

Mapping consumer preference for the sensory and packaging attributes of Cheddar cheese

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Abstract

Products' packaging attributes can predispose the consumer to purchase whilst products' sensory attributes confirm liking and may determine repeat purchases. Products should, therefore, convey their sensory character by their pack and, by doing so, consumer expectations generated by the pack will be met. In this study, a trained panel measured the packaging attributes of Cheddar cheese by descriptive analysis using a vocabulary of 20 attributes. This panel also evaluated the sensory characteristics of the cheeses using 32 aroma, flavour, texture and appearance attributes. In addition, 200 consumers rated the cheeses' packaging for preference and 207 different consumers rated the cheeses for sensory preference. Analysis of variance showed that all 20 packaging attributes and 22 of the sensory attributes discriminated between the cheeses. Principal components analysis then illustrated the relationships between products and sensory or packaging attributes. Hierarchical cluster analysis and principal components analysis of preference data revealed groups of consumers within the two samples who had diverse preferences for cheeses' packaging and sensory attributes. Consumer clusters' preference for packaging and sensory attributes was then successfully predicted using partial least squares regression. Relationships between descriptive packaging and sensory attributes were also investigated and determined only general associations between products' sensory and packaging attributes. © 2000 Elsevier Science Ltd. All rights reserved.

1. Introduction

Product optimisation in terms of consumer preference is the ultimate aim of every food manufacturer and a company's ability to produce a product which satisfies consumer requirements leads to success and profitability (McEwan, 1996). Consumer acceptance of a food is, however, dependent on many different factors which may be related to the product itself, the consumer or the consumer environment (Engle, Blackwell & Minard, 1995; Randall & Sanjur, 1981; Shepherd, 1990; Steenkamp, 1996). In particular, the sensory appeal of a food product and the visual appearance of its' packaging are powerful influences on consumer acceptability (Cardello, 1994; Tuorila & Pangborn, 1988). Therefore, to achieve an optimal product, manufacturers should attempt to understand the sensory and packaging characteristics of a food product which drive consumer preference within the market segment of interest.

Preference mapping (McEwan, 1996; McEwan, Earthy & Ducher, 1998; Schlich, 1995) is a technique which has been widely used to help scientists understand the sensory attributes which drive consumer preference (Beilken, Eadie, Griffiths, Jones & Harris, 1991; Dalliant-Spinnler, MacFie, Beyts & Hedderley, 1996; Helgensen, Ragnhild & Naes, 1997; Hough, Bratchell & Wakeling, 1992; Muñoz & Chambers, 1993). The procedure requires an objective characterisation of products' sensory attributes, achieved by descriptive analysis which is then related to preference ratings for the product obtained from a representative sample of consumers.

Understanding the packaging aspects of products that drive consumer preference has until now presented a challenge. However, recently it was found that descriptive analysis could successfully characterise and discriminate between products on the basis of their packaging attributes (Murray & Delahunty, 2000a). This procedure could, therefore, facilitate the use of preference mapping to help understand the packaging attributes which drive consumer preference, as has been done previously for products' sensory attributes.

In addition to determining consumer preference for the sensory and packaging attributes of food products,

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it is also important to consider how such attributes complement one another. Packaging, advertising and product information generate consumer expectations (Stokes, 1985), if these expectations are not subsequently met by the sensory delivery of the product, consumer disconfirmation may occur. For many years market researchers have addressed the question of how failure to deliver to expectation affects consumer satisfaction of products (Cardello, 1994). However, it is only recently that sensory scientists have begun to address how expectation effects may influence consumer perceptions of sensory attributes (Deliza & MacFie, 1996; Lange, Rousseau & Isshanchou, 1999). Ultimately, products that will best satisfy consumers should accurately convey their sensory character by their pack. Relationships between products' sensory and packaging attributes could thus be determined by relating objective sensory data to objective packaging data.

The following paper presents a study that assessed consumer preference for the intrinsic sensory and the extrinsic packaging attributes of Cheddar cheese using preference mapping. In addition, relationships between objectively measured packaging and sensory attributes were determined using regression analysis. It is proposed that this research provides methodology which allows for a broader assessment of product acceptability than has been gained in previous studies because it integrates consumer preference assessments from both sensory and packaging perspectives. Cheddar cheese was chosen as the food product to be assessed as it is of economic importance in Ireland and the UK and has been the subject of much descriptive sensory research (Bogue, Delahunty, Henry & Murray, 1999; Delahunty & Murray, 1997; Hunter & McEwan, 1998; McEwan, Moore & Colwill, 1989; Muir & Hunter, 1992; Muir, Hunter & Banks, 1997; Muir, Hunter, Banks & Horne, 1995; Muir, Hunter & Watson, 1995; Neilson & Zannoni, 1998; Piggott and Mowat, 1991).

2. Materials and methods

2.1. Cheese samples

Eight commercially available Cheddar cheeses [Farmhouse Cheddar (FhsC), Premium Cheddar (PC), Light-Cheddar (LtC), Vegetarian Cheddar (VgC), Mature Cheddar (MC), Vintage Cheddar (VC), Supermarket Brand Cheddar (SbC) and Medium Mature Cheddar (MmC)] were purchased from local supermarkets in Cork, Ireland. The sample set was chosen to be diverse in terms of their sensory and packaging attributes. Samples were stored at 4°C prior to the evaluation and were presented as 5 g cubes (at 21°C) in covered glass containers for the sensory evaluation and as purchased for the packaging evaluation.

2.2. Objective descriptive analysis of cheeses' sensory attributes

The eight cheeses were individually assessed for 32 sensory attributes of aroma, flavour, texture and appearance (Tables 1 and 2) by 15 trained assessors using 100 mm unstructured linescales. The aroma/flavour vocabulary had been previously developed by these assessors and reference standards were available to demonstrate the attributes (Murray & Delahunty, 2000b). The texture and appearance vocabularies were developed using similar methodology and the same assessors as those used for the aroma/flavour vocabulary. Cheeses were evaluated in duplicate, in a sensory laboratory by an incomplete block design (four cheeses per evaluation session). Order of presentation was balanced to account for first order and carry-over effects (MacFie, Bratchell, Greenhoff & Vallis, 1989) and data were collected using the PSA system (OP & P & Talcott, PO Box 14167, 3508 SG, Utrecht, The Netherlands).

2.3. Objective descriptive analysis of cheeses' packaging attributes

The eight cheeses were individually assessed for 20 packaging attributes (Table 3) by 15 trained assessors using 100 mm unstructured linescales. The packaging vocabulary was previously developed by the assessors who had also developed the sensory vocabulary (Murray & Delahunty, 2000a). Cheeses were evaluated for their packaging, in duplicate in a sensory laboratory by an incomplete block design (four cheeses per evaluation session). Order of presentation was balanced to account for first order and carry-over effects (MacFie et al., 1989) and data were again collected using the PSA system.

2.4. Subjective evaluation of cheeses' sensory attributes

A sample of 207 Cheddar cheese consumers, whose age and gender distribution were based on a quota calculated from the most recent census of the Irish population, tasted all 8 cheeses and gave preference ratings for cheeses' sensory characteristics on a nine point hedonic scale (Peryam & Pilgrim, 1957). Testing of the cheeses took place at 6 different points of sale, chosen to reflect the variety of retail points in Ireland and consumers of different demographics. Order of tasting cheeses was balanced to account for first order and carry-over effects (MacFie et al., 1989). Demographic data and information relating to cheese purchasing habits were collected from all respondents.

2.5. Subjective evaluation of cheeses' packaging attributes

A sample of 200 Cheddar cheese consumers gave preference ratings for cheeses' packaging attributes on a

Table 1
Descriptive vocabulary used to characterise cheese aroma and flavour

Flavour attribute	Definition
<i>Aroma</i>	
Pungent (Pu)	A physically penetrating sensation in the nasal cavity. Sharp smelling or irritating
Caramel (Car)	The aromatics associated with burnt sugar or syrup; toffee made with sugar that has been melted further
Sweaty/sour (SwSo)	The aromatics reminiscent of perspiration generated foot odour which are sour, stale and slightly cheesy
Sweet (Sw A)	The aromatics reminiscent of sweet foods
Creamy (Cr)	The aromatics associated with cream and dairy products
Fruity (Fr)	The aromatic blend of different fruity identities
<i>Flavour</i>	
Buttery (Bu)	Fatty, buttery tasting, of the nature of, or containing butter
Rancid (Ra)	The taste associated with sour milk and oxidised fats. Having the rank unpleasant aroma or taste characteristic of oils and fats when no longer fresh
Mushroom (Mu)	The taste associated with raw mushrooms
Mouldy (Mou)	The taste associated with moulds. They are usually earthy, dirty, stale, musty and slightly sour
Nutty (Nu)	The non-specific nut like taste characteristic of several different nuts, e.g. peanuts, hazelnuts and pecans
Smoky (Smk)	The penetrating smoky taste, which is similar to charred wood. Tainted by exposure to smoke
Soapy (So)	A detergent like taste. Similar to when a food is tainted with a cleansing agent
Processed (Pr)	A bland, shallow and artificial taste. Made by melting, blending and frequently emulsifying other cheeses
Sweet (SwF)	The fundamental taste sensation of which sucrose is typical
Salty (Sa)	The fundamental taste sensation of which sodium chloride is typical
Acidic (Ac)	A sour, tangy, sharp, citrus-like taste. The fundamental taste sensation of which lactic and citric acids are typical
Bitter (Bi)	A chemical-like taste. The fundamental taste sensation of which caffeine and quinine are typical
Astringent (Ast)	A mouth-drying and harsh sensation. The complex of drying, puckering and shrinking sensations in the lower cavity causing contraction of the body tissues
<i>Overall flavour</i>	
Strength (St)	The overall intensity of aroma and flavour, the degree of mildness and maturity
Balanced (Bal)	Mellow, smooth, clean. In equilibrium, well arranged or disposed, with no constituent lacking or in excess

Table 2
Descriptive vocabulary used to characterise cheese appearance and texture

Attribute	Definition
<i>Appearance</i>	
Colour (Col)	The colour of Cheddar ranging from pale yellow to orange, the palest of yellow representing the start of the scale
Mottling (Mot)	The evenness of colour shading within the cheese sample, with the most uniform coloured cheese being free from mottling, marbling or any other deficiencies in colour
Open (Op)	The extent to which the interior of the cheese (that is the cut surface) is open. This encompasses cracks, pinholes, irregular shaped holes and any other openings
Shiny (Sh)	The extent to which the surface of the cheese is shiny, glossy, moist, or sweaty looking, as opposed to looking matt or dull
<i>Texture</i>	
Firm (Fi)	The extent of resistance offered by the cheese (assessed in the first half of chewing using the front teeth)
Rubbery (Rub)	The extent to which the cheese returns to its initial form after biting (assessed during the first 2 to 3 chews)
Crumbly (Cru)	The extent to which the cheese structure breaks up in the mouth
Smooth (Sm)	The smoothness of the cheese against the palate as it breaks up during mastication
Moist (Mo)	The extent to which the cheese has a moist or wet texture around the palate during mastication
Grainy (Gr)	The extent to which granular structures are formed as the sample breaks down (perceived in the second half of chewing)
Mouthcoating (MoC)	The extent to which the cheese coats the palate and teeth during mastication

nine-point hedonic scale. The same retail points and quota sample were used as for the subjective evaluation of cheese sensory attributes, however, the individual consumers were not the same. For the evaluation all cheeses were first covered and were presented (revealed)

one at a time to participants in a balanced order (MacFie et al., 1989). In this way, first-order and carry-over effects were accounted for and consumers could not directly compare one cheese to another. Comparisons could only be made from memory as would be the

Table 3
Descriptive vocabulary used to evaluate cheese packaging attributes

Attribute	Definition
<i>Shape</i>	
Unconventional (UnS)	The extent to which a cheese does not conform to the conventional block shape
<i>Aesthetics</i>	
Illustrative work (IllW)	The amount of illustrations, graphics or pictures which appear on a cheese label or pack
Bold colours (BCol)	The extent to which a cheese label or pack is shaded in colours which are striking, bold or loud
Rich colours (RCol)	The extent to which a cheese label or pack is shaded in colours which are intense and rich
Variety of colours (VCol)	The variety of different colours which appears on a cheese label or pack
Pastel colours (PCol)	The extent to which a cheese label or pack is shaded in colours which are pastel or light
<i>Product performance</i>	
Sensory information (SenInfo)	The amount of information on a cheese label or pack relating to flavour, texture and appearance
Specialised for diet (SpDiet)	The extent to which a cheese is specialised for consumers following specific diets, for example vegetarian or low fat diets
Maturity level (Mat)	The extent to which a cheese has been matured
Branding (Br)	The extent to which a cheese brand, trademark or manufacturer name is reinforced on the label or the pack
Nutritional information (NutInfo)	The amount of information on a cheese label or pack relating to nutritional value
Other information (OInfo)	The amount of other information (not covered by other attributes) which appears on a cheese label or the pack, including manufacturers information, ingredient information and product guarantees
<i>Packaging performance</i>	
Convenience of pack (CPk)	The extent to which a cheese is perceived to be easy to open
Security of pack (SPk)	The extent to which a cheese pack is sealed, fastened, tamper proof and secure
<i>Presentation in pack</i>	
Visibility of cheese (Vis)	The extent to which a cheese is perceptible to the eye through the pack
Colour of cheese (ChCol)	The intensity of cheese colour ranging from pale yellow to orange. Where a cheese is not visible in the pack, no score is assigned
<i>Overall packaging features</i>	
Hand-made (Ha)	The extent to which a cheese is perceived as having been produced in small quantities, by hand, in a small process, as opposed to being mass produced on a factory scale
Original (Or)	The extent to which a cheese is perceived as original, innovative or creative
Traditional (Tr)	The extent to which a cheese is perceived as old fashioned, quaint and traditional
Expensive (Ex)	The extent to which a cheese is perceived as being associated with high price

case during evaluation of sensory preference. Demographic data and information relating to cheese purchasing habits were collected from all respondents.

3. Statistical analysis

The statistical methodology used for the analysis of sensory and packaging data was almost identical and thus are discussed together here. For the purpose of clarity however, the results are reported and discussed separately. Assessor performance was initially evaluated on Senstools V2.1, (OP & P & Talcott, PO Box 14167, 3508 SG, Utrecht, The Netherlands). Analysis of Variance (ANOVA) and Hierarchical Cluster Analysis (HCA) were then carried out using SPSS version 7.5 (SPSS Inc., 444 North Michigan Avenue, Chicago, IL 60611, USA). Other multivariate data analysis was carried out using Unscrambler version 6.0 (Camo A.S., Olav Tryggvassonsgt, 24, N-7011, Trondheim, Norway).

3.1. Objective descriptive data

The descriptive analyses yielded duplicate data matrices consisting of:

1. 15 assessors by 32 sensory attributes by 8 cheeses
2. 15 assessors by 20 packaging attributes by 8 cheeses

The performance of assessors in both descriptive studies was initially checked prior to averaging the session data. Analyses performed included the presence of assessor/attribute interactions, correlations between assessors and PCA checks on assessor agreement.

Panel mean scores of each replicate for both descriptive sensory and descriptive packaging data were then calculated and one-way ANOVA was used to determine whether significant differences ($P \leq 0.05$) existed between cheeses on the basis of their sensory or packaging attributes. Duncans' multiple range test then determined critical values where significant differences existed.

Principal Components Analysis (PCA: Piggott & Sharman, 1986) of the replicated analyses indicated again that the panel of assessors were reproducible in their evaluations of both sensory and packaging attributes, and one-way ANOVA of the replicated principal component (PC) scores was used to determine how many PC's of the analyses ($P \leq 0.05$) were significant at discriminating between cheeses. In a final PCA replicated evaluations were averaged and the data matrices of 8 cheeses by 22 discriminating sensory attributes and 8 cheeses by 20 discriminating packaging attributes were represented in the analyses.

3.2. Subjective preference and questionnaire data

PCA was also applied to the preference data for sensory and packaging attributes obtained from the two consumer samples respectively (two separate analyses). The two data matrices represented:

1. 207 consumer preference scores for the sensory character of 8 cheeses;
2. 200 consumer preference scores for the packaging character of 8 cheeses.

The internal preference maps obtained by this technique illustrated individual consumers preferred cheeses in terms of their sensory or packaging attributes.

Individual consumer preference ratings for both packaging and sensory attributes were then subjected separately to HCA, using Wards' linkage (McEwan et al., 1998). Each case (consumer) in both analyses were considered as separate clusters and the method decided which clusters should be combined at each step of the agglomerative clustering. For each cluster, the means of all variables were calculated and the squared euclidean distance to the cluster means was calculated. These distances were summed for all cases and at each step the two clusters that merged were those that resulted in the smallest increase in the overall sum of the squared within cluster distances. The resulting dendrogram illustrated the amalgamation of all preference scores into one cluster and steps where values changed substantially identified points for partitioning into smaller clusters. Information on the demographic status and cheese purchasing habits of consumers were also computed and tabulated.

3.3. Relationships between descriptive and consumer preference data

Relationships between descriptive sensory and sensory preference data and between descriptive packaging and packaging preference data were examined using Partial Least Squares regression (PLS2; Martens & Martens, 1986). Two PLS analyses were carried out. In

both cases, the descriptive data (sensory or packaging) were considered to be the predictor variables, input as standardised scores, and the consumer segments obtained by HCA (for packaging or sensory preference) were the variables to be predicted, input as unstandardised scores. Full-cross validation was used in the analyses. The external preference maps obtained provided visual representations of the association between cheese attributes (sensory or packaging) and consumer preference. Examination of correlation coefficients, prediction residuals and the PLS model fit determined the strength of the relationships between the descriptive and preference data sets and the validity of both models to predict preference for other cheeses, similar to those calibration samples used to build the models.

3.4. Relationships between cheeses' packaging and sensory attributes

The relationships between the packaging and sensory attributes of cheese were explored using PLS1 regression. Descriptive packaging attributes were considered the predictor variables and descriptive sensory attributes were predicted one at a time from these.

4. Results and discussion

4.1. Descriptive sensory data

The panel mean scores, standard deviations, ANOVA and Duncan's critical values from the session averaged descriptive data are shown in Tables 4 and 5. Twenty two of the sensory attributes discriminated between the cheeses and these were subsequently input to PCA. This analysis significantly discriminated between the cheeses ($P \leq 0.05$) on the first three PC's and accounted for 51, 22 and 9% of the experimental variance between cheeses respectively (Figs. 1 and 2).

On PC 1 (Fig. 1) the Farmhouse, Vintage and Mature cheeses were characterised by the attributes "salty", "strength", "acidic" "rancid", "mouldy", "astringent", and "bitter" flavour, "pungent" aroma, "open" appearance and "crumbly" and "grainy" texture. The Medium Mature cheese was also defined by these attributes, particularly by "bitter" flavour. In contrast, the Light Cheddar type was characterised by "processed" and "soapy" flavour, "rubbery" texture and "coloured" and "shiny" appearance. Supermarket Brand cheese also rated highly for these attributes and also for "processed" flavour and "smooth" and "moist" texture. The Premium and Vegetarian cheeses were "balanced", "buttery" and "sweet" in flavour. These differences appeared to separate the cheeses on the basis of their maturity level, mature cheeses have previously been demonstrated to have stronger flavour (Piggott &

Table 4
Means, standard deviations, analysis of variance and Duncans' multiple range test for the aroma and flavour attributes of 8 cheeses

Attribute	Cheese									Sig	D
	FhsC	PC	LtC	VgC	MC	VC	SbC	MmC	Mean (standard deviation)		
<i>Aroma</i>											
Pungent	56.4 (4.1)	32.9 (4.0)	26.3 (2.2)	32.9 (4.3)	40.6 (0.4)	56.3 (6.8)	22.1 (11.6)	35.5 (8.2)	0.00	15	
Caramel	18.3 (0.4)	29.9 (8.5)	31.3 (16.0)	37.8 (4.7)	25.2 (0.6)	20.2 (4.6)	27.0 (6.9)	33.9 (3.0)	0.25	—	
Sweaty/sour	46.0 (0.3)	32.5 (4.9)	20.9 (0.6)	18.1 (4.4)	38.3 (1.4)	43.6 (6.6)	22.8 (6.5)	33.3 (6.5)	0.02	12	
Sweet	21.6 (3.6)	31.4 (5.2)	32.5 (13.3)	40.2 (8.3)	27.6 (4.3)	35.9 (5.8)	36.6 (3.4)	40.8 (2.5)	0.39	—	
Creamy	16.5 (1.0)	30.0 (3.6)	32.0 (13.2)	29.7 (13.8)	31.5 (3.3)	25.0 (12.3)	30.3 (8.3)	26.7 (3.8)	0.70	—	
Fruity	22.9 (4.3)	22.2 (4.5)	19.6 (1.9)	19.4 (3.6)	25.3 (4.7)	28.1 (0.2)	25.6 (1.9)	25.8 (4.7)	0.28	—	
<i>Flavour</i>											
Buttery	23.4 (3.3)	48.8 (1.4)	39.6 (10.3)	45.0 (5.2)	35.4 (3.2)	32.0 (4.6)	42.1 (3.6)	30.1 (8.6)	0.03	14.4	
Rancid	48.5 (1.7)	20.3 (3.7)	21.6 (8.4)	25.0 (0.8)	32.8 (6.7)	46.3 (8.1)	17.4 (1.8)	25.4 (3.5)	0.02	13.1	
Mushroom	22.4 (0.3)	16.3 (0.3)	13.8 (3.8)	16.4 (5.0)	18.4 (0.2)	21.4 (1.6)	14.3 (5.1)	17.9 (5.6)	0.27	—	
Mouldy	30.4 (0.1)	12.4 (1.51)	12.1 (2.9)	10.4 (3.3)	23.8 (7.1)	26.2 (6.7)	12.4 (1.8)	18.2 (0.4)	0.00	9.8	
Nutty	9.0 (3.6)	16.8 (2.7)	7.7 (1.0)	22.3 (0.7)	21.8 (7.1)	21.7 (6.1)	10.0 (1.4)	10.2 (0.2)	0.12	—	
Smoky	11.5 (0.9)	12.6 (1.1)	7.4 (0.2)	16.5 (3.0)	17.6 (3.1)	9.9 (3.6)	7.3 (2.1)	8.6 (1.1)	0.09	—	
Soapy	21.1 (1.0)	15.8 (5.2)	33.7 (6.7)	11.0 (2.0)	13.5 (2.4)	11.3 (0.7)	30.7 (3.0)	15.9 (0.6)	0.01	8.7	
Processed	18.5 (1.3)	18.6 (5.5)	41.6 (3.8)	20.5 (3.2)	12.9 (0.6)	15.5 (2.9)	36.0 (2.3)	12.1 (5.2)	0.00	8.8	
Sweet	12.2 (1.1)	41.0 (3.9)	16.9 (8.0)	41.5 (5.6)	28.5 (1.8)	25.9 (0.4)	23.7 (2.0)	17.3 (2.4)	0.00	10.0	
Salty	34.3 (3.3)	30.6 (9.2)	18.8 (0.9)	29.7 (3.9)	43.1 (2.3)	42.6 (3.0)	26.7 (5.0)	34.2 (6.7)	0.01	12.5	
Acidic	52.0 (6.6)	39.0 (1.9)	30.9 (15.7)	38.4 (1.7)	40.8 (7.6)	54.3 (7.8)	17.5 (5.5)	51.0 (0.7)	0.00	17.2	
Bitter	56.4 (5.1)	20.6 (0.7)	53.4 (19.8)	19.1 (0.2)	30.5 (4.6)	31.9 (7.0)	22.3 (5.4)	48.4 (2.5)	0.00	20.2	
Astringent	48.3 (1.7)	22.0 (1.5)	31.5 (11.5)	29.1 (1.9)	33.4 (2.1)	48.0 (6.3)	15.8 (1.7)	42.3 (5.8)	0.02	13.3	
<i>Overall flavour</i>											
Balanced	24.0 (3.8)	54.6 (4.0)	27.7 (9.42)	57.0 (5.3)	41.1 (4.8)	34.1 (7.3)	38.1 (3.0)	34.9 (0.2)	0.03	20.3	
Strength	63.0 (1.9)	47.6 (3.6)	35.8 (15.3)	50.4 (2.3)	60.1 (6.6)	69.3 (8.1)	24.7 (1.8)	60.1 (1.0)	0.00	16.8	

Table 5
Means, standard deviations, analysis of variance and Duncans' multiple range test for the appearance and texture attributes of 8 cheeses

Attribute	Cheese									Sig.	D
	FhsC	PC	LtC	VgC	MC	VC	SbC	MmC	Mean (standard deviation)		
<i>Appearance</i>											
Colour Intensity	80.0 (1.1)	18.0 (1.0)	80.0 (1.0)	80.0 (1.0)	18.5 (3.4)	14.2 (2.0)	80.8 (6.8)	20.4 (1.8)	0.00	7.4	
Mottled	24.6 (1.8)	22.5 (4.5)	34.2 (3.8)	27.8 (2.6)	28.6 (9.6)	26.9 (4.8)	20.7 (4.6)	20.2 (1.4)	0.19	—	
Open	24.9 (5.0)	20.5 (11.8)	22.2 (1.5)	30.3 (3.1)	28.7 (7.7)	52.1 (2.2)	16.3 (3.8)	21.5 (6.3)	0.00	15.3	
Shiny	41.2 (1.6)	44.2 (2.9)	48.2 (1.9)	39.1 (4.6)	35.1 (6.5)	20.8 (5.1)	49.9 (5.7)	40.9 (2.7)	0.00	10.7	
<i>Texture</i>											
Firm	47.4 (0.8)	38.4 (9.2)	37.5 (9.6)	44.6 (9.3)	44.4 (8.5)	64.6 (0.2)	33.4 (4.0)	52.2 (0.9)	0.28	—	
Rubbery	22.0 (10.8)	17.0 (1.4)	57.2 (5.6)	20.3 (0.4)	20.1 (2.5)	16.4 (5.4)	36.1 (1.9)	17.1 (3.4)	0.00	12.6	
Crumbly	20.2 (3.5)	18.8 (6.1)	17.8 (6.7)	29.7 (9.9)	39.5 (2.0)	67.7 (0.7)	18.3 (9.0)	39.0 (9.9)	0.00	17.3	
Smooth	60.9 (3.2)	70.5 (6.6)	52.5 (16.8)	64.9 (8.4)	45.5 (4.0)	25.2 (4.9)	59.0 (8.9)	34.2 (6.1)	0.00	20.8	
Moist	48.2 (3.9)	58.2 (2.3)	49.2 (3.1)	58.3 (0.4)	45.7 (3.6)	29.3 (5.4)	57.5 (8.0)	43.2 (3.0)	0.00	10.8	
Grainy	20.5 (1.5)	13.0 (1.5)	16.4 (9.1)	15.5 (9.8)	33.8 (4.7)	39.0 (5.0)	13.8 (1.6)	27.2 (1.9)	0.00	13.7	
Mouthcoating	58.5 (1.6)	52.1 (3.3)	36.6 (1.2)	51.9 (3.4)	43.8 (5.0)	41.3 (4.6)	45.4 (7.7)	41.5 (2.1)	0.11	—	

Mowat, 1991) and more crumbly texture (Hort, Le Grys & Woodman, 1997). PC 2 separated the Light and Medium Mature cheeses as “bitter” while the Premium and Vegetarian cheeses were “sweet”, “balanced” and “buttery” in flavour.

The third PC of the analysis tended to distinguish cheeses on the basis of more subtle sensory characteristics. The Farmhouse cheese was “crumbly” in texture and “open” in appearance while the Medium cheese was particularly “smooth” and “moist” in texture.

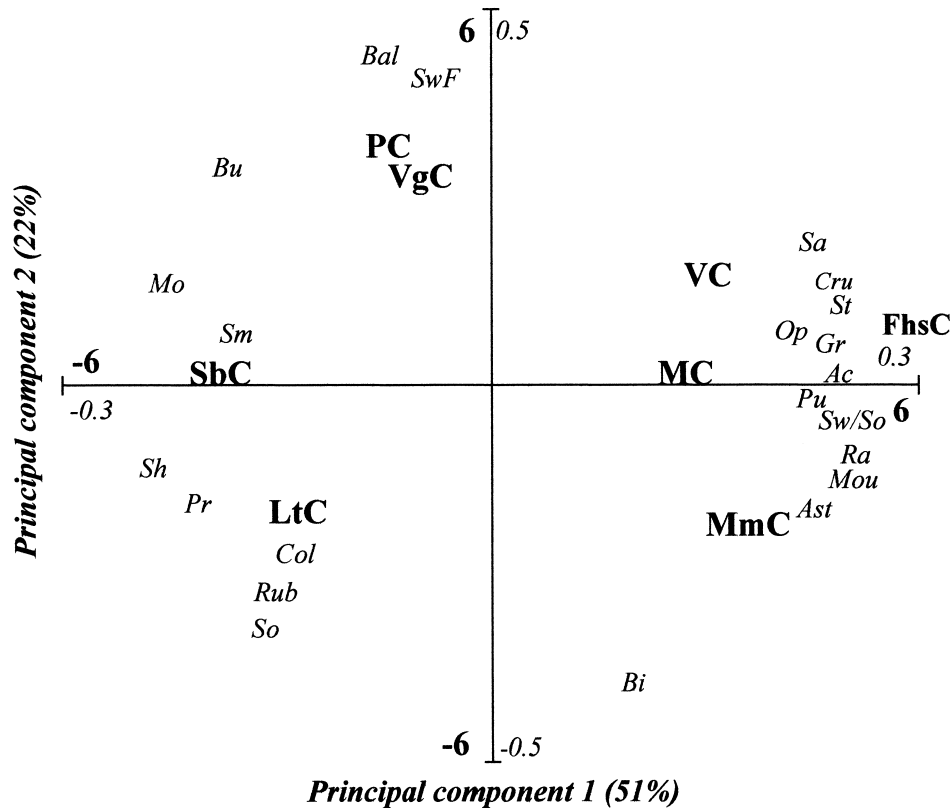


Fig. 1. Scores and loadings for PCA of 8 cheeses sensory attributes on PC's 1 and 2. An explanation of abbreviations can be obtained in Tables 1 and 2, cheeses are explained in Section 2.1.

4.2. Preference mapping and hierarchical cluster analysis of sensory preference data

An internal preference map illustrated the direction and intensity of individual consumer preferences for the cheeses' sensory attributes and allowed preference for each cheese to be compared (Fig. 3). Few consumers preferred the Light cheese, (average score: 4.6) and most consumers preferred the Premium cheese (average score: 6.7).

HCA of these data then identified four clusters of consumers who were homogenous in their preference (Table 6). The demographic characteristics of these consumer clusters can be viewed in Table 7.

The mean preference scores of each cluster for the 8 cheeses and the descriptive sensory data were then used as the input for an external preference map (Fig. 4). This map provided a visual representation of the association between cheeses, their sensory attributes and consumer segments' preference. Correlation coefficients (r) indicated the ability of the model to predict the preference of the clusters.

The preferences of cluster 1 were easily identified ($r=0.73$). These consumers liked the Vintage cheese, and their preference was influenced by its "strong", "salty" and "acidic" flavour. Their position was also

determined by their dislike of the Light cheese. These consumers tended to be married (54%) and had relatively high income (34% earned over £IR21,000). Cluster 2 ($r=0.96$) also preferred the Vintage cheese and least liked the Mature cheese. However, their preference was not as easily determined, as they rated all cheeses, particularly the mature cheeses highly (Table 6) and thus were non-discriminating in their preference. These consumers were older than the consumers in the other 3 clusters (40% were over 55 years of age) thus, changes in their sensory acuity (Stevens, Cruz, Hoffman & Patterson, 1995) or less likelihood to show extremes in behaviour may have caused their lack of discrimination but slight preference for more intense flavours.

Cluster 3 ($r=0.95$) liked the Farmhouse and the Premium cheeses, however, this clusters' position on the map was largely determined by their intense dislike for the Light cheese. This cluster consisted mainly of married consumers (50%) over the age of 35 (57%). Cluster 4 ($r=0.99$) consisting mainly of younger consumers (43% were aged between 15 and 24), preferred the Vegetarian cheese and were influenced by its "moist" and "smooth" texture, "shiny" appearance and slightly "processed" flavour. They strongly disliked the Farmhouse cheese.

The analysis, therefore, provided information about consumer segments' preference for cheeses' sensory

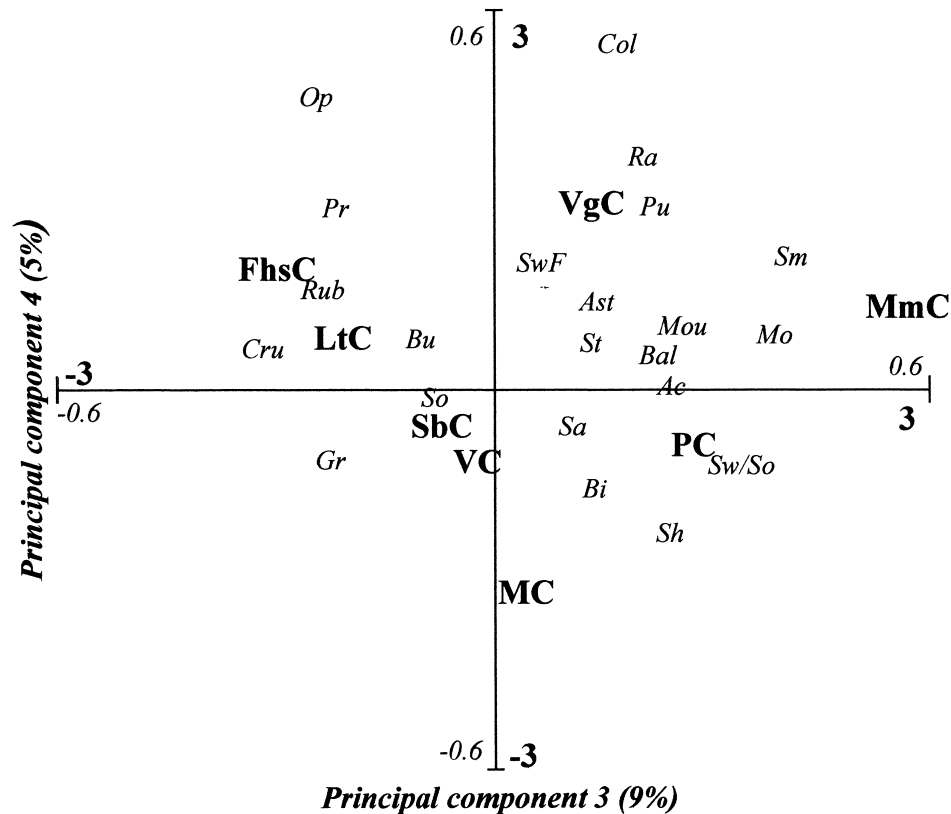


Fig. 2. Scores and loadings for PCA of 8 cheeses sensory attributes on PC's 3 and 4. An explanation of abbreviations can be obtained in Tables 1 and 2, cheeses are explained in Section 2.1.

attributes. The ability of preference mapping to define the most favourable or “optimal” product for consumer segments is an advantage which this technique has over traditional market research and sensory test methods, as reliance on averaged preference data only may not optimise preference for the majority of consumers. The model correlation coefficients indicated strong relationships between the descriptive and preference data sets. In addition, prediction residuals were low (determined by the differences between the observed and predicted values during the modelling process). These observations indicated that the model could predict preference for other similar cheeses within the range of the calibration samples used to build the model.

Collecting demographic data determined whether characteristics such as age, sex etc. influenced consumers' hedonic responses to cheeses. Age, in particular may have been an important factor in determining preference for cheese sensory character. Middle aged consumers (clusters 1 and 3) were found to like mature cheese with strong flavour, and the oldest consumers (cluster 2) rated all mature cheeses highly. However, younger consumers (cluster 4) liked a mild cheese. Bogue et al. (1999) also determined that younger consumers preferred milder cheeses, whereas middle aged and older consumers preferred mature cheeses.

To some extent the preference of consumers reflected their reported purchase habits (Table 11). The light cheese, most disliked, was purchased by only 4% of consumers whereas the Medium cheese, liked moderately, was purchased by 16.5% of consumers. Hedonic ratings for cheeses' sensory attributes have been found to be indicative of purchase intent (Solheim & Lawless, 1996; Tuorila & Pangborn, 1988). However, the most liked cheeses, the Premium and Vintage, were purchased by only 2.4 and 3% of consumers respectively. Thus, other mechanisms which have been identified as important in food choice, such as appropriateness of use (Jack, Piggott & Paterson, 1994) and price (Moskowitz, 1995) may have influenced the types of cheeses purchased.

4.3. Descriptive packaging data

The panel mean scores, standard deviations, ANOVA and Duncan's critical values calculated from the descriptive packaging data are shown in Table 8. Values for “colour of cheese” were missing for cheeses 2 and 6 as these products were not visible from their packaging. Significant differences were found between the cheeses for all packaging attributes ($P \leq 0.01$). PCA of these data significantly discriminated between cheeses on the

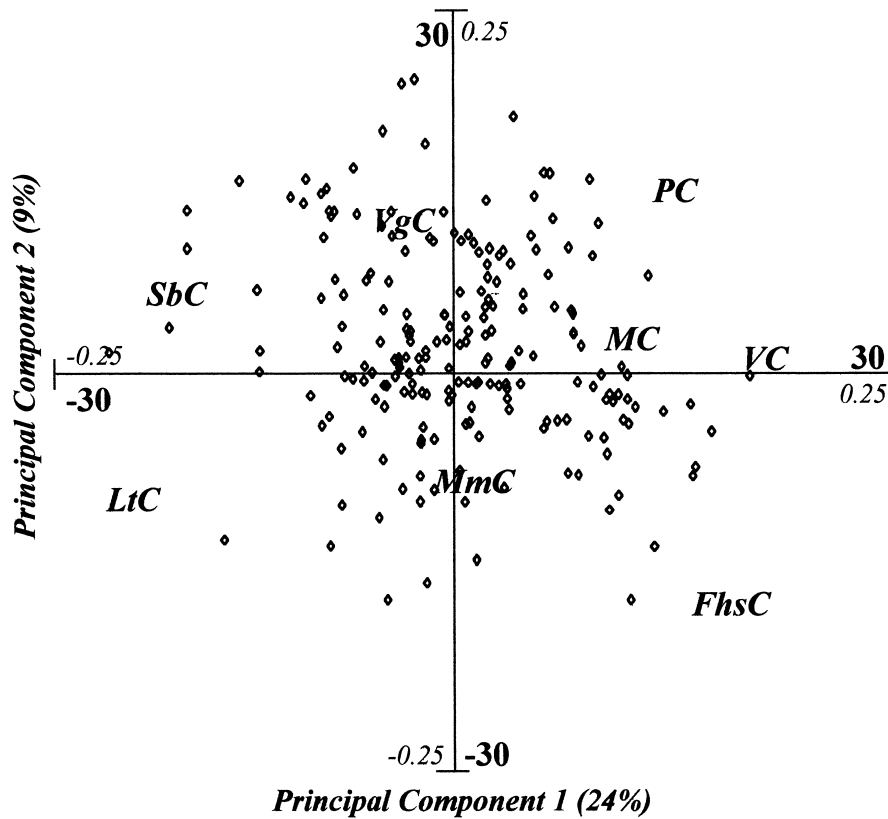


Fig. 3. Internal preference map obtained by PCA of individual consumer preference ratings for the sensory attributes of 8 cheeses. Cheeses are explained in Section 2.1.

Table 6
Mean preferences for 4 clusters of consumers obtained from hierarchical cluster analysis of taste preferences

Cluster	No.	Cheese	FhsC	PC	LtC	VgC	MC	VC	SbC	MmC
1	82		5.6b ^b	6.0a	3.3a ^a	4.5a	5.6b	6.1b	3.7a	5.3a
2	53		7.4c	7.1b	7.0c	7.2b	7.0c	7.6c	7.1c	7.6b
3	51		7.7c^a	7.6b	3.9a	6.8b	6.4c	7.3c	5.5b	5.4a
4	21		2.2a	5.9a	5.1b	6.7b	4.2a	2.9a	5.7b	5.3a
ANOVA			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
All	207		6.1	6.7	<u>4.6</u>	6.0	6.0	6.5	5.2	5.9

^a Most liked products are in bold, least liked products are underlined.

^b LSD test determined products with the same letters were not significantly different.

first 4 PC's ($P \leq 0.05$), accounting for 34, 15, 11 and 10% of the experimental variance between cheeses respectively (Figs. 5 and 6).

On PC1, the Light, Vegetarian and Supermarket Brand cheeses were distinguished from all other cheeses on the basis of “colour of cheese”. These cheeses were also assigned low scores for “expensive”, “rich colours” and “maturity level”. “Convenience of pack”, “unconventional” shape, “original” and “visibility of cheese”

also discriminated between cheeses on this PC. On PC 2, the Farmhouse cheese was characterised as “hand-made” and “traditional” and was negatively correlated with the attributes “other information”, “bold colours”, “security of pack” and “sensory information”.

PC 3 distinguished the Supermarket Brand cheese from other cheeses, due to a negative correlation with “illustrative work”, “variety of colours” and “pastel colours”. PC 4 was strongly characterised by “branding” and “other information”, which particularly distinguished the Premium cheese. The Vintage cheese was also separated on this PC, it scored highly for “maturity level” and “security of pack”.

4.4. Preference mapping and hierarchical cluster analysis of packaging preference data

An internal preference map revealed the direction and intensity of consumer preferences for cheese packaging attributes and allowed preference for each cheese to be compared (Fig. 7). Few consumers liked the packaging of the Supermarket Brand cheese (average score: 4.3) and most liked the packaging of the Vintage cheese (average score: 6.3) and the Premium cheese (average score: 6.2).

Subsequent analysis of preference data using HCA identified four clusters of consumers who were homogenous

Table 7
Demographic profile of four consumer clusters who expressed preference for cheeses' sensory attributes

	Cluster 1 %	Cluster 2 %	Cluster 3 %	Cluster 4 %
<i>Age</i>				
15–24	20	9	28	43
25–34	25	25	16	38
35–54	39	26	26	10
55+	16	40	31	9
<i>Gender</i>				
Male	46	43	41	52
Female	54	57	59	48
<i>Employment</i>				
Full-time	43	23	26	34
P/T, within home	28	37	33	19
Student/other	29	40	41	47
<i>Marital status</i>				
Married	54	49	50	33
Single	35	30	42	57
Other	11	21	8	10
<i>Income</i>				
Benefits, < IR£12,000	21	38	20	19
IR£12,000–20,000	13	23	16	24
IR£21,000–30,000	17	8	18	5
> IR£30,000	17	7	4	–
Student grant/other	32	25	43	52

in their preference for packaging (Table 9). The demographic characteristics of this sample are shown in Table 10. The mean preference scores of clusters were related to descriptive packaging data to provide an external preference map (Fig. 8). This allowed a visual representation of the association between cheeses, their packaging attributes and consumer segments' preference. Correlation coefficients (*r*) indicated the ability of the model to predict the preference of the clusters.

Cluster 1 (*r* = 0.98) expressed preference for the Light cheese and to a lesser extent the Vegetarian cheese, the attributes “variety of colours”, “specialised for diet” and “visibility of cheese” appeared to influence their preference. They disliked the Farmhouse cheese intensely. Many young consumers (37%) were found in this cluster, therefore perhaps younger consumers found “healthy eating” more conceptually appealing than the other clusters.

Cluster 2 (*r* = 0.97) liked the Premium cheese and their preference was influenced by “expensive”, “mature”, “rich colours” and “branding”. This consumer cluster had the highest % of consumers over the age of 55 years (39%) and tended to score all cheeses highly, thus displaying a lack of discrimination. Older consumers were also found to be non-discriminating in their preference for sensory attributes. This suggests that perhaps

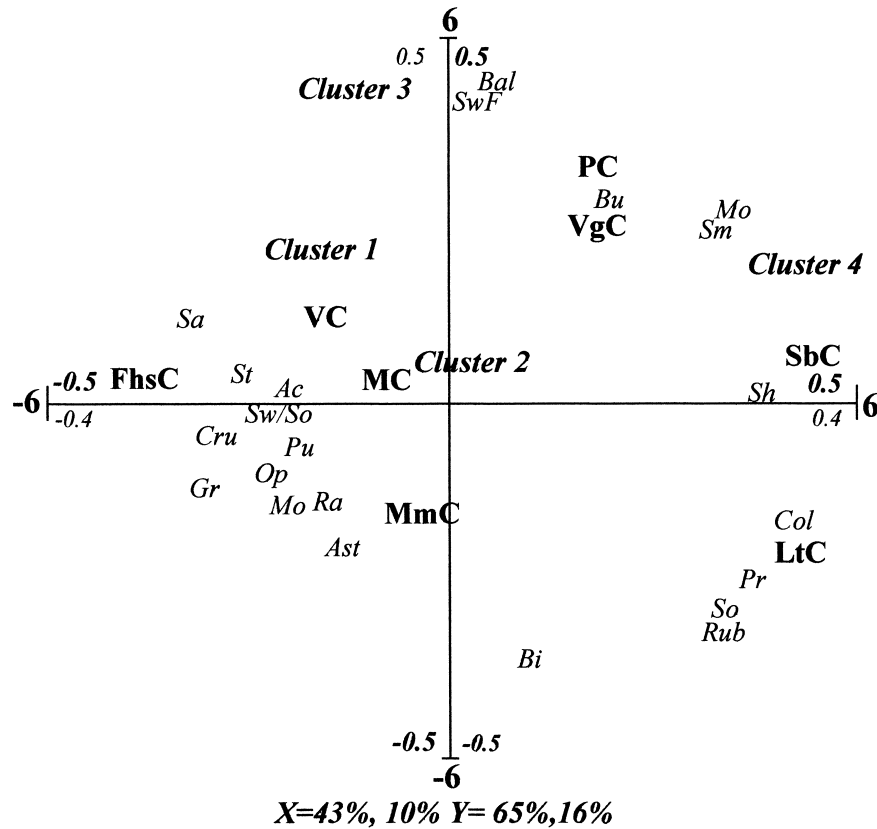


Fig. 4. External preference map obtained by PLS2 analysis of descriptive and clustered consumer preference data for the sensory attributes of 8 cheeses. An explanation of abbreviations can be obtained in Tables 1 and 2, cheeses are explained in Section 2.1.

Table 8
Means, standard deviations, analysis of variance and Duncans' multiple range test for the packaging attributes of 8 cheeses

Attribute	Cheese									Sig	D
	FhsC	PC	LtC	VgC	MC	VC	SbC	MmC			
	Mean (standard deviation)										
<i>Shape</i>											
Unconventional	54.4 (0.6)	85.9 (2.3)	7.7 (0.9)	6.7 (0.4)	12.8 (5.8)	85.0 (0.8)	6.3 (9.1)	8.4 (6.1)	0.00	5.6	
<i>Aesthetics</i>											
Illustrative work	28.6 (1.7)	48.7 (0.7)	63.2 (0.7)	67.9 (2.1)	64.0 (1.3)	51.9 (3.2)	13.0 (1.0)	82.2 (0.5)	0.00	2.5	
Bold colours	22.5 (0.8)	86.0 (0.9)	30.5 (0.5)	47.8 (6.2)	68.6 (5.7)	68.6 (4.3)	58.7 (1.2)	33.2 (4.6)	0.00	9.6	
Rich colours	35.5 (2.2)	85.6 (6.6)	19.4 (1.7)	36.4 (6.9)	70.4 (6.3)	62.9 (7.6)	31.5 (2.3)	31.4 (5.3)	0.00	12.1	
Variety of colours	15.5 (0.5)	32.2 (0.8)	65.1 (1.9)	72.3 (1.6)	60.7 (5.9)	48.4 (0.8)	18.9 (1.5)	5.4 (4.0)	0.00	6.9	
Pastel colours	41.1 (4.6)	8.2 (1.0)	73.2 (4.5)	68.9 (0.4)	24.0 (0.5)	25.0 (3.9)	6.7 (1.3)	83.7 (2.4)	0.00	7.1	
<i>Product performance</i>											
Sensory information	9.6 (4.0)	75.3 (4.6)	14.4 (6.0)	8.7 (1.2)	78.4 (3.1)	22.0 (1.0)	6.0 (1.0)	8.3 (1.4)	0.00	7.5	
Specialised for diet	4.9 (8.1)	5.9 (0.6)	89.3 (1.3)	88.0 (5.2)	5.3 (0.3)	5.1 (0.8)	4.9 (4.0)	10.6 (4.1)	0.00	6.1	
Maturity level	20.8 (0.8)	52.9 (1.4)	10.9 (0.2)	13.4 (0.8)	73.2 (0.4)	93.5 (0.8)	11.6 (0.3)	15.6 (1.2)	0.00	2.1	
Branding	56.4 (2.2)	75.5 (1.1)	53 (1.0)	47.3 (2.6)	54.3 (3.4)	37.0 (5.6)	49.2 (1.9)	61.3 (3.0)	0.00	7.4	
Nutritional information	5.0 (0.4)	8.5 (1.6)	84.8 (1.3)	8.2 (0.4)	5.6 (0.7)	4.5 (0.4)	6.3 (1.5)	6.8 (1.4)	0.00	2.7	
Other information	25.9 (0.7)	69.6 (5.0)	37.9 (5.0)	38.1 (4.1)	43.2 (2.9)	16.9 (1.6)	26.2 (4.9)	26.2 (4.9)	0.00	9.1	
<i>Packaging performance</i>											
Convenience of pack	51.8 (1.2)	38.3 (5.8)	68.8 (2.4)	70.8 (0.3)	17.7 (2.9)	16.1 (1.1)	67.4 (1.9)	69.9 (3.4)	0.00	7.3	
Security of pack	58.4 (3.4)	80.1 (0.3)	76.7 (0.6)	77.9 (2.6)	87.3 (4.5)	90.0 (0.6)	76.9 (0.2)	59.3 (1.9)	0.00	4.4	
<i>Presentation in pack</i>											
Visibility of cheese	40.2 (0.3)	3.8 (0.1)	90.2 (0.8)	89.8 (9.0)	85.5 (3.4)	7.3 (3.9)	89.7 (1.1)	41.8 (4.8)	0.00	6.4	
Colour of cheese	14.4 (0.5)	M	78.1 (5.7)	82.1 (2.1)	15.8 (2.1)	M	81.6 (3.3)	65.5 (1.5)	0.00	8.0	
<i>Overall image</i>											
Hand-made	73.7 (1.8)	26.3 (2.5)	7.4 (0.9)	9.0 (1.7)	22.7 (2.1)	68.3 (4.7)	7.1 (0.3)	49 (3.9)	0.00	6.6	
Original	71.8 (1.7)	83.4 (3.3)	30.2 (1.3)	34.9 (5.5)	44.0 (1.3)	81.0 (2.8)	8.2 (2.4)	52.6 (0.7)	0.00	6.9	
Traditional	77.5 (2.0)	11.7 (0.7)	10.2 (1.1)	9.5 (0.3)	32.1 (3.8)	62.8 (1.6)	7.8 (2.0)	58.5 (9.0)	0.00	9.1	
Expensive	69.7 (0.7)	85.8 (3.8)	25.1 (0.5)	27.8 (2.7)	64.8 (3.6)	88.0 (0.4)	7.5 (1.0)	52.2 (3.8)	0.00	6.3	

Table 9
Mean preferences for 4 clusters of consumers obtained from hierarchical cluster analysis of expressed pack preferences

Cluster	No.	Cheese								
		FhsC	PC	LtC	VgC	MC	VC	SbC	MmC	
1	44	3.4a ^a	5.7a ^b	6.9c	6.6c	6.5c	5.2a	5.7c	5.7b	
2	29	<u>7.2c</u>	7.7b	7.2c	7.4d	7.2c	7.6c	6.3c	7.5c	
3	96	6.7c^a	6.1a	5.0b	5.0b	5.7b	6.5b	<u>3.7b</u>	6.1b	
4	31	4.7b	5.9a	2.6a	2.4a	4.2a	6.1ab	<u>2.1a</u>	3.9a	
P=	0.00	0.00	0.00	0.00	0.00	0.00	0.00	<u>0.00</u>	0.00	
All	200	5.8	6.2	5.4	5.3	5.9	6.3	<u>4.3</u>	5.8	

^a Most liked products are in bold, least liked products are underlined.

^b LSD test determined products with the same letters were not significantly different.

a cultural/generation difference between older and younger consumers may have caused the older consumers to use the hedonic scale in a non-discriminating manner.

Cluster 3 ($r=0.98$) expressed a preference for Farmhouse cheese and was influenced by “traditional” and “handmade”. This cluster position was also influenced

by a liking for the Vintage cheese and dislike of the Supermarket Brand cheese. These consumers tended to be of medium income and between the ages of 35 and 55 (37%). Cluster 4 ($r=0.99$) liked the Vintage cheese and disliked the Supermarket brand cheese. Their preference was influenced by “expensive”, “rich colours”, “original” and “unconventional” shape. This group of

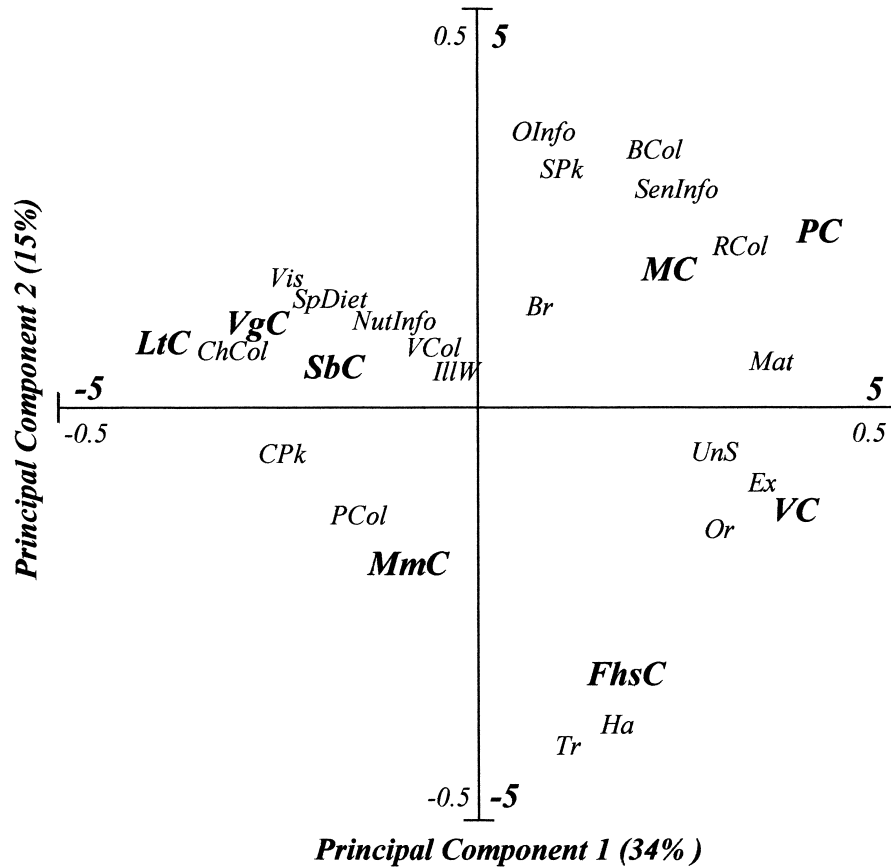


Fig. 5. Scores and loadings for PCA of 8 cheeses packaging attributes on PC's 1 and 2. An explanation of abbreviations can be obtained in Table 3, cheeses are explained in Section 2.1.

consumers consisted mainly of men (65%) who had a relatively high income (33% earned £IR21,000–30,000 and 25% earned over £IR30,000).

Determining consumer preference for packaging attributes using preference mapping identified the optimal cheeses for consumers in terms of their packaging. The overall preference result indicated that the Vintage and Premium cheeses were most liked, and these were optimal for 2 segments of consumers (clusters 2 and 4). However, cluster 1 preferred the Light cheese and cluster 3 preferred the Farmhouse cheese. A deeper insight into preference for packaging attributes was, therefore, gained. The model correlation coefficients indicated strong relationships between cheese packaging attributes and consumer preference. Prediction residuals were low, indicating the model was valid and could be used to predict preference for the packaging of other, similar cheeses.

Demographic data assisted to determine factors that may have influenced hedonic responses towards cheeses' packaging. Interestingly, age appeared to be influential, as it was when cheeses were tasted blind. Younger consumers (cluster 1) expressed a preference for the Light cheese. In contrast, the other 3 segments, (clusters 2, 3 and 4) which consisted of elderly and middle aged con-

sumers liked the Premium, Farmhouse and Vintage cheeses respectively. The attribute "maturity level" was important for this discrimination, which could suggest preference for more mature cheeses by older consumers.

Preference for cheese packaging was to some extent indicative of cheeses which consumers reported they purchased (Table 11). Supermarket Brand cheese (least liked) was purchased by only 4% of consumers, whereas Medium cheese, liked moderately for its' packaging was purchased by 16% of consumers. However, the Vintage and Premium cheeses were purchased by few consumers (5 and 6% respectively). Thus, despite these cheeses desirable intrinsic sensory and extrinsic packaging attributes these did not result in regular purchase. This finding illustrates the complexity and multi-dimensional nature of consumer food choice and demonstrates that although liking for cheese sensory and packaging attributes could be indicative of cheese choice, other factors were again influential such as appropriateness of use and price (Jack et al., 1994; Moskowitz, 1995).

It may also be worth considering the extent to which consumer preference for packaging attributes was influenced by the wider context of product image. For example Cluster 4 liked the Vintage cheese and were influenced by the attributes "expensive", "rich colours",

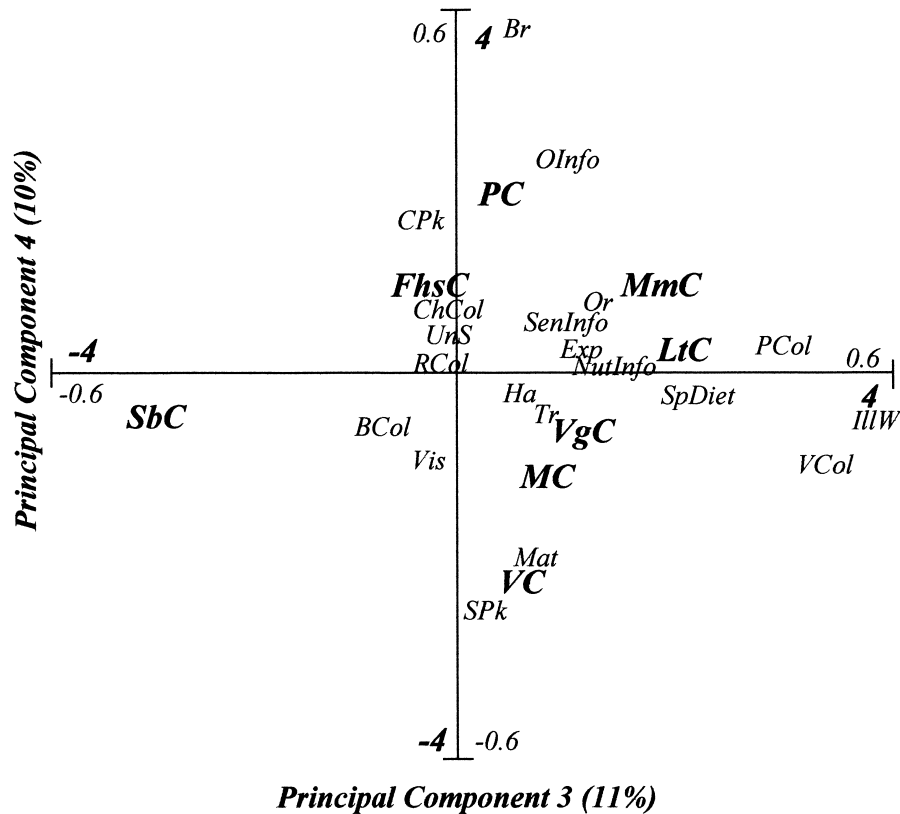


Fig. 6. Scores and loadings for PCA of 8 cheeses packaging attributes on PC's 3 and 4. An explanation of abbreviations can be obtained in Table 3, cheeses are explained in Section 2.1.

“original” and “unconventional” shape. However, it may not be that this affluent group inherently liked, for example, “rich colours”, but have learned by exposure to cultural and environment influences that they are associated with expensive foods and thus express a preference for these. Preference for packaging is thus perhaps more biased by external influences and learned behaviours than that of sensory attributes. Future studies should consider this observation.

Although preference mapping is widely carried out in market research, relatively few of these studies are reported (Hough & Sanchez, 1998). Most published studies have discussed external preference mapping as a tool for optimising sensory acceptance of food products. To the knowledge of the authors, this study represents the first account of applying sensory analysis and preference mapping techniques to product packaging attributes. This could represent a more objective, reliable and cost effective method for optimising consumer preference for packaging attributes.

4.5. Relationships between cheeses' packaging and sensory attributes

Investigation of relationships between cheese packaging and sensory attributes using PLS1 analysis indi-

cated by examination of correlation coefficients (r) that 5 sensory attributes [“pungent” aroma ($r=0.99$); “rancid” flavour ($r=0.99$); “soapy” flavour ($r=0.68$); “processed” flavour ($r=0.82$) and “rubbery” texture ($r=0.76$)] were related to cheese packaging. These sensory characteristics were associated with the most and least liked cheeses. “Pungent” aroma and “rancid” flavour characterised the Vintage and Premium cheeses (most liked), and “soapy” and “processed” flavour and “rubbery” texture characterised the Light cheese (least liked).

The Vintage and Premium cheeses were particularly characterised by “rich colours” thus, there may be a general relationship between intense colours on packaging and intensity of flavour. These products were found to be appealing both in terms of their sensory and packaging attributes.

The Light cheese was particularly characterised by “specialised for diet”, “nutritional information” and “visibility in the pack”. It could be that the more specialised for diet a product is, the more likely it will be that the traditionally expected sensory character of the product is changed, differentiating it from others in its category. For example the sensory characteristics of “soapy” and “rubbery” would not usually be associated with an acceptable Cheddar product.

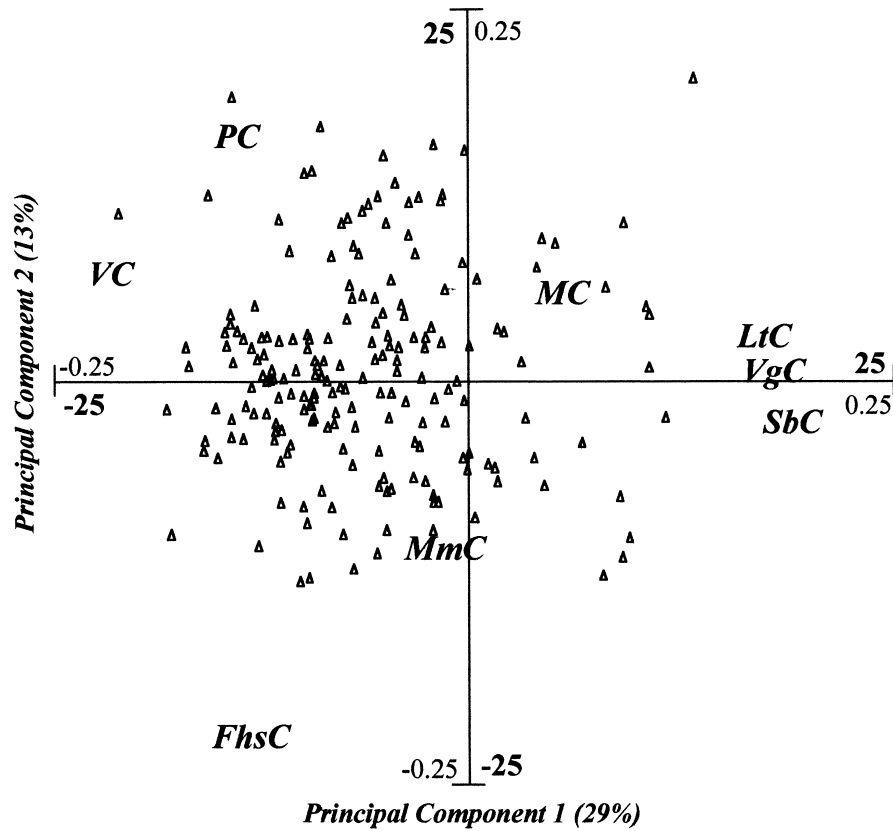


Fig. 7. Internal preference map obtained by PCA of individual consumer preference ratings for the packaging attributes of 8 cheeses. Cheeses are explained in Section 2.1.

Table 10
Demographic profile of 4 consumer clusters who expressed preference for cheeses' packaging attributes

	Cluster 1 %	Cluster 2 %	Cluster 3 %	Cluster 4 %
<i>Age</i>				
15–24	37	17	30	29
25–54	22	18	21	29
35–54	31	25	37	32
55+	10	39	12	10
<i>Gender</i>				
Male	45	31	51	64
Female	55	69	49	36
<i>Employment</i>				
Full-time	16	35	37	42
P/T, within home	32	34	29	26
Student/other	52	31	34	32
<i>Marital status</i>				
Married	46	62	49	39
Single	43	24	46	48
Other	11	14	5	13
<i>Income</i>				
Benefits, < IR£12,000	20	23	20	13
IR£12,000–20,000	20	20	24	21
IR£21,000–30,000	16	26	19	31
> IR£30,000	9	11	20	25
Student grant/other	35	21	17	10

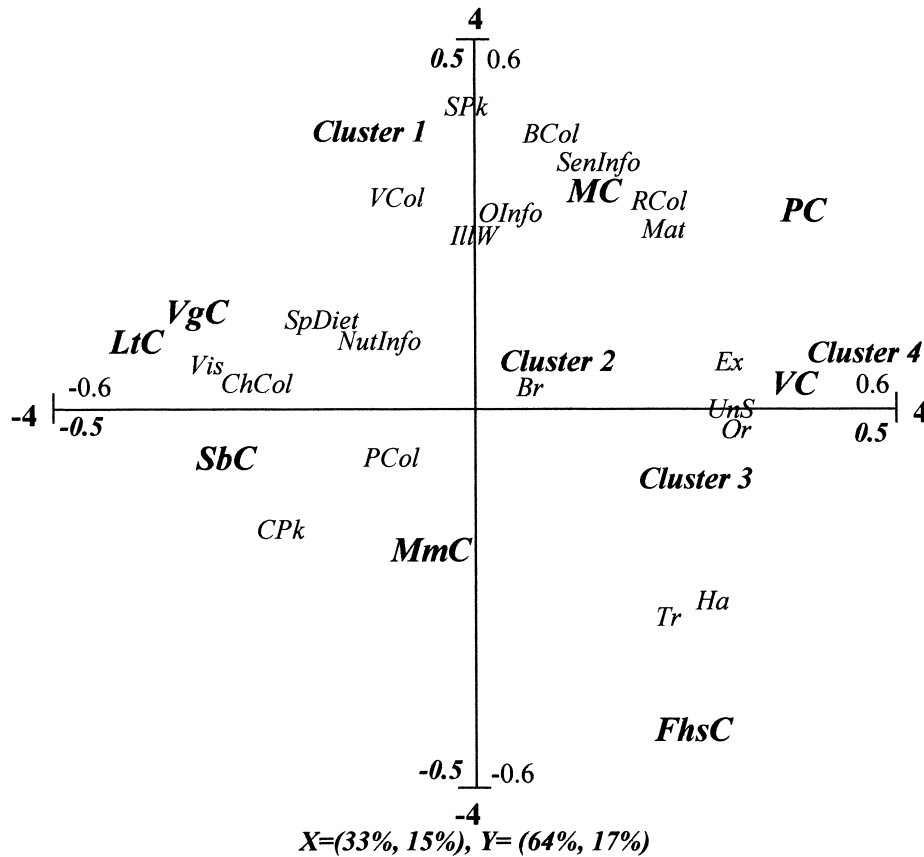


Fig. 8. External preference map obtained by PLS2 analysis of descriptive and clustered consumer preference data for the packaging attributes of 8 cheeses. An explanation of abbreviations can be obtained in Table 3, cheeses are explained in Section 2.1.

Table 11
Cheese types purchased by consumers who expressed preference for cheeses' sensory and packaging characteristics

Cheese type	Sensory consumers % (n=207)	Packaging consumers % (n=200)
Medium	17	16
Mature	17	18
Vintage	3	5
Premium	2	6
Vegetarian	8	6
Light	4	6
Farmhouse	10	9
Processed	6	6
Prepared	9	8
Speciality brand (e.g. Dubliner)	10	8
Processed	6	5
Supermarket Brand	4	4
Other	4	3

These observations indicated only general relationships between objectively measured packaging and sensory attributes, which may suggest that refinement of the technique is required to allow these relationships to be understood with greater ease. However, it is more

likely that at present the packaging attributes and sensory attributes of products are related only in the most general sense and specific relationships are difficult to determine. Despite the lack of specific relationships between cheese sensory and packaging attributes, some of these were relatively successful on the market. It could thus be the case that the lack of direct relationships were compensated for by consumer assimilation (Lange et al., 1999) thus limiting consumer dissatisfaction.

In the near future, however, it is expected that the consumer will become increasingly demanding, seeking greater convenience as less time becomes available for shopping than ever before (Steenkamp, 1996). Additionally, the consumer will probably demand product information which is “right first time” and conveys the type of product (on a sensory basis) which is being purchased. This will undoubtedly lead to attempts for increasing synergy between product packaging and sensory attributes.

5. Conclusions

Preference mapping of cheeses' sensory and packaging attributes allowed the preferred cheeses of consumer

segments, and their associated attributes to be identified. Preference mapping for cheeses' packaging attributes could represent a methodological advance in research that aims to investigate consumer responses towards product packaging. Demographic information allowed a general characterisation of the consumers who expressed different preferences to be made. Cheese purchase information allowed an assessment of the relationships between consumer preference for cheese (in terms of either sensory or packaging attributes) and reported purchasing habits. Investigation of the relationships between packaging and sensory attributes found few specific relationships, although general relationships were ascertained.

Analysis of both sensory and packaging attributes, and the relationships between these helped to evaluate consumer acceptance of cheese from a broader research perspective. Steenkamp (1996), stated "there is a lack of research which takes a broad approach aimed at integrating factors from several categories. Developing an integrated program is a major challenge for food consumer behaviour research in the future." It is hoped that this study, by incorporating data from two different perspectives provides a methodology by which to account for the multi-faceted nature of food choice.

Acknowledgements

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