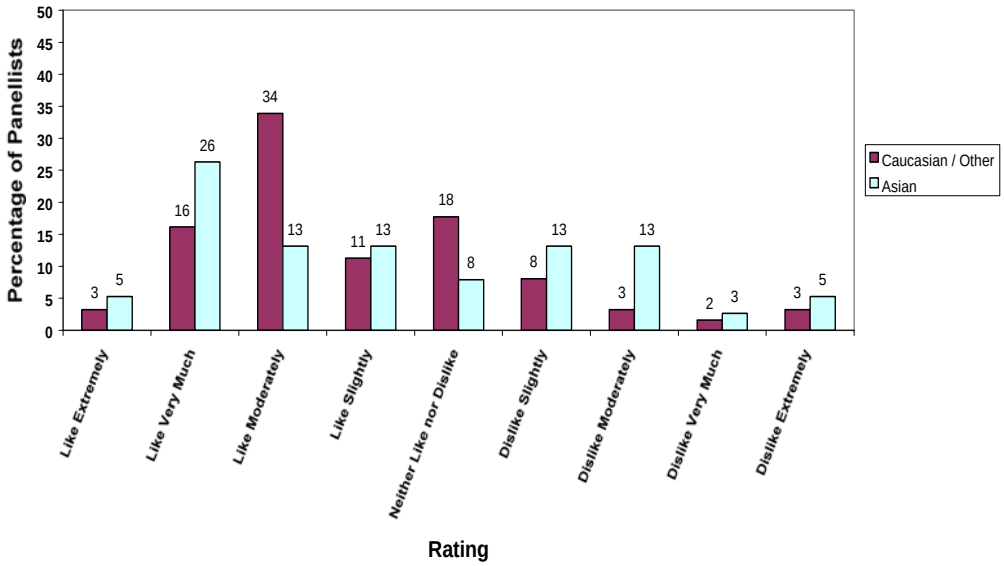
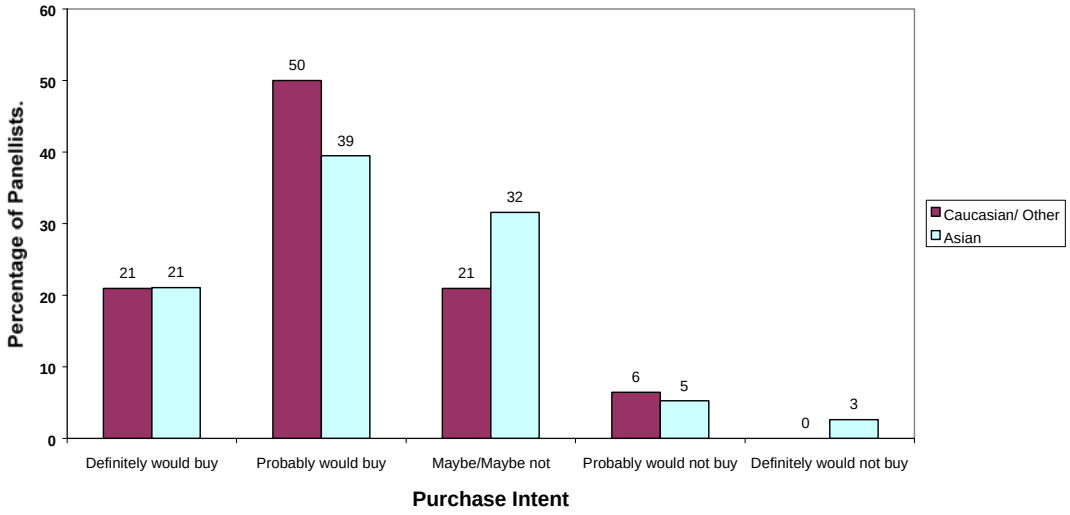


Figure 14 presents the distribution of responses for overall purchase intent. 71% of Caucasian consumers and 60% of Asians said they 'definitely would' or 'probably would buy' the product.

Figure 14: Distribution of Responses for Purchase Intent of Nashi Juice Product.



7.5 DISCUSSION AND CONCLUSIONS

The distribution of responses to the overall appearance question suggested that the overall appearance of the nashi juice product was acceptable to the majority of consumers. However, with responses from the Asian group skewing further to the right, this suggested that the Asian group had a lower overall acceptability of the appearance. A wide range of responses to the colour acceptability question, along with general comments, suggested that one major factor possibly contributing to the lower appearance acceptability of the juice was colour. Suggestions on improving the colour of the juice however, were limited, as consumers had mixed opinions on colour preference. The clarity of the juice may also be of concern as some consumers commented that the juice appeared 'murky' or 'dirty', and that the residue floating in the juice was undesirable. Such characteristics may be modified by revising processing methods.

The majority of consumers found the overall odour of the nashi juice acceptable with a few consumers commenting that the nashi juice had an unpleasant odour.

The perception of flavour as a whole, was highly acceptable by the majority of consumers with only a small group of Asian consumers 'disliking' the flavour of the juice. Comments from consumers gave no indication as to why this group of consumers 'disliked' the flavour of the product. The majority of consumers perceived the sourness intensity level as 'just right', however consumer responses to sweetness intensity were more varied with 30% of the Caucasian group and 19% of the Asian group rating the juice towards the 'too sweet' side of the scale. Although this suggested the level of sweetness may need to be fine-tuned, it is recommended that the target market be properly defined before determining the changes necessary to the different flavour components. This variation, both within and between the

consumer groups indicated that it is important to have an understanding of target consumers expectations. For example, if the product is intended for export into the Asian market, then consumers may have different flavour preferences to the Australian market**.** Serving temperature may also be of importance, as temperature can have a dramatic effect on the perception of flavour. It was noted that the Asian tasters consisted of consumers from different Asian countries and preferences of consumers from different countries would most likely vary. Thus, depending on the country to which the product is to be exported, the evaluations should be repeated in that country or at least use consumers from the country of interest.

Overall, the nashi juice product was generally acceptable to the majority of consumers with many positive comments made. Although the majority of consumers suggested they 'definitely would' or 'probably would' buy the product, there was a small group of Asian consumers that said they 'definitely would not buy' the product. Comments from consumers suggested that nutritional value and packaging might also play an important role in purchase intent. The inclusion of additives to improve flavour and colour attributes should be carefully considered, as attempts to increase flavour and appearance acceptability may in fact jeopardise sales in a highly-competitive 'additive-free' or 'natural' juice market. Packaging may contribute to purchase intent, with consumers suggesting they would like conveniently sized packaging with informative labelling. Placing the juice in a carton or translucent bottle and/or with a bright label may also help to improve or disguise the colour of the juice. Although there were mixed opinions about the appearance of the nashi juice in the plastic bottle, the main objective of including the bottled sample in the evaluations was to help determine whether consumers could detect the residue present, rather than use it as a focus for packaging information.

7.6 RECOMMENDATIONS

Overall, the nashi juice product was found to be acceptable by both the Asian and Caucasian consumers. The variation in colour acceptability and sweetness intensity scores suggested that the nashi juice may require minor modifications. However, before modifications are carried out, it was deemed to be important to define the intended target group and consider factors such as serving temperature and packaging. If this product is intended for export, it is important to gain an understanding of the expectations of the consumers within that region, as product characteristics acceptable to the Australian market, particularly in relation to appearance and flavour, may not be acceptable to export markets. It was recommended that if industry proceeds with the commercialisation of nashi juice, then further consumer studies be carried out following product modifications, to confirm whether the product does in fact become more acceptable to target consumers.

7.7 APPENDICES

Consumer evaluation questionnaire

SENSORY EVALUATION QUESTIONNAIRE
Nashi Fruit Juice

Various questions relating to demographic and consumption details.

Examine sample and evaluate the following.

Appearance

Dislike Extremely	Neither Like nor Dislike	Like Extremely

Colour

Dislike Extremely	Neither Like nor Dislike	Like Extremely

Aroma

Dislike Extremely	Neither Like nor Dislike	Like Extremely

Now taste sample as required and evaluate the following characteristics.

Overall Flavour

Dislike Extremely	Neither Like nor Dislike	Like Extremely

Sweetness

Not sweet Enough	Just Right	Too Sweet

Acidity

Not sour Enough	Just Right	Too Sour

Overall Acceptibility

Dislike Extremely	Neither Like nor Dislike	Like Extremely

The hedonic category scale for each of the attributes was as follows:

Like extremely
Like very much
Like moderately
Like slightly
Neither like nor dislike
Dislike slightly
Dislike moderately
Dislike very much
Dislike extremely

Question asking for a rating of acceptability of 2L bottle.
Question asking for purchase intent for a nashi juice product.

8.0 TECHNOLOGY TRANSFER

The outcomes of the project were constantly presented to the growers, stakeholders, commercial companies, industry bodies, scientific communities and the public throughout its life. Every year Food Science Australia project team attended the Australian Nashi Growers Association (ANGA) Annual General Meeting to give oral presentations on the progress of the project. The team also participated in their annual R&D committee meetings with Horticulture Australia Ltd. (HAL) and provided an update in ANGA's issue of Nashi News every year.

Food Science Australia has also been actively promoting the concept products to companies and related industries through discussions and presentation of information and/or product samples. Some of these companies/industries are Sunbeam Foods, Ardmona, SPC, Robern Menz , Sundown Foods, Murray Mallee 2000, two major companies in Japan and a couple of juice companies.

The outcomes of the project were also promoted through major international conferences and publications in food and trade magazines as detailed below:

8.1 PRESENTATION / PUBLICATIONS/ ARTICLES LIST:

- Article in ***Good Fruit & Vegetables***, (vol 11, April 2001) – "Adding Value to Low Grade Nashis".

- Oral presentation on "New value-added Products from Low-grade Fruits using Combination Drying Technology" by Kean Leong at ***International Symposium on Tropical and Subtropical Fruits*** organised by International Society for Horticulture Science, (Nov 2000, Cairns).

- Article in ***Food Australia*** 57(7) July 2000 - " Nash snack"

- Article in ***AFIST Sunlander*** (March 2000) - "New Nashi Product"

- Article in ***Food Facts 4*** (Autumn 2000) - "Nashi Pear- converting low price fruit to high value product".

- Article in ***What's New in Food Tech. & Manufacturing*** (Nov/Dec 1999) - "New Ways with Nashi"

- Poster on " New value-Added Nash Pear Products Using Combination Technology" (K. Leong & Vic Reyes) at ***10th World Congress of Food Science & Technology*** (Oct 1999, Sydney).

- Poster on "Value adding of Nash Pears" (K. Leong & David O'Beirne) at ***Snack Fruit Conference*** (1999, Canberra).

- Horticulture Australia final report "Feasibility of Adding Value to Low Grade Nashis" (Kean Leong & David O'Beirne) 2000.

- Annual article in ***Nashi News***, a publication of Australian Nashi Growers Association.

The promotions, discussions and publications have generated quite a number of enquiries and interest. Generally the technology and products were well accepted and some companies have express interest in the commercialisation of the products pending on the returns on investment, the risks involved and consumer acceptability. Peter Stevens who have assisted in the pilot scale trials have also expressed interest in getting a licence to produce the products commercially using their facilities.

There are opportunities for the commercialisation of developed products, either through growers themselves, small scale local established processors or large processors with established national and overseas markets. Food Science Australia, Horticulture Australia and the Australian Nashi Growers Association will be meeting in early April to discuss and determine the best path to commercial adoption.

9.0 RECOMMENDATIONS

The outcomes of this project have demonstrated that the value added nashi products are economically viable to produce and has great potential for success in the market. There are opportunities for the commercialisation of developed products, either through growers themselves, small scale local established processors or large processors with established national and overseas markets. It is recommended that Food Science Australia, ANGA and HAL to actively pursue the commercialisation of these products by exploring these options and seek suitable commercial partners in producing and putting one or two of these products on the market.

It is also recommended to extend the technology developed in this project to other tree fruits such as apricots, plums, nectarines, pear and peaches. It is anticipated that this will facilitate a viable commercial production of a mixture of these value-added fruit products, with sufficient tonnages for most parts of the year. A full proposal titled 'New Value-added Tree Fruits Using Developed Combination Drying Technology' was submitted to HAL (through the Dried Fruits Research & Development Council) in 2001 but was not accepted.

As the cost/benefit analysis of the chips and slices was based on setting up the business from scratch, it is recommended that a full business plan and analysis be made if an existing processor is interested to commercialise the products. It is anticipated that the cost of production will be reduced and the returns on investment improved.

The variation in colour acceptability and sweetness intensity scores of the nashi juice during the consumer evaluation suggested that the nashi juice may require minor modifications. However, before modifications are carried out, it was deemed to be important to define the intended target group and consider factors such as serving temperature and packaging. This will be applicable to the chips and slices too. If the products are intended for export, it is important to gain an understanding of the expectations of the consumers within that region, as product characteristics acceptable to the Australian market, particularly in relation to appearance and flavour, may not be acceptable to export markets. It was recommended that if industry proceeds with the commercialisation of nashi juice or the chips and slices, then further consumer studies be carried out following any product modifications, to confirm whether the product does in fact become more acceptable to target consumers

Studies to determine the shelf-life of these products are also recommended since the studies in this project did not take into account how the sensory characteristics of a product may change over a period of time.