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CONSUMER PREFERENCES FOR FRESH AND AGED APPLES: A CROSS-CULTURAL COMPARISON

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ABSTRACT

Sensory preference for three apple varieties varying in degree of mealiness was investigated among British and Danish consumers. The experimental design was reflected in the sensory profiles, where differences in flavour were mainly related to varieties and differences in texture mainly to mealiness condition. Internal preference mapping showed that preference was more strongly related to variety than mealiness condition. Overall, Boskoop apples were less preferred than Cox and Jonagold. Mealiness was considered a negative quality attribute associated with fluffy appearance, stale flavour and floury and granular texture. The preference patterns for British and Danish consumers were similar and reflected no cross-cultural differences. Differences between individuals varying in Private Body Consciousness (PBC) were not reflected in the preference patterns. Internal preference maps obtained from high and low PBC individuals were largely similar. However, high PBC individuals appeared to rely more strongly on the sensory characteristics of apples than low PBC individuals when forming preference ratings. © *1998 Elsevier Science Ltd. All rights reserved*

Keywords: Apples; mealiness; consumer preferences; internal preference mapping; cultural differences; individual differences; PBC.

INTRODUCTION

In Britain, the consumption of fresh fruit has increased steadily over the last two decades. However, the popularity of apples is being challenged by other types of fruit, notably bananas, soft citrus and grapes (MAFF, 1996). Further, British grown apples which currently supply about 30% of the UK consumption, are facing competition from apples grown in New Zealand, South Africa, Eastern Europe and the US. Newer bi-coloured varieties like Jonagold, Elstar, and, particularly Fuji, Gala and Braeburn are becoming very popular at the cost of traditional major commercial varieties like Red Delicious, Golden Delicious, and Granny Smith (Seaton, 1996). However, Britain is not unique in this respect. Similar changes in the fresh fruit consumption are taking place throughout Europe.

In the apple industry these changes have created a growing awareness of the importance of keeping the varietal mix in line with consumer preferences. Recent market research conducted for ENZA, the marketing organisation for New Zealand apples in the UK, has shown that nearly 80% of UK consumers consider quality more important than price (Market Review, 1996). While flavour undoubtedly contributes greatly to consumer acceptance of apples, it is not the only sensory property of importance. History has shown that screening to optimise one sensory characteristic often results in losses in quality of others, e.g. texture (McDaniel, 1995). Recent research on twelve commercially available dessert apple varieties (Dalliant-Spinnler *et al.*, 1996) showed that both flavour and texture played important roles for consumer preference. Further, texture and flavour were more important than aroma or appearance, although the latter appeared to drive the lower preference dimensions. Sensory characteristics like spongy texture and negative flavour attributes (e.g. soapy, off-flavour and pear-like) influenced consumer preference negatively. Most consumers' preference vectors were lying in the direction positively associated with firmness, juiciness and sweetness. Note that these results are in line with the shift in preference patterns from Golden Delicious toward Braeburn and Fuji mentioned above.

Some fruits including apples, peaches and tomatoes vary in susceptibility to becoming mealy. Growers and traders in the apple industry consider mealiness, a characteristic associated with powdery, floury and granular texture, a negative quality attribute. The susceptibility to becoming mealy differs not only among fruits but also within varieties of each type of fruit. For apples, Jonagold and Cox varieties are more susceptible to becoming mealy than, for example, Granny Smith and Fuji. Although the importance of mealiness for consumer perception of apple quality has not been established exactly, it is expected to be negative. This notion is tested in the

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present study, which aims to explore the sensory changes occurring when apples become mealy, and the influences of these on consumer preference. *Specifically, it is predicted that consumers perceive mealiness as a negative quality attribute, and show higher liking for fresh than aged apples (hypothesis 1).*

The total world supply of apples is predicted to reach 53 million tonnes in 2000, an increase of more than 50% compared to 1980 (Seaton, 1996). One likely result of this dramatic rise in output is an increase in international trading, with produce being consumed in a different part of the world to where it was grown. This development is, however, no different for apples than many other commodities. All markets are becoming increasingly international (Buisson, 1995), and products are sold worldwide to consumer populations with differing preference patterns. Thus, producers, growers and trade organisations are faced with not only understanding the relationship between consumer preference and product characteristics, but also how this relationship depends on the cultural context. Although research in this area is not new, the growing internationalisation of markets is reflected in an increased interest in cross-cultural research. Prior to 1990, there was little research on cross-cultural differences particularly with reference to foods rather than simple aqueous solutions. However, results from the latter, showing that chemosensory perception is largely similar across cultures (e.g. Druz and Baldwin, 1982; Prescott *et al.*, 1992), have also been confirmed in food products, for example, coffee (Lundgren *et al.*, 1978) and orange juice, corn-flakes and ice-cream (Prescott *et al.*, 1997). In contrast to sensory perception, preferences tend to differ between cultures (Prescott and Bell, 1995). For example, Druz and Baldwin (1982) reported substantial differences in the levels of sweetness preferred by Koreans and Nigerians compared to North American Caucasians. Differences between Taiwanese and US students with respect to sweetness in cookies were reported by Bertino *et al.* (1983). MacDonald *et al.* (1993) found some differences between Peruvian and Canadian consumers' preferences for bitterness and salt in potato purée. For apples, there has been little published research on consumer preferences. The study by Dalliant-Spinnler *et al.* (1996) was performed with British consumers only, and consumer preferences for dessert apples have not yet been explored in a cross-cultural context. We attempt to do so in this study by comparing preference patterns for British and Danish consumers.

Food related cultural differences have previously been identified using the food-related lifestyle instrument (Brunsø *et al.*, 1996), theory of Planned Behaviour (Ajzen, 1988), and laddering and means-end chain methodology (Gutman, 1982; Reynolds and Gutman, 1988). Using these methodologies, cultural differences between Denmark and Britain have been established with respect to food choice and value perception (e.g. Shepherd *et al.*, 1998) and consumer attitudes to food (e.g. IEFS, 1996). A recent EU project on 'the development of models for understanding and predicting consumer food choice' (AIR2-CT94-1315) has contributed substantially to this research. During this project, differences between Danish and British consumers, specifically with respect to attitudes to buying organic pork and product perceptions of beef and vegetable oil, were established (Shepherd *et al.*, 1998). *Based on the findings outlined above, we predict that preference patterns for apples among British and Danish consumers differ (Hypothesis 2).*

Several different approaches to the identification of consumer segments, including demographic characteristics, product benefits and lifestyle are used in consumer and market research. In brand preference studies these approaches have successfully been used to characterise consumer segments with different preferences for, e.g. fermented lamb sausages (Helgesen *et al.*, 1997), restructured steaks (Nute *et al.*, 1988), lager (Greenhoff and MacFie, 1994) and the likelihood of consuming starchy foods (Monteleone *et al.*, 1998). Personality characteristics have also been identified as influencing consumer perception and preferences (Pangborn, 1981). Private Body Consciousness (PBC: Miller *et al.*, 1981), an individual difference measure of inner bodily awareness, is one such personality characteristic. Subjects are classified as being either high or low in PBC on the basis of their sensitivity to changes in body temperature, internal tensions, heart rate, dryness of mouth and throat, and hunger sensations. The Private Body Consciousness measure has previously been successfully linked to differences in aspects of human behaviour including stress (Baradell and Klein, 1993); problem solving (Klein and Barnes, 1994); perception of pain (Ahles, 1993); and effects of alcohol (Zuber *et al.*, 1988).

In accordance with PBC theory, which predicts that high PBC individuals are more sensitive to changes in their bodily state than low PBC individuals, Miller *et al.* (1981) found that administration of caffeine, a substance known to induce psychological changes, caused larger changes in high PBC individuals than in low PBC individuals. That is, individuals who scored high on the PBC scale were more aware of the stimulating effect of caffeine than those who scored low. Systematic investigations of differences in sensory perception among individuals varying in PBC were first conducted by Stevens. He reported differences in perception of sensory attribute intensity (Stevens, 1990), and hedonic responses (Stevens *et al.*, 1989) among high and low PBC individuals. Solheim and Lawless (1996) linked differences in PBC to the relative importance of sensory and informational cues for product acceptance. Generally, individuals low in PBC were more affected by information on cheese fat content than high PBC individuals. In comparison, high PBC individuals appeared to pay more attention to sensory cues than product information when forming preference ratings. This indicated that high PBC individuals were more aware of sensory characteristics in food products consumed, and more able to discriminate between products on the basis of sensory attributes than

low PBC individuals. Collectively these studies suggest that sensory characteristics may be more important to high PBC than low PBC individuals in terms of product acceptability. That is, because high PBC individuals are more sensitive to sensory changes, they are more likely to base their preference judgements on characteristics linked to these changes than individuals who are less aware of sensory differences. *Specifically, it is predicted that preference is more strongly associated with sensory characteristics in high than low PBC individuals (hypothesis 3).*

MATERIALS AND METHODS

Samples

Three apple varieties, selected among commercially important varieties known to be susceptible to varying degrees of mealiness, were used, namely Belle de Boskoop (B), Cox's Pippin Orange (C), and Jonagold (J). The apples were grown and harvested in Belgium (Flanders Centre for Postharvest Research) and kept in commercial storage until required for testing. Different stages of mealiness were introduced by storing apples at an increased temperature (21°C, 80% ±5% R.H.) for either 1 or 2 weeks in a climate-room. Together with untreated samples, this resulted in three varying levels of mealiness, characterised as 'fresh', 'mid-point' and 'mealy'. These are referred to as 1 (fresh), 2 (mid-point), and 3 (mealy), respectively. After arriving in Denmark and Britain the apples were kept in cold storage (between 2 and 4°C) from which they were removed between 12 and 24 h before testing commenced.

Descriptive sensory analysis

The sensory panel consisted of 12 females, all experienced in sensory evaluation of apples. The panel's initial training in sensory evaluation of apples is described in detail by Dalliant-Spinnler *et al.* (1996), and at the time of this study a majority of the panellists had participated in ten or more sensory profiling studies of apples. Apple samples were presented peeled, cored and quartered. Bottled water and neutral biscuits (crackers) were used for neutralisation. Sensory booths were equipped with artificial daylight lighting, air extraction and air conditioning. Data were collected automatically via PC by scoring attributes on a 16 cm graphical line scale from 0 to 100. Samples were profiled in two replicates using a vocabulary of 41 attributes, which was derived from previous sensory analysis of Southern Hemisphere eating apples (Dalliant-Spinnler *et al.*, 1996). Nine samples were tested in one session using a presentation design balanced for order of presentation and first-order carry over effects (MacFie *et al.*, 1989). Panellists were instructed to score attributes in the order of first bite texture, texture during chewing, and flavour during chewing. The panellists then waited for 15 s before scoring afterswallow characteristics. Attributes relating to internal appearance and internal odour were scored last.

Consumer preference testing

All consumers, both Danish and English, were recruited and selected on the basis that they ate apples at least once a week. In Denmark, 140 consumers from the Kolding area were recruited, of which 117 (84%) participated. In England, 150 consumers from the Reading area were recruited and 127 (85%) participated. After being introduced to the test objective and the testing procedure consumers rated ten samples for preference. The consumers rated each sample for liking on a 9-point hedonic box scale from 'dislike extremely' to 'like extremely'. Samples were presented monadically, balancing the order of presentation and first order carry-over effects (MacFie *et al.*, 1989). Water and biscuits were available for neutralisation. To avoid first-sample effects (Meilgaard *et al.*, 1995, p. 40) a warm-up sample was presented first. The consumers were then presented with a questionnaire booklet consisting of general demographic questions, variables on product use and awareness, and the Private Body Consciousness (PBC: Miller *et al.*, 1981) questionnaire. The latter is a 5-item scale measuring awareness of changes in internal physical parameters such as temperature, hunger, and tension. Subjects indicated how characteristic each statement was to them on a 5-point scale from 'extremely uncharacteristic' to 'extremely characteristic'.

DATA ANALYSIS

The profiling data from each sensory attribute was subjected to a two-way analysis of variance using samples (variety and mealiness) and assessors as main factors. Averaging across assessors and replicates, the sample mean values for each attribute were input to principal components analysis (PCA: Piggott and Sharman, 1986) of the correlation matrix. The preference data was analysed using preference mapping methodology. Preference mapping (Carroll, 1972) constitutes a group of statistical techniques aimed at the analysis of preference data, taking account of individual differences in consumers' perception of preference. Internal preference mapping (Greenhoff and MacFie, 1994) refers to the analysis of preference data only, and provides a summary of the main preference directions and the associated consumer segments. Information about the sensory properties driving preference may be obtained by projecting sensory attributes onto the sample map spanned by the first internal preference dimensions (MacFie and Hedderley, 1993). Recent developments in internal preference methodology has resulted in techniques for the

significance testing of individual consumers fitted by the preference model and whether differences between product preferences are significant (e.g. Dalliant-Spinnler *et al*., 1996; Monteleone *et al*., 1998; Wakeling and MacFie, in preparation). In this study preference data obtained from Danish and British consumers were submitted to internal preference mapping of the correlation matrix. Significance testing was carried out at the 5% level. The means of the sensory attributes were correlated ($r^2 > 0.5$) with the two-dimensional internal preference space to interpret this in terms of the sensory variation driving preference. Validity of the British and Danish PBC scales were explored by correlation and principal components analyses. The PBC test scores were divided into tertiles (three groups of equal size) separating consumers high, medium and low in PBC. Differences in preference scoring between individuals varying in PBC were explored by analysis of variance. Further, data for the high and low PBC consumer groups were analysed separately by internal preference mapping. The influence of demographic characteristics and product use variables on consumer preference was examined by analysis of variance.'tpb 1pc

RESULTS

Descriptive sensory analysis

Analysis of variance showed a significant effect ($p < 0.001$) of variety and mealiness treatment for 16 attributes, suggesting that apple flavour and texture differed with respect to both variety and mealiness treatment. A significant effect of variety but not mealiness treatment was found for a further nine attributes suggesting that there were large flavour differences between varieties. Cox and Jonagold had a more sweet and fruity flavour than Boskoop apples, which were more acidic. Mealiness treatment was significant for four attributes ($p < 0.05$). Grassy odour and pear-drop flavour decreased as the degree of mealiness increased, whereas residue and pulpy texture increased. For all attributes the effect of assessors was highly significant ($p < 0.0001$). Overall, the absence of large assessor by sample interactions indicated that the mean scores for most attributes gave a reliable estimate of the samples' sensory properties and that it was acceptable to analyse the averaged data by PCA.

The PCA of the correlation matrix resulted in a two-factor solution accounting for 79.9% of the total variation, of which 51.5% was explained by the first principal component (PC) and 28.4% by the second. In the plot spanned by the first two PC scores (Fig. 1a) samples were separated according to mealiness treatment along the sensory direction from the lower right hand to upper left hand corner of Fig. 1a. Along this axis, 'mealy' apples had higher positive scores than 'mid-point' apples, which in turn had higher positive scores than 'fresh' apples. It was interesting to note that 'fresh' and 'mid-point' Jonagold apples were perceived to be similar to each other and distinct from 'mealy' samples, whereas 'mid-point' and 'mealy' Boskoop samples were similar to each other and distinct from 'fresh' Boskoop apples. Another axis, perpendicular to this mealiness axis, spanned between the lower left hand and upper right hand corner separating Cox and Jonagold from Boskoop apples. This axis was mainly related to odour and flavour differences.

The axis related to varietal differences was spanned between red apple, floral, pear-like, cox-like, plum/cherry and sweet flavours with high negative correlations and unripe odour, green appearance, green lines, apple, acid/sour, green apple, cooked apples and bitter flavours, and bitter aftertaste with high positive correlations (Fig. 1b). The mealiness axis was spanned between juicy appearance, first bite hardness and juiciness, and juicy and crisp texture with high negative correlations and fluffy appearance, stale flavour, floury, granular and slimy texture, drying aftertaste, and residue in after-swallow, with high positive correlations. This indicated that the sensory changes related to the mealiness treatment strongly affected apple texture. 'Fresh' apples were perceived more hard, juicy and crisp than 'mealy' apples, which were characterised as old, stale and floury. The third principal component, which accounted for 7.7% of the total variance, related mainly to flavour differences between 'fresh' Cox and the mealier Jonagold samples. 'Fresh' Cox apples were characterised by cox-like, pear-drop, and plum/cherry flavours whereas 'mid-point' and 'mealy' Jonagold apples were characterised as watery.

Consumer preference testing

Analysis of variance suggested that variety and mealiness treatment significantly affected ($p < 0.05$) preference ratings in both consumer groups. Although the Danish consumers overall gave higher preference ratings than the British, all consumers showed a strong dislike for Boskoop apples. There was no difference in preference for Jonagold and Cox apples. While the British consumers preferred 'fresh' apples more than 'mid-point' and 'mealy' apples, the Danish consumers appeared to distinguish only between 'fresh' and 'mealy' apples. When the samples were considered as nine individual products the British consumers preferred 'fresh' Jonagold and Cox to other Jonagold and Cox samples, whereas Danish consumers did not make such a distinction (Table 1). For Boskoop apples the 'fresh' samples were less disliked than the more mealy samples.

Internal preference mapping was performed on preference data from the British and Danish consumers separately. For both groups two preference dimensions were significant ($\alpha = 0.05$) and accounted for between 47% and 50% of the total variance. In the preference

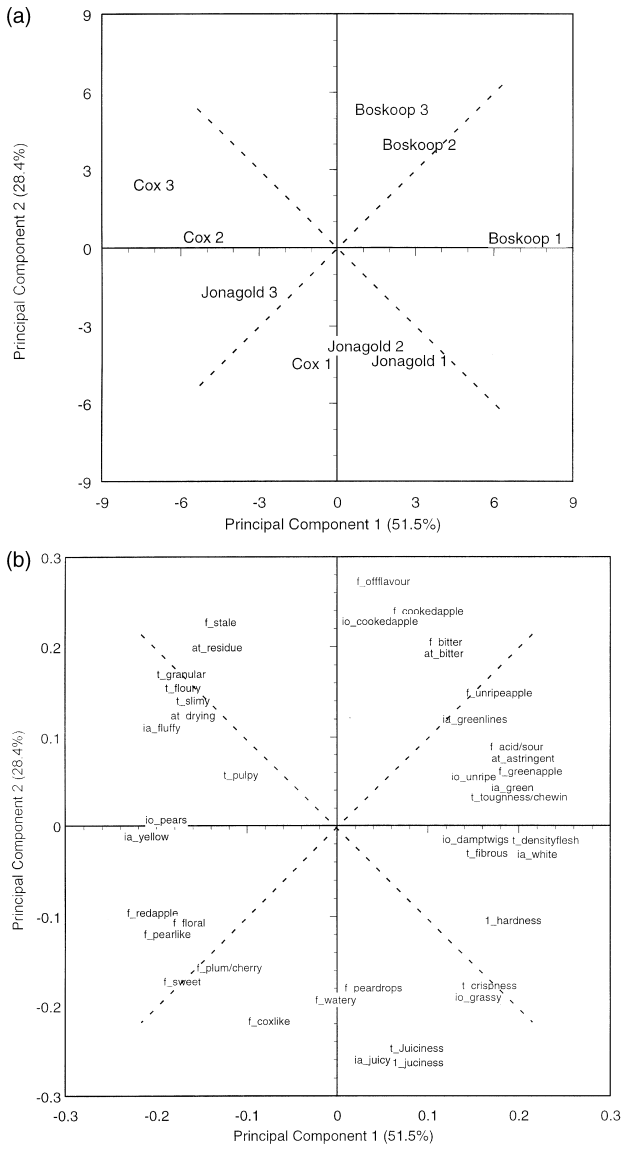

FIG. 1. (a): Plot of the apple samples in the plane spanned by the two first principal components. See text for legend. (b): Plot of the 41 attributes used to describe the apple samples with the first two principal components. (1) = first bite texture, (t) = texture during chewing, (f) = flavour during chewing, (at) = afterswallow, (io) = internal odour, and (ia) = internal appearance.

spaces spanned by the two first dimensions 57 (48%) Danish and 51 (40%) British consumers, respectively, were significantly fitted at the 5% level. That is, they were placed outside the 95% confidence ellipse. The two-dimensional sample maps were very similar to each other (Fig. 2a and b) and to that derived from PCA of the sensory profiling data (Fig. 1a). Boskoop samples were separated from Cox and Jonagold apples along the first preference dimension. While Danish consumers (Fig. 2a) showed similar preference for Boskoop samples, the British found the 'mid-point' and 'mealy' Boskoop similar to each other but different from 'fresh' Boskoop (Fig. 2b). Samples appeared to be separated according to mealiness treatment on the second preference dimension. The Danish consumers perceived 'fresh' Jonagold, and to a lesser extent 'fresh' Cox, different from the more mealy samples, which were considered quite similar. In comparison, British consumers found 'fresh' and 'mid-point' Jonagold apples different from the 'mealy' Jonagold and all three Cox samples.

The consumer scores plots suggested that the segmentation patterns for Danish and British consumers were very similar. Most consumers were placed at the right hand side of the consumer plots (Fig. 2c and 2d), suggesting that Boskoop apples were generally disliked. There was a tendency toward two segments among the Danish consumers. One segment, positioned in the upper half of Fig. 2c, preferred 'fresh' samples, particularly Cox and Jonagold, although a minority also showed high preference for 'fresh' Boskoop. The second segment was positioned in the lower right hand corner of Fig. 2c, and consisted of consumers who preferred Cox and generally more mealy samples. However, it was not possible to distinguish between preference for Cox and Jonagold apples in this segment. Similarly, visual inspection suggested a tendency toward two preference segments among the British consumers (Fig. 2d), separating consumers who preferred the 'fresh' samples, particularly 'fresh' Jonagold, from those who generally preferred Cox apples. No consumers in either Britain or Denmark expressed preference for 'mid-point' or 'mealy' Boskoop apples. When data from the British and Danish consumers were analysed together the product and consumer maps were no different to those obtained in the separate analyses. Two preference dimensions were significant and accounted for 48% of the total variance. At the 5% significance level 114 consumers (47%), of which 59 were Danish and 55 British, were significantly fitted. There was no obvious segmentation of consumers with respect to nationality.

The product characteristics driving preference were identified by projecting the mean sensory attributes ($r^2 > 0.5$) onto the combined internal preference map obtained from the British and Danish consumers (Fig. 3). On the first preference dimension sweet, red apple and floral/fruity flavours were associated with Cox and, to a lesser extent, Jonagold apples. Sour/acid, unripe, green apple flavours were particularly associated with 'fresh' Boskoop, whereas bitter, cooked apple and off-flavour characteristics were more strongly associated with the mealier Boskoop samples. On the second preference dimension hard, juicy and crisp textures were strongly associated with 'fresh' Boskoop and Jonagold samples, and to a lesser extent, 'mid-point' Jonagold. In comparison, floury and granular texture, stale flavour, residue in afterswallow and fluffy internal appearance were characteristic of Cox apples, and the mealier samples in general. Overall, the first preference dimension was more strongly related to flavour differences and the second to texture differences.

TABLE 1. Mean Preference Scores for British and Danish Consumers

Code	Sample	Britain			Denmark		
		Mean	**S.D.**	**Duncan**	**Mean**	**S.D.**	**Duncan**
J1	Fresh Jonagold	6.74[a]	1.92	A[b]	6.87	1.97	A
J2	Mid-point Jonagold	6.14	2.00	B	6.62	1.68	A
J3	Mealy Jonagold	6.05	1.91	B	6.53	1.78	A
B1	Fresh Boskoop	4.74	2.40	CD	5.32	2.07	B
B2	Mid-point Boskoop	4.93	2.23	C	4.79	1.88	C
B2	Mealy Boskoop	4.39	2.12	D	5.00	2.07	BC
C1	Fresh Cox	6.80	1.61	A	6.94	1.66	A
C2	Mid-point Cox	6.05	1.79	B	6.98	1.49	A
C3	Mealy Cox	5.86	2.03	B	6.63	1.66	A

[a]Preference was scored on a 9-point scale from 1 = 'dislike extremely' to 9 = 'like extremely'.
[b]Duncan multiple range testing is significant at the 5% level if letters differ within a column.

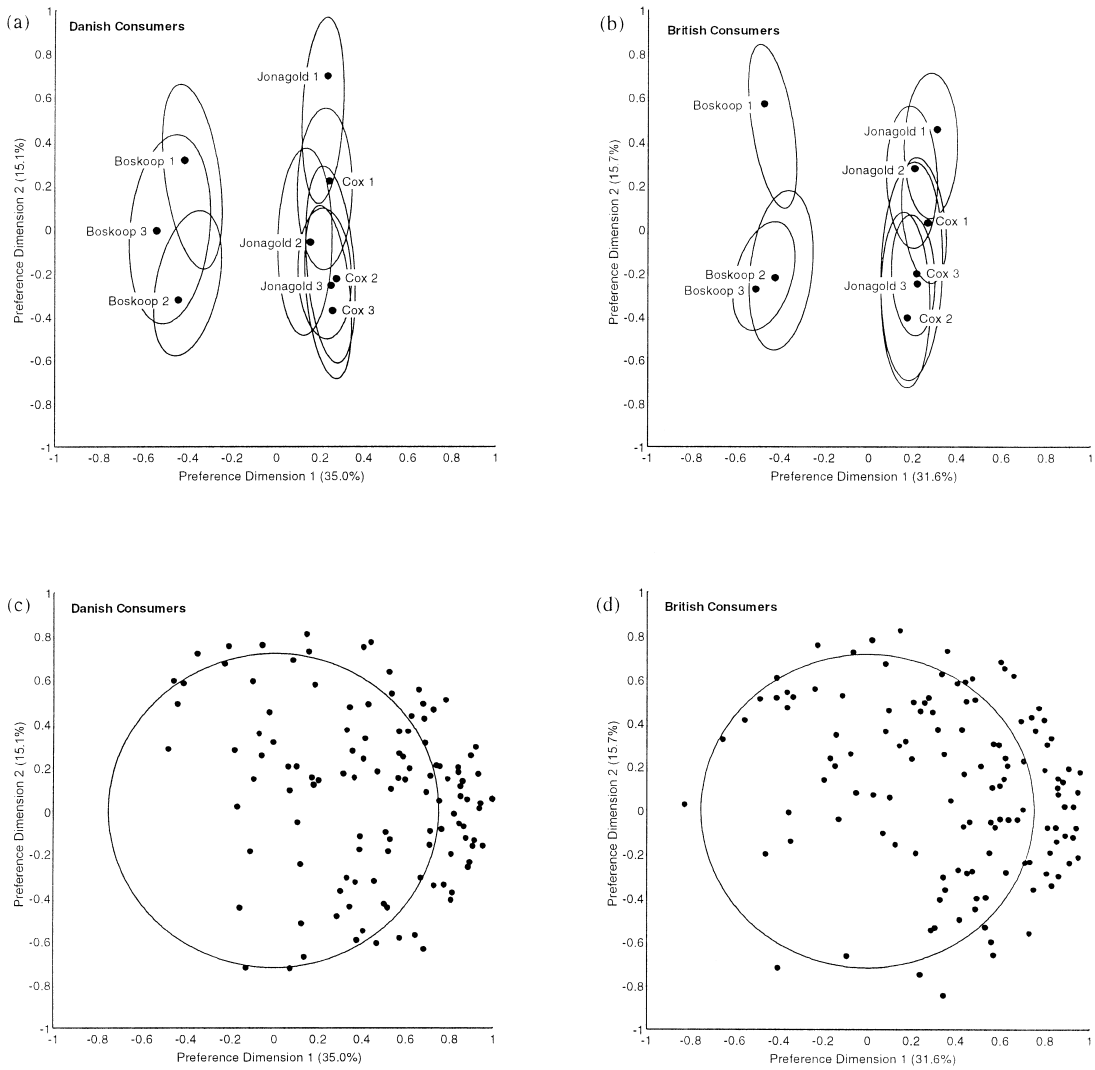

FIG. 2. (a): Plot of the apple samples in the plane defined by the two first preference dimensions from the Danish consumers. Product ellipses are 95% confidence regions obtained by bootstrapping. (b): Plot of the apple samples in the plane defined by the two first preference dimensions from the British consumers. Product ellipses are 95% confidence regions obtained by bootstrapping. (c): Plot of the Danish consumers significantly fitted (5% level) by internal preference mapping in the plane defined by the two first preference dimensions. (d): Plot of the British consumers significantly fitted (5% level) by internal preference mapping in the plane defined by the two first preference dimensions.

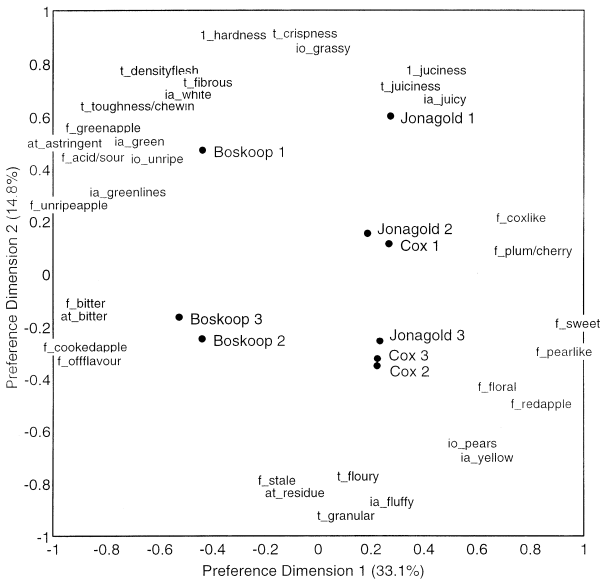

FIG. 3. Plot of the apple samples and of the sensory descriptors significantly correlated with the two first preference dimensions obtained from the British and Danish consumers.

Demographic and other variables

There was a near even spread between the number of male and female consumers taking part in the test. Chi-square testing suggested that the British and Danish consumer groups differed with respect to age composition and type of occupation. The Danish consumers were generally older than the British. There was, however, a more even spread between young (<35 years), middle-aged (36–55 years), and old (>56 years) consumers in the Danish than British sample. With respect to occupation there were more British consumers in 'part-time work' and fewer 'not in work' than Danish. These differences did, however, not appear to influence preference. Analysis of variance found no effect of demographic variables on preference scores. With respect to product usage variables analysis of variance showed no significant effects of gender and age, except for the frequency of eating apples, where the youngest consumer group ate apples less frequently than the older consumers. Approximately 5% of the consumers reported not eating apples weekly, as specified in the recruitment criteria. The importance of product characteristics like flavour, lack of blemish, country of origin etc. when buying apples revealed little difference between Danish and British consumers. In general, flavour and texture were considered most important for choice. Then followed appearance, lack of blemish and aroma. Packaging, availability, apple variety, country of origin and price seemed least important.

Correlation analysis and PCA indicated that the PBC scales were reliably measuring one single underlying construct. Cronbach's coefficient alpha was 0.66 for the British and 0.64 for the Danish scale. All scale items were positively correlated with the first principal component, which, in both cases, explained approximately 42% of the total variance. Analysis of variance for PBC scores showed that there was no effect of gender among the Danish consumers. British women, however, had significantly higher PBC scores than British males. There was a significant interaction effect ($p=0.006$) between gender and country, when data from British and Danish consumers were analysed together. While there were no differences between males, British women scored significantly higher than their Danish counterparts. Following rank ordering of PBC scores from both British and Danish consumers, 87 consumers were classified in the low PBC group (PBC $\leq$10), and 70 in the high PBC group (PBC $\geq$14). One-way analyses of variance showed no effect of PBC on preference scores, indicating that consumers in different PBC groups expressed similar preferences for the nine apple samples. PBC showed no effect on product use variables such as the frequency of eating apples, the popularity of apples versus other types of fruit, and the importance of flavour, texture, price, packaging, etc. for choice. When performing internal preference mapping with the high and low PBC groups separately, the resulting preference maps were largely similar and appeared little different from the internal preference mapping results obtained when analysing all consumers together. The amount of variance accounted for by the two first preference dimensions varied between 46% and 51%. Twenty-nine sensory attributes correlated significantly with the two-dimensional internal preference map derived from the low PBC group and 34 sensory attributes with that from the high PBC group. The preference maps and projection of sensory attributes are shown in Fig. 4. There appeared to be no distinct grouping of British and Danish consumers.

DISCUSSION

For both British and Danish consumers, preference appeared more strongly related to variety than mealiness treatment. In each country, as well as in the combined analysis, the first preference dimension separated samples with respect to variety, highlighting the low acceptance of Boskoop apples. Indeed, the position of consumers' preference vectors suggested that preference was driven by dislike of Boskoop more so than liking of Jonagold and Cox apples. Greenhoff and MacFie (1994) have previously described this tendency, noting that if acceptance of one or several products is much lower than that of other products, the preference segmentation tends to be driven by dislike for those particular products. In this case the preference segmentation indicated that consumers generally disliked the bitter, acid, cooked apple and unripe characteristics of Boskoop apples. This suggested that dislike for Boskoop apples related more to flavour than texture characteristics. Although the level of mealiness appeared less important to consumer

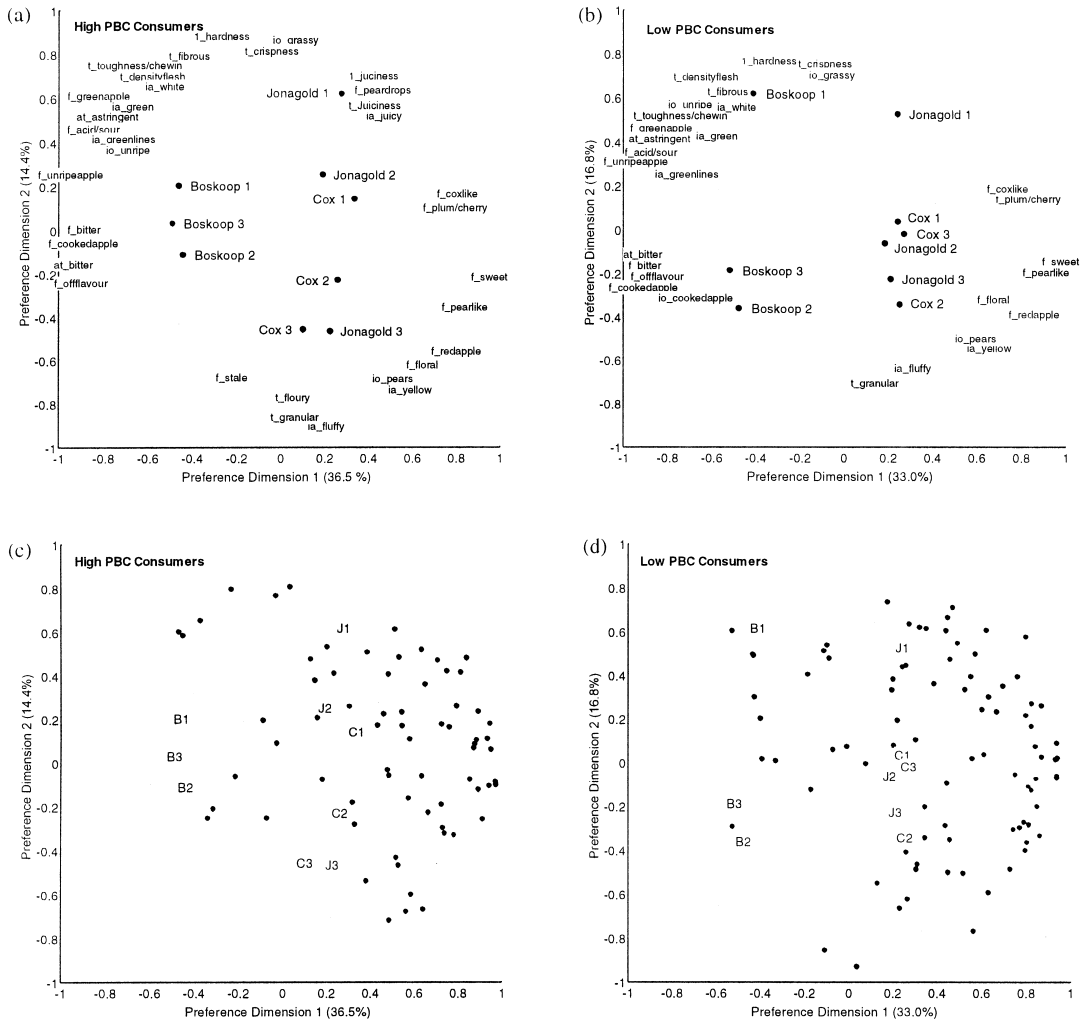

FIG. 4. (a): Plot of the apple samples and of the sensory attributes significantly correlated with the two first preference dimensions from the high PBC consumers. (b): Plot of the apple samples and of the sensory attributes significantly correlated with the two first preference dimensions from the low PBC consumers. (c): Plot of the high consumers significantly fitted (5% level) by internal preference mapping in the plane defined by the two first preference dimensions. (d): Plot of the low PBC consumers significantly (5% level) fitted by internal preference mapping in the plane defined by the two first preference dimensions.

preference than flavour differences, the results confirmed that consumers perceived mealiness as a negative quality attribute. The consumers perceived the more mealy samples, particularly 'mid-point' and 'mealy' Cox and Jonagold, as having a granular and floury texture. Thus, the results supported hypothesis 1, which predicted that 'mealy' apples were generally less liked than 'fresh' apples.

Internal preference mapping suggested the presence of two consumer segments: one with a higher preference for 'fresh' samples, particularly Jonagold, and another with higher preference for Cox apples and the mealier Jonagold samples. In the first segment 'fresh' and 'mid-point' Jonagold apples were most liked, although a few consumers also expressed preference for 'fresh' Boskoop. Hard, crisp, and juicy texture, grassy odour, and white appearance seemed to drive preference in this segment. In comparison, consumers in the second segment showed a higher preference for particularly Cox apples. But where preference appeared to be driven mainly by texture in the first segment, flavour was more important in this second segment. In particular, preference seemed to be driven by sweet and fruity/floral flavours. In accordance with recent market research conducted in the UK (Market Review, 1996) and Dalliant-Spinnler *et al.* (1996), the results of the present study underlined the importance of flavour and texture for consumer preference. Both British and Danish consumers reported these two characteristics as being more important in choice decisions than other sensory qualities, packaging, price etc.

The apple varieties included in this study were specifically selected for their susceptibility of varying degrees of mealiness (FAIR, 1995). In comparison to Cox and Jonagold, Boskoop is not a very familiar and popular variety in many European countries, and is generally considered a cooking apple. Further, the selection of apples included in this study is suspected to have influenced the results unduly. In accordance with the

two-factorial experimental design, the sensory differences between samples were strongly related to variety and mealiness treatment. Specifically, the sensory descriptive analysis showed that overall differences between varieties were greater than differences between samples within varieties varying in mealiness. Thus, the sensory changes taking place as apples aged were less characteristic than differences between varieties. Therefore, it was not surprising that consumers, untrained in sensory evaluation, noticed differences relating to mealiness treatment to a lesser degree than the sensory panel. It may therefore be possible to improve the present understanding of the importance of mealiness for consumer preference by studying another and more popular variety like Starking, which is also known to be susceptible to mealiness. The problematic product selection may also have contributed to the lack of agreement with the study by Dalliant-Spinnler *et al.* (1996) on the issue of a product opportunity for a more acidic apple on the UK market place. Acidic, unripe, green apple, and bitter aroma and flavour characteristics were more dominant in the disliked Boskoop apples than the preferred Jonagold and Cox apples. Thus, knowledge about consumer preferences for other apple varieties are needed before the issue of a product opportunity for a more acidic apple in the UK can be verified.

Cultural differences between Denmark and Britain have previously been established in several food related areas. The food-related lifestyle instrument (Brunsø *et al.*, 1996), an analytic tool used for the in-depth analysis of consumers' food related cognitive structures and value perception, has successfully been used to identify cultural differences between European consumer populations. In the UK, more than half of the population were found not to have any interest in food and food products. In comparison, only a third of Danish consumers fell into the uninvolved, careless and conservative consumer segments (Grunert *et al.*, 1996). Cultural differences in food choice have been established using laddering and means-end chain methodology (Gutman, 1982; Reynolds and Gutman, 1988). A salient issue emerging from comparisons of Denmark and Britain is the British consumers' apparent lack of interest in food and food consumption. Shepherd *et al.* (1998) conclude that 'the British seem relatively more interested in the more tangible or pragmatic aspects of food consumption, and appear to think that cooking is something that just has to be done' (p. 165). Evidence of cross-cultural differences between Denmark and Britain are further supported by a recent pan-EU survey on consumer attitudes to food, nutrition and health (IEFS, 1996). Differences in the influences of 'taste', 'healthy eating' and 'convenience' on food choice, use of sources of information on healthy eating, and trust in information on healthy eating highlighted cross-cultural differences between Denmark and Britain with respect to consumer attitudes to healthy eating.

There was however, little evidence of cross-cultural differences between British and Danish consumers with respect to preference for the apples tested in this study. Although Danish consumers gave higher absolute preference ratings than British consumers, the relative differences between samples were similar. Internal preference mapping further revealed a high degree of similarity in the two consumer populations' preference patterns. Similarly, there was no evidence of a country specific segmentation pattern when preference data from British and Danish consumers was analysed together. The similarity of the two consumers groups with respect to demographic characteristics and product use variables further supported this result. Thus, hypothesis 2, which predicted cross-cultural differences in preferences, was not supported. This finding was, in light of the established cultural differences between British and Danish consumers with respect to their food related attitudes, beliefs and values, somewhat surprising. A tentative explanation may be that the food related cognitive constructs and structures, with respect to which Danes and Britons have been shown to differ, were not activated during formation and rating of preference scores for apples, as measured in this study.

Several authors (e.g. Moskowitz *et al.*, 1975) have suggested that cross-cultural differences in consumer preference may be linked to varying familiarity with the products tested among culturally distinct populations. For example, Bertino *et al.* (1983) suggested that US students gave higher preference ratings to cookies because they were more familiar with this type of product than Taiwanese students. In comparison, Taiwanese students were proposed to give higher preference ratings to salty aqueous solutions, due to their greater familiarity with salty solutions, such as soy sauce, in their cuisine. Evaluating consumer responses to a range of Australian and Japanese foods Laing *et al.* (1994) found that consumers gave higher sweetness and/or saltiness hedonic ratings to foods from their own culture. Comparing Australian and Japanese preference responses to foods in which the sweetness level had been manipulated Prescott *et al.* (1997) only found differences for one product, namely corn-flakes, which also was the least familiar product with the Japanese consumer sample. In comparison, orange juice and ice-cream, both highly familiar products, were equally well liked by Australian and Japanese consumers. Another example is a recent European study on coffee carried out by the European Sensory Network (ESN, 1996). Comparison of consumer preferences from seven different countries revealed no clear preference segmentation by country. It is interesting to note that in those few studies where products have been equally familiar to the cultures being compared, there has been little evidence of cross-cultural differences.

Overall, it is clear that there is a need to consider the role of product familiarity when conducting cross-cultural research. However, in contrast to Prescott *et al.* (1997) who suggested that an unbiased assessment of

preference may only be possible with culturally novel foods, a more realistic approach may be to ensure that consumers have a similar degree of familiarity with products prior to cross-cultural comparisons. This may, for example, be achieved by matching consumer populations on frequency of consumption of the types of foods under study, as tentatively suggested by Prescott *et al.* (1997). To further investigate the importance of familiarity, one approach may be to compare culturally distinct populations varying in product familiarity. Judging from data on *per capita* consumption, apples appear to be a very familiar product category throughout Europe. In this study comparison of British and Danish consumers with respect to frequency of apple consumption, types of apples eaten (red vs. green), apple consumption vs. consumption of other types of fresh fruit suggested no differences in consumer familiarity with apples between the two countries. This similar degree of familiarity with apples among Danish and British consumers together with emerging evidence in the literature that cross-cultural differences in preferences are lacking when products are equally familiar to the populations compared, may also provide some explanation as to why no cultural differences were found in this study.

Although the role of PBC on consumer preferences has previously been explored, it appears PBC related effects have not been studied using an experimental design where consumers are not given any additional product information. Moreover, the results from previous studies, where products have been evaluated in conjunction with sensory or nutritional information are not equivocal. For example, Stevens *et al.* (1989) reported an effect of PBC on liking for chicken soup. In this study subjects rated samples, varying in salt concentration and were presented with three kinds of verbal information, for acceptability. The low PBC group consistently preferred samples labelled as 'flavour added' over those labelled 'flavour reduced', although there were no differences in the ingredients. In contrast, there was no consistent relationship between salt concentration, verbal information and hedonic ratings in the high PBC group. On the other hand, Kähkönen *et al.* (1997) found no effect of PBC on consumer preference for strawberry yoghurt. There were no differences between individuals varying in PBC for preference of yoghurt samples labelled as 'strawberry yoghurt', 'fat-free strawberry yoghurt' or 'new, tasty fat-free strawberry yoghurt'. Kähkönen *et al.* (1997), comparing their results to those of Stevens *et al.* (1989), suggested that the effect of PBC in Stevens's study was linked to differences between the least liked and the better liked samples. Specifically, it appeared that the effect of PBC was stronger for the least liked than better liked samples. Although there were large differences between preference scores for Boskoop and for Jonagold and Cox apples, this explanation did not hold for the present study. Analysis of variance revealed no difference in preference scores with respect to PBC for any of the nine apple samples tested. However, it cannot be ruled out that the product selection contributed to this result. The general dislike for Boskoop apples may have been so strong that it dominated any other preference-related effects, which may have been visible in a less distorted product space.

The preference maps for high and low PBC consumers were largely similar. It appeared that consumers separated the Cox and Jonagold samples in two groups, fresh and mealy, respectively. Where the low PBC consumers found 'fresh' Jonagold different from the remaining Cox and Jonagold samples, high PBC consumers grouped 'fresh' Jonagold and Cox and 'mid-point' Jonagold as the more fresh samples. The projection of sensory attributes onto the preference maps suggested that the fresh vs. mealy grouping of Cox and Jonagold apples was predominantly linked to juiciness in the case of low PBC consumers. In comparison, it appeared that attributes associated with mealiness were also important to the high PBC consumers. That is, they appeared to base their perception of differences between Cox and Jonagold apples on more sensory attributes than the low PBC consumers. This may tentatively be interpreted as support for hypothesis 3, which predicted that high PBC individuals were more likely to base their preference judgements on characteristics linked to sensory characteristics than low PBC individuals. Given that these preliminary results reflect a true difference in sensory perception between individuals varying in PBC, this may affect sensory evaluation practices. A preliminary exercise would be to compare sensory profiles obtained from sensory panellists varying in PBC to ascertain whether their sensory abilities differ. In consumer and marketing research PBC may be used as a mediating variable explaining differences in food related consumer behaviour.

CONCLUDING REMARKS

The study reported in this paper investigated preferences among Danish and British consumers for apples varying in mealiness. Consumers generally showed a strong dislike for Boskoop apples. Mealiness was considered a negative quality attribute associated with granular and floury texture. No evidence of differences in preference patterns from Danish and British consumers were found, leaving the hypothesis about cross-cultural differences in consumer preferences for apples unsupported. It was tentatively suggested that the failure to activate consumers' cognitive food related structures and/or the similarity in product familiarity may help to explain this lack of cultural difference in the study. There was some support for the hypothesis pertaining to the role of PBC in preference formation. Specifically, it appeared that high PBC individuals based their preference ratings on a higher number of sensory attributes than did the low PBC individuals.

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