Preferences of fresh pineapple by European consumers

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Executive summary

The Ghana Private-Public Partnership for Food Industry Development (PFID) project which is funded by USAID and managed by MSU intends to promote the export and sale of Ghanaian pineapples on the international market. PFID-F&V would like to have an indication of the consumer preference and an evaluation of sensory attributes of fresh pineapple in eight European countries. Furthermore, PFID-F&V would like to know if consumers are willing to pay for pineapples which are grown organically and/or traded 'fair'.

Indicative sensory consumer research was conducted in Sweden, Germany, France, Switzerland, Italy, Spain, United Kingdom and the Netherlands. Per country, approximately 50 consumers participated in the test. The test products were three varieties of fresh pineapple:

- MD2
- Smooth Cayenne
- Sugar Loaf (Netherlands and United Kingdom only)

The varieties were evaluated on liking using two different liking measures, and on the sensory attributes yellow, uniform color, sweet, sour, pineapple taste, firm, juicy and ease to swallow. The outer appearance was evaluated for attractiveness.
In addition, consumers in the Netherlands and United Kingdom participated in an experiment to study the relative importance of information on fair trade and organic production on the purchase intent of pineapples (conjoint analysis experiment).

The main findings of the study are:

With regard to preference and sensory attributes:

- In the Netherlands MD2 was liked most, Smooth Cayenne was second most liked and Sugar Loaf was liked least.
- In the United Kingdom, MD2 and Smooth Cayenne were liked equally. For Sugar Loaf contrasting results were found with the two preference measures. With preference ranking Sugar Loaf was liked equally, based on the ranking scores it was liked less than the other varieties. This could be due to a decrease in preference after repeated exposure.
- In Sweden, Germany, France, Switzerland, Italy and Spain, MD2 and Smooth Cayenne were liked equally. An exception was Sweden, where Smooth Cayenne was liked better than MD2 based on liking scores.
- The products differed in their sensory profiles as established by consumers. These sensory profiles were similar across all countries. MD2 was yellow and uniform in appearance, sweet, not sour, had a pineapple taste and was easy to swallow. It was less firm than Smooth Cayenne. Compared to MD2, Smooth Cayenne was less yellow and uniform, less sweet and less easy to swallow but more sour and firm. Sugar Loaf was the least yellow in appearance and had the least pineapple taste. On the attributes uniform appearance, sweet, sour, juicy and ease to swallow Sugar Loaf did not differ from Smooth Cayenne.
- Liking was most closely related to pineapple taste and juicy.

- The outer appearance of Smooth Cayenne was liked most. Only in the United Kingdom, Smooth Cayenne and MD2 were liked equally for outer appearance.
- Consumption frequency of pineapple differed across countries. In Germany, France and Spain pineapples were consumed most frequently. In the Netherlands, United Kingdom and Sweden pineapples were consumed least frequently.
- The low consumption frequency in the Netherlands, the United Kingdom and Sweden suggest room for market growth.

With regard to the conjoint experiment:

- In both the Netherlands and United Kingdom there seems to be a market for organically produced pineapples and for pineapples that are 'traded fair'. However, these markets are likely small, as only a subgroup of consumers would prefer these products over regular pineapples. Other consumers either are not willing to pay additionally or have a negative attitude towards these features. Interesting is that for a subgroup of British consumers price seems to be a quality indicator.
- Variety is most important for purchase intent, accounting for over 45% of variance. Organic production and price are equally important, each accounting for about 20% of variance. Fair trade is accounting for 15% of variance in the total group of consumers. The same results were found for the Netherlands as for the United Kingdom
- In a choice simulation test, 44% of the Dutch and 66% of the British consumers preferred an organic pineapple at a higher price to a regular pineapple. For fair trade, 45% of Dutch and 64% of the British consumers preferred the fair trade pineapple to the regular pineapple.

Contents

1 Introduction

The Ghana Private-Public Partnership for Food Industry Development (PFID) project which is funded by USAID and managed by MSU intends to promote the export and sale of Ghanaian pineapples on the international market. Two main varieties of pineapple are grown in Ghana- Smooth Cayenne and Sugar Loaf- depending on the region. Smooth Cayenne is the predominant variety. MD2 is the main variety grown in Costa Rica. PFID-F&V would like to have an indication of the consumer preference and an evaluation of sensory attributes of fresh pineapples in eight European countries. Furthermore, PFID-F&V would like to know if consumers are willing to pay for pineapples which are grown organically and/or traded 'fair'.

Research questions

- Which variety of fresh pineapple is preferred by consumers in several European countries?
- Are consumers willing to pay more for pineapples that are grown organically and/or traded 'fair'?

2 Material and methods

Indicative sensory consumer research was conducted in Sweden, Germany, France, Switzerland, Italy, Spain, United Kingdom and the Netherlands.
Agrotechnology and Food Innovations (A&F) carried out the research in the Netherlands and coordinated the research in the other countries. The research outside the Netherlands was subcontracted to local research organisations, all members of the European Sensory Network.

A&F was responsible for the research, which included:
- Coordination of the research (no actual travelling to the locations was included)
- Research design and test protocol, including the preparation instructions, questionnaire and testing materials for the conjoint analysis experiment.
- Conduction of data analysis, data linking and writing of the report.

The local research organisations were responsible for:
- The recruitment of the consumers
- Conducting the consumer test
- Delivery of data file with results

2.1 Consumers

Per country, approximately 50 consumers participated in the test. The criteria for selection of consumers was that they consume fresh pineapple at least 2 to 3 times per year and that they are European by nationality. There were no quota for age or sexe. The consumer test took place at the research organisations site. Prior to the test the consumers were screened and scheduled to participate.

2.2 Product

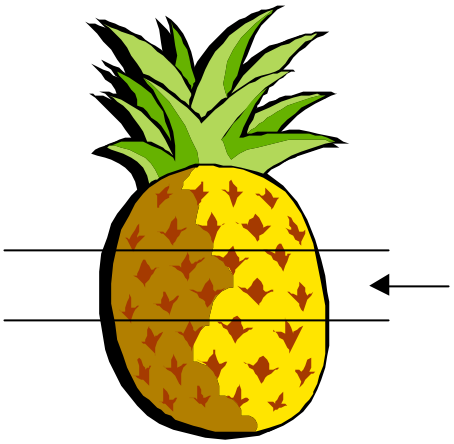
The test products were three varieties of fresh pineapple:
- MD2
- Smooth Cayenne
- Sugar Loaf (Netherlands and United Kingdom only)

Per country 15 to 18 fresh pineapples were received per variety. The quality of the pineapples was good. The pineapples were stored between 7 and 10°C. At the end of the day prior to the consumer test the products were kept at room temperature to be acclimatized the following day.

Between one and three pineapples (per variety) with good visual quality were selected for evaluation of outer appearance. The remaining pineapples (with a minimum of 12 pineapples of each variety) were used in the tasting sessions. The pineapples were equally divided among the sessions; e.g. if six sessions were held, two pineapples per variety per session were used.

Just prior to consumption the pineapples were prepared using the following preparation protocol:
Place the pineapple on its side

- Cut off the green top and the bottom of the pineapple
- Cut off the skin thickly to remove the skin well
- Cut out any remaining eyes
- Cut the rest of the pineapple in slices of 1 to 1,5 cm thick
- Remove the hard kernel
- Remove rotten parts if present. If a great part of the pineapple is rotten, discard the whole pineapple
- Slice pieces of 3-3,5 cm (widest side)
- Use as much as possible the center parts of the pineapple (see picture).
- For direct comparison, put two pieces of pineapple in a container. For semi-monadic testing, put one piece of pineapple in a container
- Use plastic containers with a lid
- Close the container with a lid to avoid dehydration



- The pieces have to be given to a participant for consumption within 20 minutes after cutting

Random three digit codes were used to identify the pineapples. Separate codes were used for 1) direct comparison (pairwise comparison or ranking), 2) liking and sensory perception and 3) outer appearance. In all tasks, the presentation order of the samples was balanced across the respondents (e.g. for 2 varieties, 25 consumers received MD2 first and 25 consumers received Smooth Cayenne as the first sample).

2.3 Tasting session

In France, Italy, Sweden, Switzerland, Germany and Spain the consumers evaluated two types of pineapple: MD2 and Smooth Cayenne. In the Netherlands and United Kingdom, a third variety, Sugar Loaf, was included.

The consumers received oral and (same) written instructions prior to the test. These instructions explained the different tasks the consumers were to conduct. The consumers were also instructed to rinse with water and/or eat a cracker between tasting the samples.

The consumers conducted three different tasks:

1. A comparison for preference of the pineapple varieties. In the Netherlands and United Kingdom this was a ranking procedure with three varieties in which the consumers were asked to rank them according to their preference. In the other countries a pairwise comparison was conducted in which the consumers were asked to indicate the preferred one.
2. An evaluation of liking and sensory attributes per variety. In this part of the test the consumers received one variety at the time (semi-monadic testing). Liking was measured using a nine point scale (with the anchor points coded 'like very little' and 'like very much') and 8 sensory attributes regarding inner appearance, taste and mouthfeel (intensity on a nine point scale; the anchorpoints used were 'very little…' and 'very..' followed by the attribute name, for pineapple taste the anchorpoints 'very weak' and 'very strong' were used). The sensory attributes the consumers scored were yellowness of the fruit, uniformity of the color, sweet, sour, pineapple taste, juicy, firm and ease to swallow. The pineapple taste refers to the strength of the pineapple flavour.
3. An evaluation of the outer appearance of the whole fruit. The outer appearance was evaluated using samples of the whole fruit and was scored for attractiveness using a nine point scale.

Finally, consumers were asked to report their consumption frequency of fresh pineapples, age and sex. Questionnaires were self-administered (see appendix 1 for questionnaire).

On the table, each consumer had a questionnaire, a pen, water and crackers, a fork and a box of tissues. The consumers received an appropriate fee for their partipication.

2.4 Conjoint experiment

In the Netherlands and in the United Kingdom the consumers participated in an additional experiment, in which the relative importance of information on fair trade and organic production on their purchase intent of pineapples was studied (conjoint analysis experiment).

In the conjoint experiment, four factors were included: variety, organic, fair trade and price. Table 1 lists the factors and levels used for the conjoint experiment.

Table 1 Factors and levels included in conjoint experiment

Factor	Level	Presentation to consumer	
		Netherlands	United Kingdom
Variety	1. MD2	Physical fruit piece	Physical fruit piece
	2. Smooth Cayenne	,,	,,
	3. Sugar Loaf	,,	,,
Organic	1. Yes	 Biologisch geproduceerd	Organically produced
	2. No		
Fair trade	1. Yes	 Eerlijke prijs voor de teler	Traded fair
	2. No		
Price	1. Regular	€ 2,95	£ 1.09
	2. Elevated	€ 3,70	£ 1.39

Consumers received a piece of pineapple in a plastic box together with a card containing information about the product with regard to organic production, fair trade and price. When the information condition for Organic or Fair Trade was 'No', no information was provided on the card. The information conditions 'Yes' for Organic and Fair Trade in the Netherlands were supported by a pictogram, as these are commonly used pictograms. As there are different pictograms for Organic and no specific pictogram for Fair Trade, only verbal descriptions were included. For the price level of the 'Normal' condition the price of a fresh pineapple in a premium quality supermarket at the time of the research was taken. The elevated price level was determined in cooperation with Ahold Ghana and Agro Fair, and was set at 15% above the regular price.

In theory, combining all factors with all levels yields 24 profiles (3 varieties x 2 levels of organic x 2 levels of fair trade x 2 price levels). As these are too many profiles for consumers to reliably assess within one session, a selection of 13 profiles was made. The first profile was the same for each consumer, the other 12 profiles were presented fully randomized. The consumers had to taste all the samples presented to them. In the instructions, consumers were told that there were only small differences between some of the pineapples, to mask the fact that they were actually consuming the same three varieties several times, and only the information was varied.

Consumers were asked to rate these profiles for liking and sensory attributes (using the same scales as described in 2.3) and for purchase intent. Purchase intent was scored on a five point scale defined by the anchorpoints 'definitely would not buy' and 'definitely would buy'.

2.5 Data analyis

Data were collected using Fizz-software (Biosystemes, v2.00k, 2003). For data analysis the software packages The Unscrambler (Camo, v7.6, 2000), Fizz calculations (Biosystemes, v2.10a, 2003) and SPSS (v 11.5, 2002) were used.

Differences in pairwise comparison of preferences were tested using the non-parametric Wilcoxon's test. Similarly, differences in preference ranking were tested using the Friedman one-way analysis of variance by ranks test.

To test the differences in liking, a paired samples t-test was conducted for two varieties. For three varieties, a oneway ANOVA. was used, and the Bonferroni test applied for posthoc testing. For these analyses, three profiles out of the conjoint set were used (one of each variety) that had the 'no' condition both in organic production and in fair trade.

Principal component analysis plots (PCA plots) or so-called biplots, were calculated in order to visualise the relations between products on the one hand, and sensory attributes on the other hand. Biplots are useful when presenting sensory data too complex for simple representation with bar charts, line profiles, and star profiles. Although biplots afford no precise information about the significance of the differences, they provide a general indication about the rank ordering of products on all depicted sensory properties, or attributes. For these reasons, they can be used to effectively demonstrate the main messages in the data while preserving simplicity of data presentation.

Conjoint analysis was used to study the importance of organic production and fair trade. Conjoint analysis is a multivariate technique with the objective of determining the contributions of the predictor variables and their respective levels to the desirability of the combination of variables to one dependent variable. In this experiment, purchase intent was used as the dependent variable. The predictor variables were the variety (3 levels: MD2/ Smooth Cayenne/ Sugar Loaf), organic production (2 levels: yes/no), fair trade (2 levels: yes/no) and price (2 levels: normal/elevated). An orthogonal design to study the main effects contains 8 profiles. In the analysis all 13 profiles were used. The advantage of using the full set of profiles is that models can be estimated more accurately. It was checked that the resulting deviation of orthogonality was acceptable.
Conjoint analysis is a technique which analyses consumer data on an individual level, that is for each consumer a model of the importance of the predictor variables is estimated. For each level of each factor part-worth estimates are calculated. The utility is a subjective preference judgement representating the holistic value of a specific object, which is formed by the combination of part worth estimates.

The importance of a factor is represented by the range of its levels (that is the range of the part-worths) divided by the sum of ranges across all levels (that is the sum of all part-worths). In this study, results were aggregated for the total group of consumers within one country, since the number of consumers in this experiment does not allow for segmentation.

For all analysis, a value of $p < 0.05$ was used as criterion for statistical significance. A trend is reported for a value of $p < 0.10$. Unless mentioned otherwise, only significant differences and trends are reported.

One respondent from the Netherlands and 2 from the United Kingdom were excluded from the data analyses due to missing values.

3 Results

3.1 Preferences

During the survey, two measures of liking were collected. A comparison between the samples was requested in a ranking task (or pair-wise comparison where only two varieties were included). Secondly, each consumer rated each sample semi-monadically on liking.

3.1.1 Preference ranking

The average preference ranks per variety per country are shown in Table 2. In the six countries where two varieties were tested, the MD2 and Smooth Cayenne are equally preferred. In Sweden, the difference in preference ranking displayed a trend (p=0.09) In the two countries where three varieties were tested, differences were found in the Netherlands, but not in the United Kingdom. In the Netherlands, MD2 is most preferred and Sugar Loaf least (P<0.005). In the United Kingdom, all three varieties were liked equally.

Table 2 Mean preference ranking per variety

Country	MD2	Smooth Cayenne	Sugar Loaf	Signi-ficance
Sweden[1]	1.62	1.38		Ns
Germany[1]	1.57	1.43		Ns
France[1]	1.58	1.42		Ns
Switzerland[1]	1.49	1.51		Ns
Italy[1]	1.54	1.46		Ns
Spain[1]	1.48	1.52		Ns
UK[2]	2.04	1.96	2.00	Ns
Netherlands[2]	1.65	2.02	2.33	***

[1] Two varieties were tested: 1 = most preferred, 2 = least preferred

[2] Three varieties were tested: 1 = most preferred, 3 = least preferred

*** = p < 0.005

3.1.2 Liking

The mean liking scores per variety are shown in Table 3.

Table 3 Mean liking score per variety

Country	MD2	Smooth Cayenne	Sugar Loaf	Signi-ficance
Sweden[1]	5.36	6.50		*
Germany[1]	6.49	6.71		ns
France[1]	5.63	4.98		ns
Switzerland[1]	6.55	6.00		ns
Italy[1]	4.72	4.86		ns
Spain[1]	6.26	5.52		ns
UK[2]	5.04	5.46	3.64	***
Netherlands[2]	6.15	5.20	4.83	**
Total	5.78	5.65	4.28	

[1] Two varieties were tested

[2] Three varieties were tested

* = $p < 0.05$

** = $p < 0.005$

*** = $p < 0.001$

In the six countries where two varieties were tested, MD2 and Smooth Cayenne were equally liked in all countries except Sweden. In Sweden, Smooth Cayenne was preferred to MD2 ($p<0.05$).

In the Netherlands and in the United Kingdom, the three varieties were not equally liked. In the Netherlands, MD2 was liked more than Sugar Loaf. In the United Kingdom MD2 and Smooth Cayenne were liked equally. Sugar Loaf was liked less than both MD2 and Smooth Cayenne. In the United Kingdom the preference ranking and the liking scores lead to different conclusions with regard to Sugar Loaf. In preference ranking a direct comparison between varieties is made by the consumer. In the liking test the consumers rate each variety separately, and a comparison is made indirectly using statistical analyses. Because of the direct comparison, usually preference ranking is more powerful in demonstrating differences in liking. In this test, every consumer conducted the preference ranking test first, and the liking test second. It is known that with repeated exposure preferences can change. Products that are initially liked equally, can display differences in liking over time (see e.g. Köster et al, 2003; de Kock, 2003) by an increase or decrease in liking over time. Possibly a decrease in the preference for Sugar Loaf is seen over time. Subsequent analysis support this reasoning. The consumers were divided into groups based on their ranking scores. The consumers who gave the highest rank to a specific variety were allocated to the same group. For each of these subgroups, mean liking scores for each variety were calculated. The results are provided in Table 4.

Table 4 Mean liking scores for subgroups of consumers based on rankings

Country	Rank 1 is MD2	Rank 1 is Smooth Cayenne	Rank 1 is Sugar Loaf
Sweden			
Liking MD2	6.8	4.5	
Liking Smooth Cayenne	5.0	7.4	
Germany			
Liking MD2	6.9	6.2	
Liking Smooth Cayenne	6.4	7.0	
France			
Liking MD2	6.6	4.9	
Liking Smooth Cayenne	4.2	5.6	
Switzerland			
Liking MD2	6.9	6.2	
Liking Smooth Cayenne	5.5	6.5	
Italy			
Liking MD2	5.7	3.9	
Liking Smooth Cayenne	3.9	5.7	
Spain			
Liking MD2	7.0	5.5	
Liking Smooth Cayenne	4.5	6.6	
United Kingdom			
Liking MD2	6.3	5.1	4.0
Liking Smooth Cayenne	5.4	5.6	5.3
Liking Sugar Loaf	3.6	3.8	3.5
Netherlands			
Liking MD2	6.1	6.4	5.8
Liking Smooth Cayenne	5.2	5.8	4.3
Liking Sugar Loaf	4.4	5.3	5.3

The British consumers that ranked Sugar Loaf highest (n=16), have lower mean liking scores for Sugar Loaf than for the other products. In the Netherlands, MD2 received the highest mean liking score in all subgroups, even when it had not been the product that received the highest ranking. This could indicate an increase in the Dutch consumer's preference for MD2 over time.

In the six countries where two products were tested the results show that consumers that provided ranking 1 to MD2, had a higher mean liking score for this product, and a lower mean liking for Smooth Cayenne. The same is seen for the consumers who ranked Smooth Cayenne highest. These consumers had higher mean liking scores for Smooth Cayenne than for MD2. The Swedish consumers that ranked Smooth Cayenne highest, liked Smooth Cayenne much more than MD2. This clarifies why the Swedish liking scores showed a significant difference, whereas the Swedish preference ranking scores did not.

With regard to the subgroups described in Table 4, it was analysed whether they differed with regard to sex, age and consumption frequency. Two significant differences were found. In Switzerland, the consumers that prefer MD2 are more often female. In Sweden, the consumers that prefer MD2 on average consume more pineapples than the consumers that prefer Smooth Cayenne.

3.2 Sensory attributes

Although there are some differences between countries, the overall patterns are quite similar. The overall evaluation of the sensory attributes are presented in a so-called “spiderweb” in Figure 1. The pineapple varieties have quite a different sensory profile. Compared with Smooth Cayenne, MD2 is more yellow and uniform in appearance, is sweeter and easier to swallow. MD2 is less sour and less firm than Smooth Cayenne. There are no differences in the intensity of pineapple aroma and juiciness. Sugar Loaf is the least yellow in appearance and has the least pineapple taste. It is less firm than Smooth Cayenne. In colour uniformity, sweet, sour, juicy and ease to swallow Sugar Loaf is quite comparable to Smooth Cayenne.

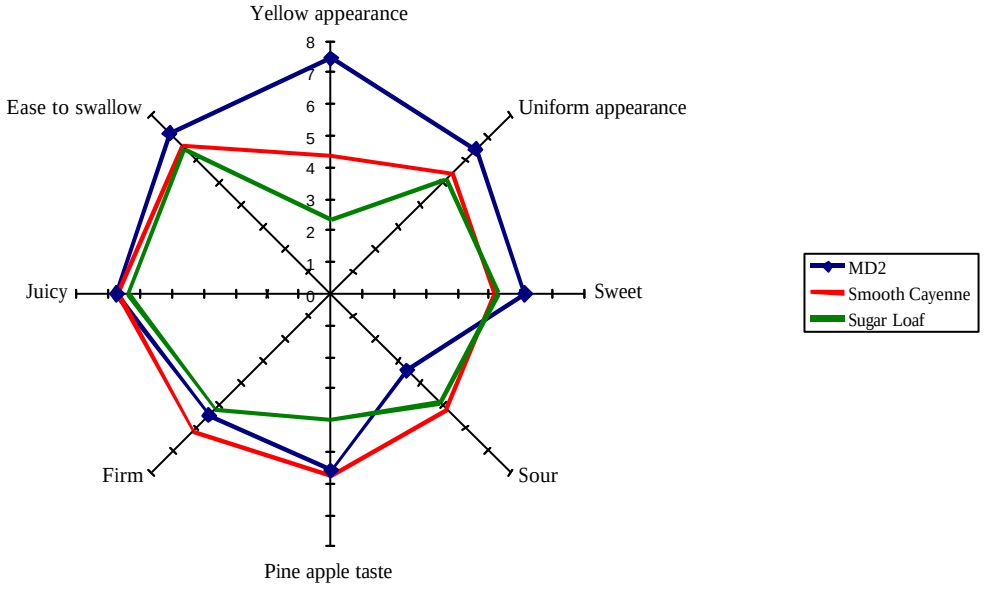


Figure 1 Sensory profiles of pineapple varieties

In Table 5 a summary of these sensory profiles is provided in numbers. Appendix 2 shows the means per variety per country.

Table 5 Summary of sensory attributes ratings

Sensory attribute	MD2 (n=405)[1]	Smooth Cayenne (n=405)[1]	Sugar Loaf (n=103)[2]	Signi-ficance
Yellow appearance	7.46[a]	4.35[b]	2.36[c]	***
Uniform appearance	6.47[a]	5.41[b]	5.12[b]	***
Sweet	6.11[a]	5.15[b]	5.27[b]	***
Sour	3.41[b]	5.16[a]	4.88[a]	***
Pineapple taste	5.58[a]	5.74[a]	3.97[b]	***
Firm	5.43[b]	6.13[a]	5.16[b]	***
Juicy	6.74[a]	6.70[a]	6.38[a]	Ns
Ease to swallow	7.19[a]	6.60[b]	6.49[b]	***

[1] Based on results from eight countries

[2] Based on results from two countries (Netherlands and United Kingdom)

[a,b,c] Products with different letters differ significantly

*** = $p < 0.001$

3.3 Relation between preferences and sensory attributes

Figure 2 shows the consumer preferences and sensory attributes in a so-called 'bi-plot'. In the bi-plot the attributes are represented by vectors that point in different directions out from the center or origin of the plot. The relationship between the vectors or attributes can be deduced from the angle between them at the origin. A small angle indicates a relatively close relationship between attributes, whereas a large angle indicates the opposite.

The relationship between the products and the attribute vectors can be interpreted by drawing a perpendicular line from the product point onto the attribute vector. When doing this, note that it is also possible to extend the vector backwards beyond the origin in the opposite direction. This would apply if products have a lower than average score on a certain attribute, in which case the perpendicular projection on the attribute vector is in the opposite direction. Attributes pointing in opposite directions have a high level of negative correlation with each other. Vectors at a 90 degree angle of each other to each other are not at all associated and there is no relationship between the scores.

The length of an attribute vector is related to the variance. The attribute which has the smallest range of mean scores, or smallest variance, is allocated the shortest vector.
A hypothetical product positioned at the origin would have average scores for every one of its attributes. Thus, it would be an 'average' product.

The primary axes do not carry a meaning by themselves. Their meaning is deduced from the attribute vector or group of attribute vectors mostly associated with them.

Note that the biplot may have multiple dimensions, all of which are projected onto a two-dimensional space. Thus, vectors in the biplot may imply a third or fourth (or even higher) dimension.

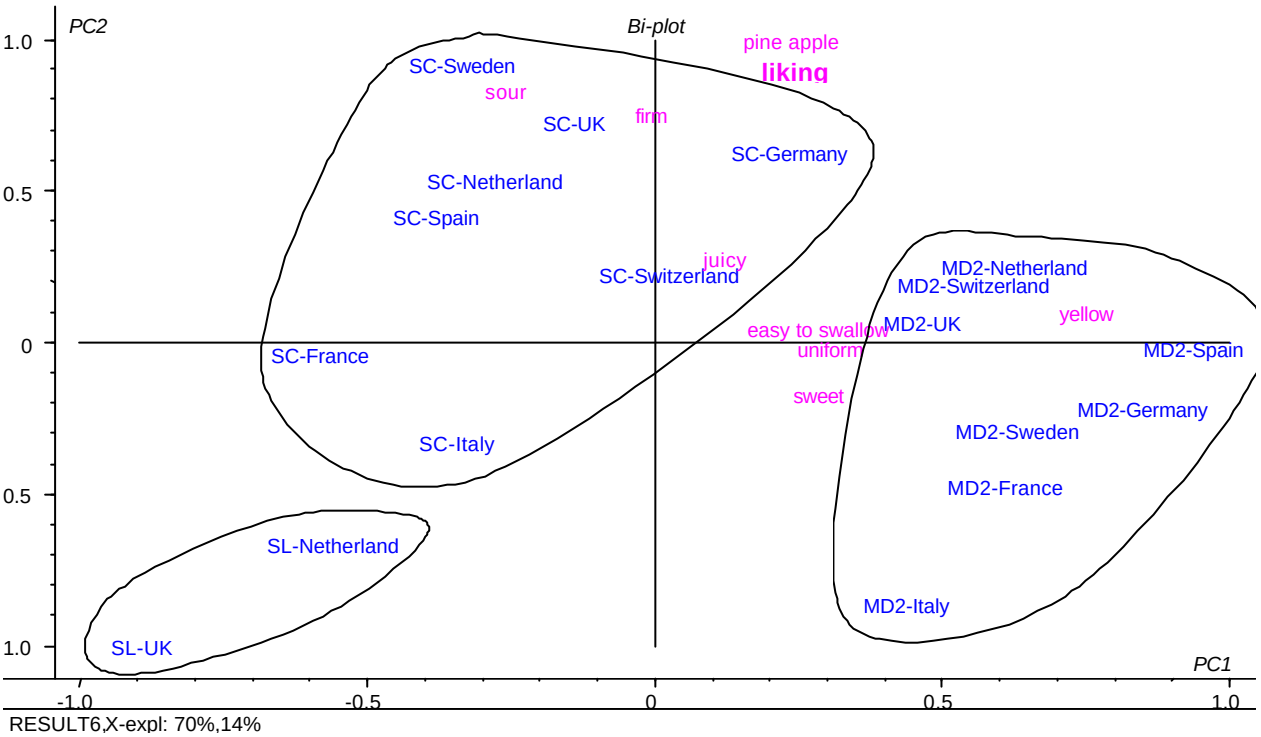


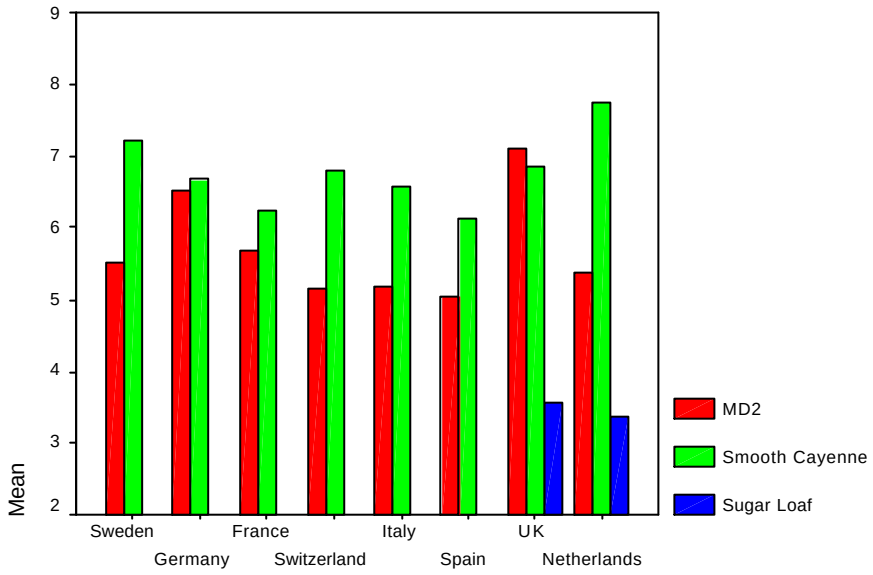
Figure 2 Bi-plot of consumer preferences and sensory attributes

In Figure 1 the products, liking and sensory attributes are shown. Products are indicated by an abbreviation of the product, followed by the country (e.g. SC-Italy is Smooth Cayenne based on sensory ratings from Italian consumers). The two principle components explain 84% of variance (70% + 14%), which means that the products are adequately represented in a two-dimensional space. The configuration of the products in the sensory space shows that the varieties are clearly distinct with respect to their sensory profiles. MD2 has a yellow and uniform color, is sweet and easy to swallow. Smooth Cayenne is the most sour variety. Sugar Loaf has the lowest score on pineapple taste. Liking is most closely related to pineapple flavour and juicy. MD2 and Smooth Cayenne are liked almost equally. Sugar Loaf is liked the least.

3.4 Outer appearance

Figure 3 shows the mean scores on evaluation of outer appearance, based on an evaluation of a sample of the whole fruit. In all countries except for the United Kingdom, Smooth Cayenne is found most attractive. In the United Kingdom MD2 and Smooth Cayenne are most and equally liked, and Sugar Loaf is least liked for its appearance. In the Netherlands, Smooth Cayenne is liked most, then MD2, and Sugar Loaf is liked least on appearance. All differences described are significant.

Figure 3 Mean attractiveness of outer appearance per country per variety (1= lowest, 9 = highest)



3.5 Effect of variety, organic production, fair trade and price on purchase intent

In the Netherlands and United Kingom, the effect of variety, organic production, fair trade and price on purchase intent was established using conjoint analysis.

3.5.1 Factor importance and estimated part-worths

Table 6 summarizes the results of this analysis by providing estimated part-worths per level and overall factor importance. Results are presented for the Netherlands and United Kingdom separately. Figure 4 displays the factor importance graphically.

Table 6 Estimated part-worths and factor importance for Netherlands and United Kingdom

	Netherlands		United Kingdom	
	Estimated part-worth	Factor importance	Estimated part-worth	Factor importance
Variety				
MD2	0.3512	46.7%	0.1986	45.5%
Smooth Cayenne	-0.0896		0.2199	
Sugar Loaf	-0.2615		-0.4184	
Organically produced				
Yes	0.0588	19.1%	0.0000	21.3%
No	-0.0588		0.0000	
Fair trade				
Yes	0.0503	14.7%	0.0957	14.8%
No	-0.0503		-0.0957	
Price				
Regular	0.1510	19.6%	-0.0426	18.4%
Elevated	-0.1510		0.0426	

Overall results in terms of the factor importance were similar for the Netherlands and the United Kingdom. Variety was the most important factor, explaining over 45% of variance. Organic production and price each contributed around 20%, and fair trade was considered least important in both countries (around 15%).

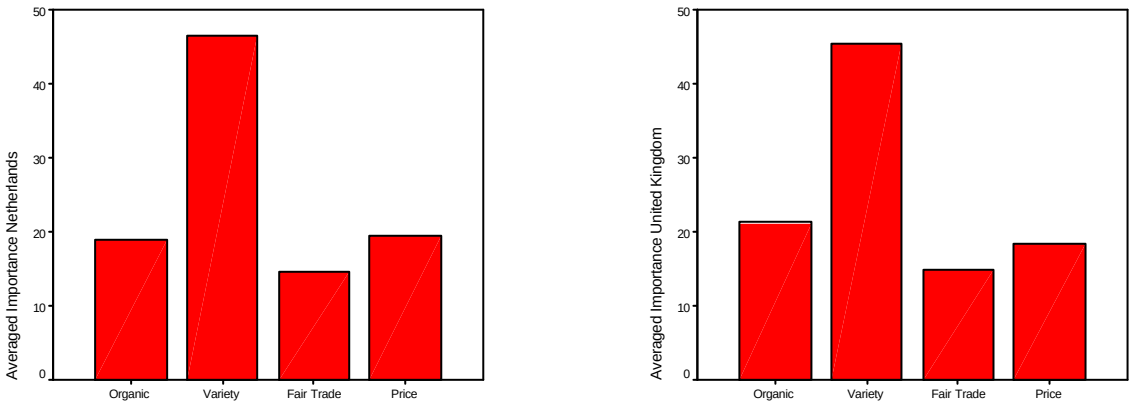


Figure 4 Importance summary for the Netherlands and United Kingdom

In Figure 5 the part-worth estimates for the different levels within each factor in the Netherlands are shown. Variety had the largest range of part-worths. Within this factor, MD2 contributed positively to purchase intent, Smooth Cayenne contributed slightly negatively and Sugar Loaf largely negatively to purchase intent.

Organic production and fair trade overall contributed positively to purchase intent, but their magnitudes were very low. A normal price was favoured over an elevated price.
Model-fit and predictive accuracy for the estimation of part-worths were acceptable (94% and 73% of explained variance respectively).

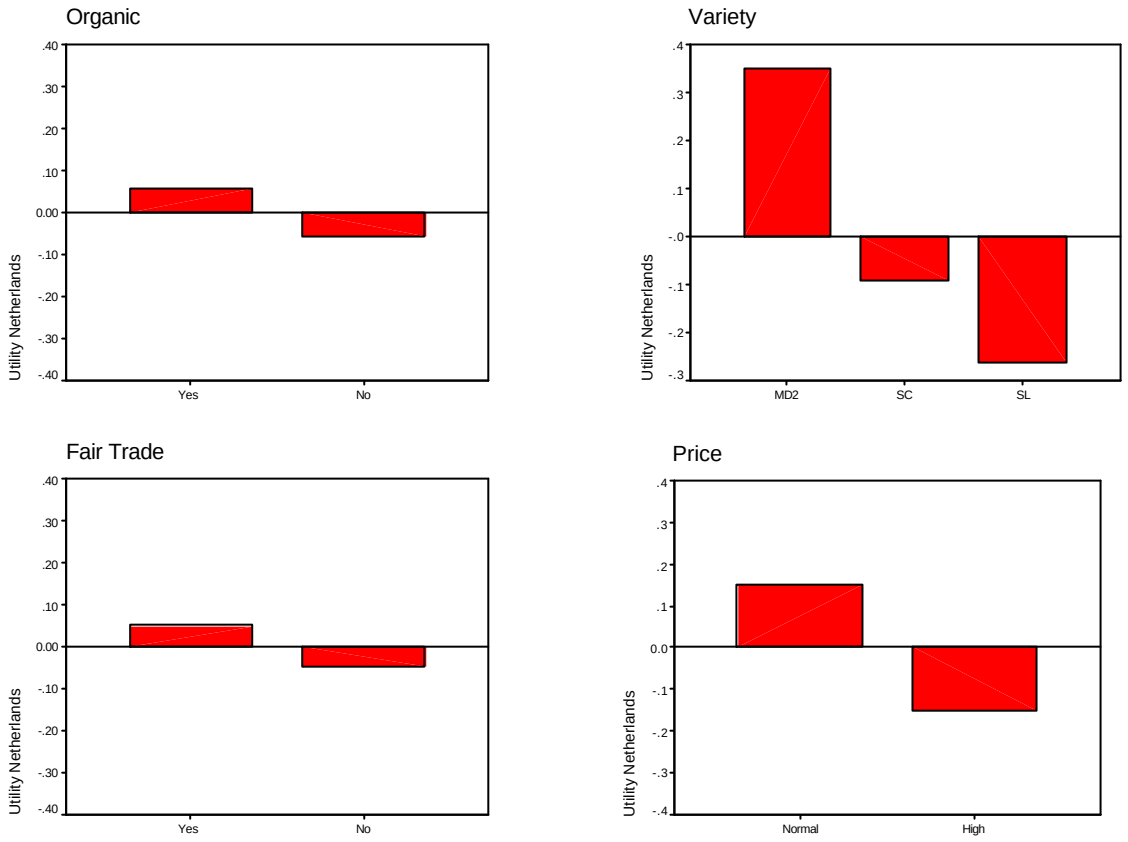


Figure 5 Part-worth estimates for the Netherlands

In Figure 6 the part-worth estimates for the United Kingdom are shown. Again, variety had the largest magnitude of part-worths. In the UK, both MD2 and Smooth Cayenne had a positive influence on the purchase intent. The purchase intent was lower in the case of Sugar Loaf. Information about organic production had no influence on the overall purchase intent. If a product was claimed to be 'traded fair', a small positive influence on the purchase intent was found. An elevated price has a positive but small influence on purchase intent.

The model-fit and predictive accuracy for the estimation of part-worth were acceptable (91% and 71% of explained variance respectively).

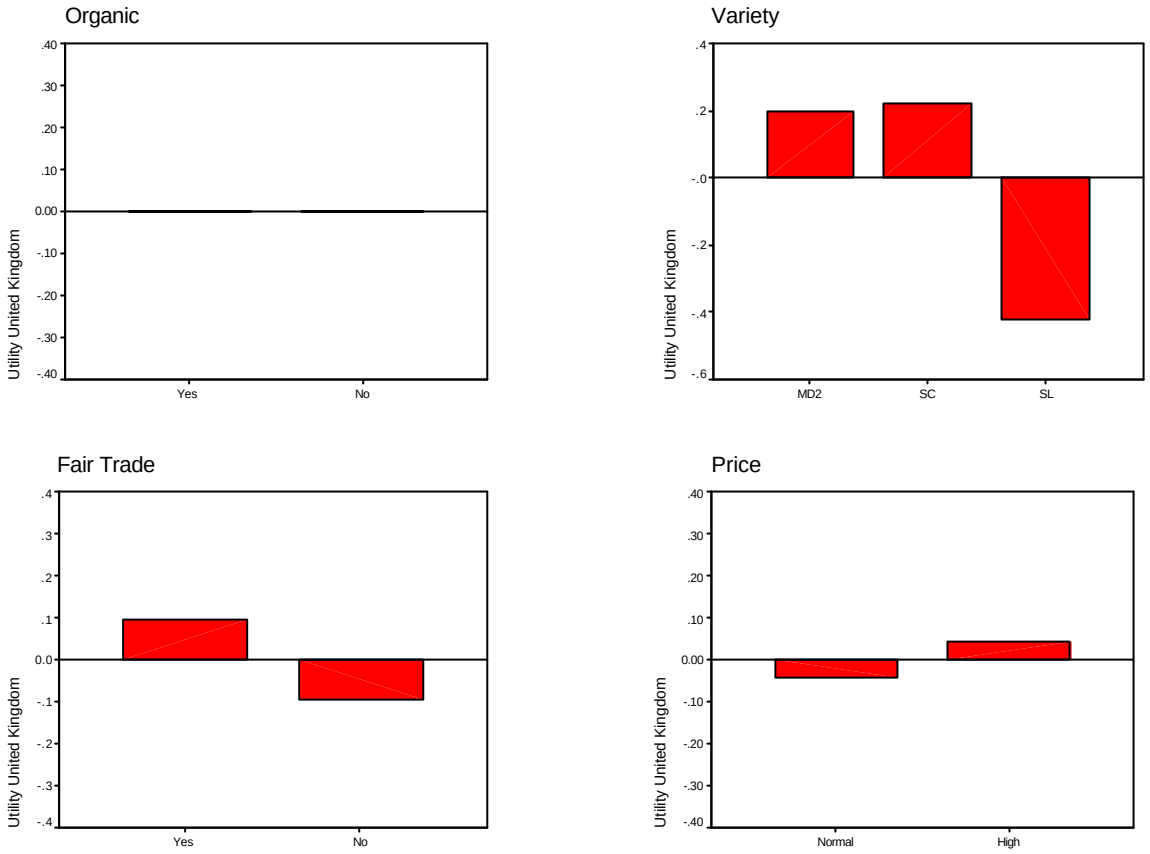


Figure 6 Part-worth estimates for United Kingdom

Part-worths for most factors (organic and fair trade in both countries, price in the United Kingdom) were low, but overall factor importance (which is derived from the range of part-worths) still was considerable. This can be explained by the fact that analyses were conducted on a group level and not on an individual level, because of the small sample size of the test. As a result, individual differences were leveled out. For instance, the overall factor importance of organic production in United Kingdom was around 20%, yet the part-worths of the level did not contribute positively or negatively to purchase intent. This indicates that the direction of the favoured option varied for individual consumers. The examination of individual results is helpful in understanding the overall results (see Figures in Appendix 3 and 4 for the Netherlands and the United Kingdom). Individual results indeed show that information about organic production positively influenced purchase intent for some consumers, but that the opposite was true for others. The same dichotomy was found for price (and to a lesser extent for fair trade) in the United Kingdom, and for organic production and fair trade in the Netherlands. This implies that the markets for organic and fair trade can not be considered homogeneous.

3.5.2 Simulation

In order to simulate what would happen in the market in the case consumers were also able to choose organic or fair trade products, two simulation tests were run. A simulation test calculates the probability of choosing a particular simulation profile as the most preferred one.

Two simulation tests were run, one for organic and one for fair trade. In the first simulation test, an organic pineapple at an elevated price was compared with a regular pineapple at a normal price. The other factors were held constant. In a second simulation, a 'fair trade' pineapple at an elevated price was compared with a regular pineapple at a normal price. Again, other factors were held constant. The results are shown in Table 7 and Table 8.

Table 7 Comparison of elevated price organic pineapple with normal price regular pineapple (simulation)

	Estimated percentage of consumers that would choose:	
	Organic pineapple at elevated price	Regular pineapple at normal price
Netherlands	44%	56%
United Kingdom	66%	34%

Table 8 Comparison of elevated price 'fair trade' pineapple with normal price regular pineapple (simulation)

	Estimated percentage of consumers that would choose:	
	Fair trade pineapple at elevated price	Regular pineapple at normal price
Netherlands	45%	55%
United Kingdom	64%	36%

In the organic simulation test, 44% of the Dutch consumers and 66% of the British consumers were estimated to choose the organic pineapple at an elevated price.
In the fair trade simulation test, 45% of the Dutch consumers and 64% of the British consumers were estimated to choose the fair trade pineapple at an elevated price.

3.6 Consumer sample

3.6.1 Sample size

In total, 408 consumers participated from 8 countries. Due to missing values 3 consumers (one from the Netherlands, two from United Kingdom) were excluded from the data analysis. Table 9 lists the number of consumers per country.

Table 9 Sample size of consumer survey per country

Country	Number of consumers
Sweden	50
Germany	51
France	52
Switzerland	49
Italy	50
Spain	50
United Kingdom	48
Netherlands	55
Total	405

3.6.2 Gender

Of the 405 consumers that participated, 34% were male and 66% were female consumers. In Figure 7 results per country are shown.

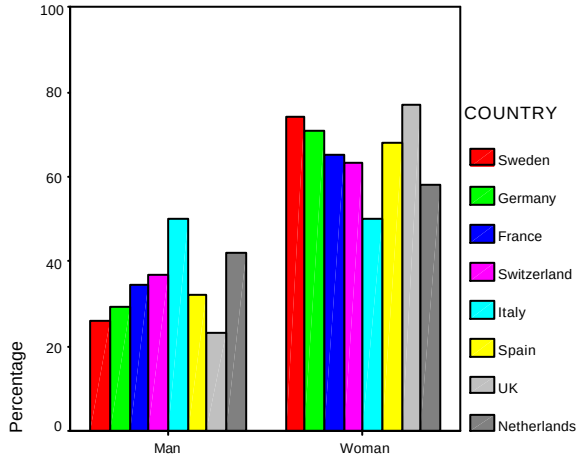


Figure 7 Gender of consumers per country

3.6.3 Age

The age distribution of the consumers is provided in Table 10. Although no specific criteria with regard to age were set, there was a fair distribution of consumers across the age groups.

Table 10 Age group distribution of consumers per country

Age group	Sweden	Germany	France	Switzerland	Italy	Spain	UK	Netherlands	Total
< 20 years			2%	2%			6%	22%	4%
21-30 years	22%	12%	10%	33%	16%	62%	26%	40%	27%
31-40 years	26%	24%	23%	22%	22%	28%	26%	16%	23%
41-50 years	12%	33%	17%	20%	22%	8%	26%	5%	18%
51-60 years	12%	24%	33%	20%	20%	2%	17%	9%	17%
> 60 years	28%	8%	15%	2%	20%			7%	10%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

3.6.4 Consumption frequency of fresh pineapple

The mean consumption frequency of fresh pineapples was 13.1 pineapple. There was a large variation between the countries (see Figure 8). In France, Germany and Spain pineapples were most frequently consumed, whereas in the Netherlands, the United Kingdom and Sweden the consumption frequency was lowest. There was also a large variation within the countries. Overall, 15% of the consumers consumed pineapples 2-3 times a year, 47% between 4 and 10 times a year, 23% between 11 and 20 times a year and 15% over 20 times a year.

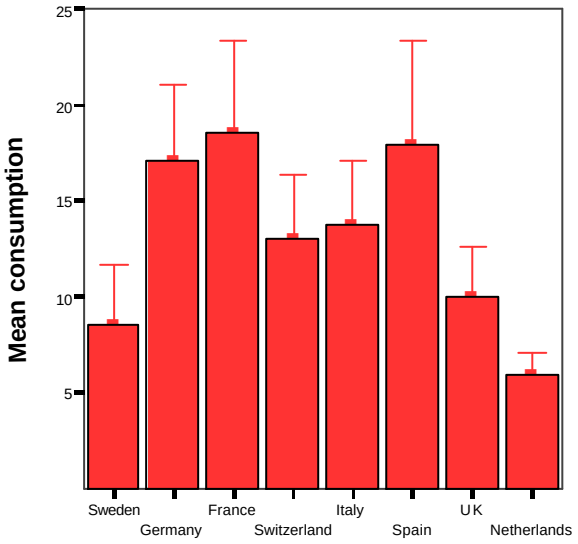


Figure 8 Mean consumption frequency (± SD) of fresh pineapple per country

4 Conclusions and discussion

4.1 Preferences and sensory attributes

The main conclusions are:

- In the Netherlands, where three varieties were tested, MD2 was liked most, Smooth Cayenne was the second most liked and Sugar Loaf was liked the least.
- In the United Kingdom, where the same three varieties were tested, MD2 and Smooth Cayenne were liked equally. For Sugar Loaf contrasting results were found with the two preference measures. With preference ranking Sugar Loaf was liked equally, based on the ranking scores it was liked less than the other varieties. This could be due to a decrease in preference after repeated exposure.
- In the United Kingdom, MD2 and Smooth Cayenne were equally liked, and Sugar Loaf was liked the least.
- In Sweden, Germany, France, Switzerland, Italy and Spain two varieties were tested. MD2 and Smooth Cayenne were liked equally, with the exception of Sweden, where Smooth Cayenne was liked better than MD2 based on liking scores.
- The products differed in their sensory profiles as established by consumers. These sensory profiles were similar across all countries. MD2 was yellow and uniform in appearance, sweet, not sour, had a pineapple taste and was easy to swallow. It was less firm than Smooth Cayenne. Compared to MD2, Smooth Cayenne was less yellow and uniform, less sweet and less easy to swallow but more sour and firm. Sugar Loaf was the least yellow in appearance and had the least pineapple taste. On the attributes uniform appearance, sweet, sour, juicy and ease to swallow Sugar Loaf did not differ from Smooth Cayenne.
- Liking was most closely related to pineapple taste and juicy.
- The outer appearance of Smooth Cayenne was liked most. Only in the United Kingdom, Smooth Cayenne and MD2 were liked equally for outer appearance.
- Consumption frequency of pineapple differed across countries. In Germany, France and Spain pineapples were consumed most frequently. In the Netherlands, United Kingdom and Sweden pineapples were consumed least frequently.
- The low consumption frequency in the Netherlands, the United Kingdom and Sweden suggest room for market growth.

The main aim of this study was to compare preferences for MD2 with Smooth Cayenne. In the Netherlands, MD2 was preferred over Smooth Cayenne. In Sweden, there is some evidence that Smooth Cayenne was preferred over MD2. In the other countries, MD2 and Smooth Cayenne were liked equally. However, this does not necessarily mean that individual consumers equally prefer both varieties. The consumers clearly perceive the products to be different in sensory properties. Possibly the market within most of the countries is segmented, with one consumer segment preferring MD2, and another Smooth Cayenne. Support for market segmentation was found in the fact that subgroups that ranked MD2 highest, had higher mean liking scores for MD2 than for Smooth Cayenne. The same was true for Smooth Cayenne.

With the following results at least two possible strategies can be considered:

1) MD2 and Smooth Cayenne are not significantly different in most countries. In deciding on which variety (varieties) to grow and export, other factors such as production and shipping costs and keepability could be included.
2) Another option is to provide the market with both MD2 and Smooth Cayenne. The sample size of this study was not sufficient to investigate market segmentation and the sizes of these market segments. A study with at least 300 consumers per country would be required to allow for such segmentations. If such a test would be carried out, it is advisable to include other demographic, socio-economic and usage and attitudes variables, which allows the determination of different consumer profiles. A strategy of market differentation could clearly benefit from such a test.

4.2 Importance of organic production and fair trade on purchase intent

The conclusions are:

- Variety is most important for purchase intent, accounting for over 45% of variance. Organic production and price are equally important, each accounting for about 20% of variance. Fair trade is accounting for 15% of variance in the total group of consumers. The same results were found for the Netherlands as for the United Kingdom
- Overall, organic production has a positive but small influence on the purchase intent in the Netherlands. In the United Kingdom, overall organic production does not contribute positively nor negatively.
- Overall, fair trade has a positive but small influence on the purchase intent in the Netherlands and in the United Kingdom.
- In the Netherlands, a higher price has a negative influence on the purchase intent. In the United Kingdom price has a small but positive influence on the purchase intent.
- In a choice simulation test, 44% of the Dutch and 66% of the British consumers preferred an organic pineapple at a higher price to a regular pineapple. For fair trade, 45% of Dutch and 64% of the British consumers preferred the fair trade pineapple to the regular pineapple.

There seem to be markets for organically produced and ‘fair traded’ pineapples in both the Netherlands and United Kingdom. However, these markets are likely small, as only a subgroup of consumers would prefer these products over regular pineapples. Other consumers either are not willing to pay additionally or have a negative attitude towards these features. Interesting is that for a subgroup of British consumers price seems to be a quality indicator.

The results of the simulation tests in this study are not the potential sizes of the market segments in real life, but are likely to be smaller. One reason is the small sample size of the study. Another reason is that although the experiment was developed carefully, is still is not a real life situation.

Although price was one of the factors included in the design, consumers were not faced with real financial consequences for their choices. In general, this is found to lead to an underestimation of the importance of price. Other research techniques, such as observational research in real-life settings, would be necessary to predict more accurately the influence of price.

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Appendix 1 Questionnaire

In an moment you will taste three pieces of fresh pine apple. Please taste the products in the order presented, from left to right.

Rank the pieces of pine apple according to your preferences: 1 for the product you prefer most,
2 for the product you prefer most after that, and 3 for the product you prefer least.
Each product should receive a different rank.

	269	843	184
1st place (most preferred)	☐	☐	☐
2nd place	☐	☐	☐
3rd place (least preferred)	☐	☐	☐

Taste the piece of pine apple before you. For each question, place a mark in the box that corresponds with your opinion of the pineapple.

How much do you like this piece of pine apple?

like very little — like very much

How yellow is the color of this piece of pine apple?

very little yellow — very yellow

How uniform is the color of this piece of pine apple?

very little uniform — very uniform

How sweet is this piece of pine apple?

very little sweet — very sweet

How sour is this piece of pine apple?

very little sour — very sour

How strong is the pine apple taste of this piece of pine apple?

very weak — very strong

How firm is this piece of pine apple?

very little firm — very firm

How juicy is this piece of pine apple?

very little juicy — very juicy

How willing are you to buy this piece of pine apple?

definitely would not buy — definitely would buy

Comments: (optional) ……
……
……

How much do you like the appearance of this pine apple?

like very little — like very much

In which age category do you belong?

20 years or younger ☐
21-30 years ☐
31-40 years ☐
41-50 years ☐
51-60 years ☐
61 years or older ☐

Are you male or female?

Male ☐
Female ☐

How many times a year do you consume fresh pine apple?

About ☐ times per year

Appendix 2 Mean scores of sensory attributes per country

Table 11 Yellow color of pineapple (1= very little yellow; 9=very yellow)

Country	MD2	Smooth Cayenne	Sugar Loaf
Sweden[1]	7.72	3.96	
Germany[1]	7.90	5.18	
France[1]	7.17	3.31	
Switzerland[1]	6.80	4.78	
Italy[1]	6.90	4.06	
Spain[1]	8.10	3.94	
UK[2]	7.67	5.10	1.79
Netherlands[2]	7.42	4.53	2.85
Total	7.46	4.35	2.36

[1] Two varieties were tested; [2] Three varieties were tested

Table 12 Uniformity in color of pineapple (1= very little uniform; 9=very uniform)

Country	MD2	Smooth Cayenne	Sugar Loaf
Sweden[1]	5.32	5.04	
Germany[1]	7.33	5.80	
France[1]	6.62	4.85	
Switzerland[1]	6.22	5.14	
Italy[1]	5.98	5.34	
Spain[1]	7.20	5.22	
UK[2]	6.60	6.48	5.60
Netherlands[2]	6.44	5.49	4.69
Total	6.47	5.41	5.12

[1] Two varieties were tested; [2] Three varieties were tested

Appendix 2 – continued –

Table 13 Sweet taste of pineapple (1= very little sweet; 9=very sweet)

Country	MD2	Smooth Cayenne	Sugar Loaf
Sweden[1]	6.16	4.78	
Germany[1]	7.49	5.82	
France[1]	6.06	4.75	
Switzerland[1]	5.47	5.94	
Italy[1]	5.40	4.66	
Spain[1]	6.88	5.06	
UK[2]	5.33	5.17	5.04
Netherlands[2]	6.00	5.02	5.47
Total	6.11	5.15	5.27

[1] Two varieties were tested; [2] Three varieties were tested

Table 14 Sour taste of pineapple (1= very little sour; 9=very sour)

Country	MD2	Smooth Cayenne	Sugar Loaf
Sweden[1]	3.64	5.94	
Germany[1]	2.10	3.92	
France[1]	3.33	5.54	
Switzerland[1]	3.80	4.33	
Italy[1]	2.84	4.22	
Spain[1]	3.04	5.46	
UK[2]	4.58	5.96	5.08
Netherlands[2]	4.02	5.89	4.71
Total	3.41	5.16	4.88

[1] Two varieties were tested; [2] Three varieties were tested

Appendix 2 – continued –

Table 15 Pineapple taste of pineapple (1= very weak; 9=very strong)

Country	MD2	Smooth Cayenne	Sugar Loaf
Sweden[1]	5.34	6.24	
Germany[1]	6.49	6.67	
France[1]	5.17	5.00	
Switzerland[1]	5.90	5.73	
Italy[1]	4.92	5.16	
Spain[1]	5.58	5.60	
UK[2]	5.21	5.88	3.56
Netherlands[2]	5.95	5.69	4.33
Total	5.58	5.74	3.97

[1] Two varieties were tested; [2] Three varieties were tested

Table 16 Firm texture of pineapple (1= very little firm; 9=very firm)

Country	MD2	Smooth Cayenne	Sugar Loaf
Sweden[1]	5.34	6.06	
Germany[1]	4.76	6.08	
France[1]	4.87	5.65	
Switzerland[1]	5.18	5.98	
Italy[1]	5.08	5.74	
Spain[1]	5.88	6.34	
UK[2]	6.38	6.73	5.29
Netherlands[2]	5.96	6.44	5.04
Total	5.43	6.13	5.16

[1] Two varieties were tested; [2] Three varieties were tested

Appendix 2 – continued –

Table 17 Juiciness of pineapple (1= very little juicy; 9=very juicy)

Country	MD2	Smooth Cayenne	Sugar Loaf
Sweden[1]	6.70	6.74	
Germany[1]	7.10	7.39	
France[1]	6.60	6.40	
Switzerland[1]	6.98	7.02	
Italy[1]	6.14	6.34	
Spain[1]	7.36	6.76	
UK[2]	6.71	7.10	6.65
Netherlands[2]	6.38	5.96	6.15
Total	6.74	6.70	6.38

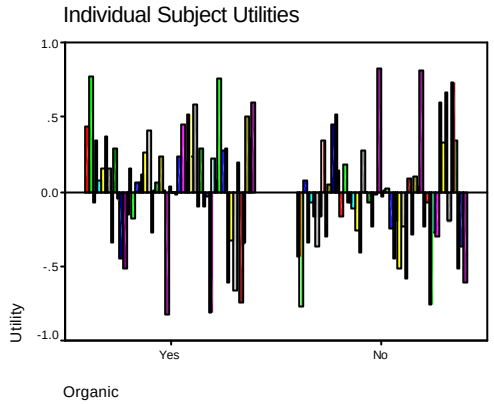
[1] Two varieties were tested; [2] Three varieties were tested

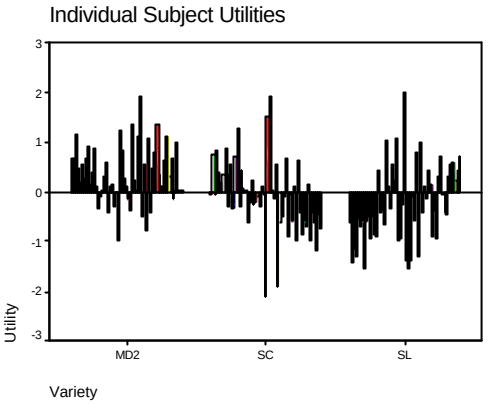
Table 18 Ease to swallow pineapple (1= very difficult; 9=very easy)

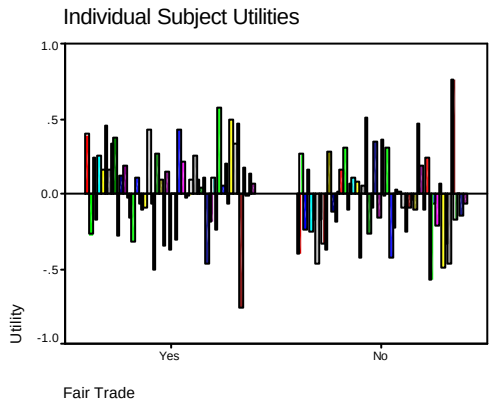
Country	MD2	Smooth Cayenne	Sugar Loaf
Sweden[1]	7.60	7.22	
Germany[1]	7.98	7.39	
France[1]	6.92	6.46	
Switzerland[1]	7.31	7.00	
Italy[1]	6.90	5.90	
Spain[1]	7.32	6.58	
UK[2]	6.88	6.54	6.60
Netherlands[2]	6.64	5.76	6.38
Total	7.19	6.60	6.49

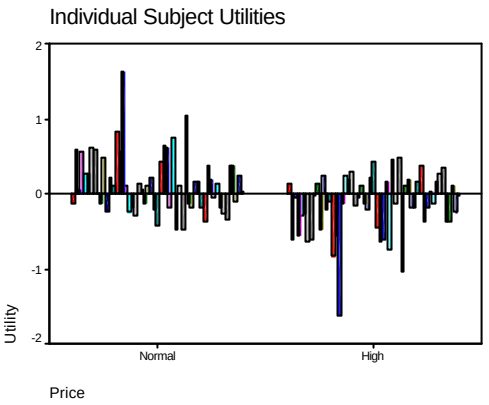
[1] Two varieties were tested; [2] Three varieties were tested

Appendix 3 Individual subject utilities for the Netherlands



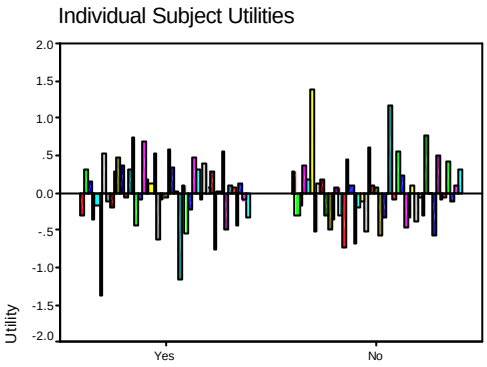


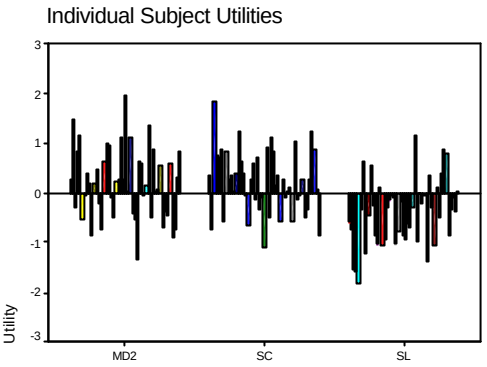


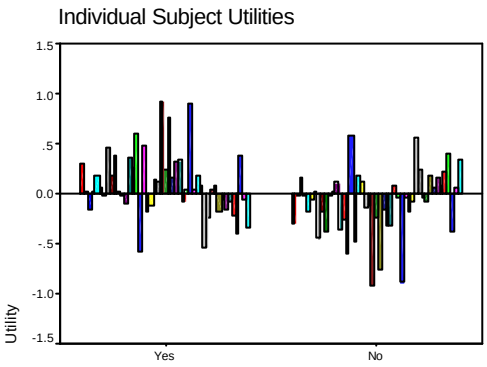


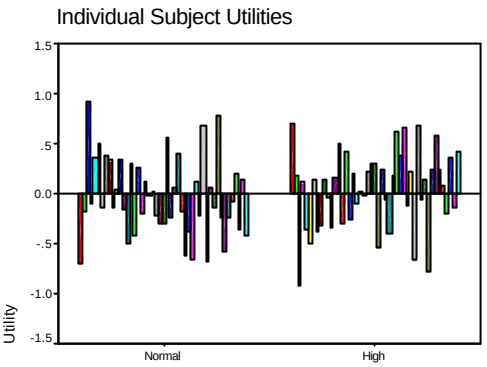
One bar respresents one consumer

Appendix 4 Individual subject utilities for United Kingdom









One bar represents one consumer.