Development of a model to predict consumer acceptance of cottage pie from sensory quality and salt content

Joanna Purdy, Gillian Armstrong, Heather McIlveen and Peter O'Donoghue

School of Hospitality, Tourism and Consumer Studies, Faculty of Business and Management, University of Ulster at Jordanstown, Co. Antrim, BT37 OQB, UK

Within the UK, national dietary surveys have quantified salt consumption well above recommended values for sodium intake. The greatest proportion (75-80%) of dietary salt intake can be attributed to processed foods (IFST, 1999). As a result the COMA report (Department of Health, 1991) and more recently the Food Standards Agency (2002) have recommended a reduction of 30% in dietary salt intake. Reducing salt in processed foods has met with some reluctance, partly due to the potential loss of flavour, texture, product yield and eventual loss of revenue. The aim of this preliminary study therefore was to develop a model to predict consumer acceptance from sensory quality and (reduced) salt content.

Eight samples of processed cottage pie, ranging from 0.67% to 0% salt were produced. A trained sensory panel (n=10) used the Quantitative Descriptive Analysis technique to evaluate the effects of a reduction in salt on sensory characteristics. The 8 samples were evaluated in triplicate, with 4 samples being presented per session using a balanced block design. A consumer panel (n=80) then used the 9-point hedonic scale to evaluate the acceptance of the 8 samples, which were evaluated once in an random order.

A principal component analysis was applied to the 15 sensory attributes in order to extract 3 PCs that explained 56.5% of the variance in the data. PC1 represented a "salt" dimension, PC2 represented a "flavour and quality" dimension while PC3 represented "aroma" and "sauce consistency" dimensions. Regression analysis was used to relate product acceptance to the 3 PCs within a regression equation of the following form for each of the 80 consumers:

$$Y = b0 + b1.PC1 + b2.PC2 + b3.PC3 \quad (1)$$

where Y is product acceptance and b0, b1, b2 and b3 are the regression coefficients.

However, the primary principal component (PC1) was highly correlated to the quantity of added salt for the 8 products ($r = 0.990$). Therefore, a second regression analysis was used to predict PC1 from the amount of salt.

$$PC1 = a + b.X \quad (2)$$

where X is the quantity of added salt and a and b are the regression coefficients.

PC1 in (1) was substituted by (2) to provide an extended predictive model for each consumer in terms of quantity of salt, X, as well as PC2 and PC3.

$$Y = a' + b1'.X + b2.PC2 + b3.PC3 \quad (3)$$

where $a' = b0 + b1.a$ and $b1' = b1.b$

A hierarchical cluster analysis was applied to the regression coefficients of the extended model (a', b1', b2 and b3) identifying four clusters of consumers whose acceptance of cottage pie products was related to salt and sensory quality in different ways. Table 1 summarises the

values of the regression coefficients for the four clusters. A series of ANOVAs including cluster as a between subjects effect revealed significant differences between the four clusters for all but the constant term of the initial model (b0).

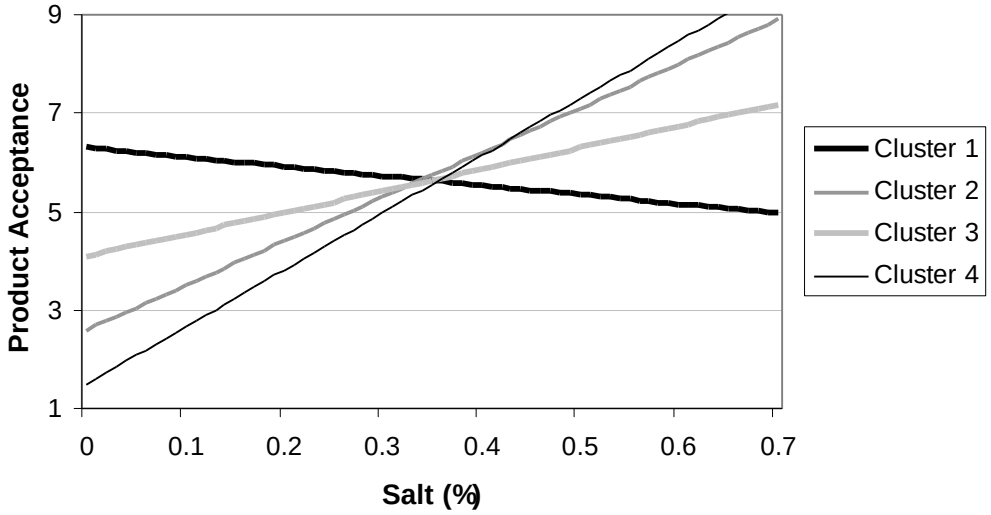
Table 1: Mean regression coefficients for each cluster of consumers.

Cluster	Initial model				Extended model	
	b0	b1	b2	b3	a'	b1'
Cluster 1 (n=26)	5.6	-0.7	-5.9	-6.5	6.3	-1.9
Cluster 2 (n=14)	5.6	3.4	7.2	4.6	2.6	9.0
Cluster 3 (n=36)	5.5	1.7	0.1	-1.9	4.1	4.4
Cluster 4 (n=4)	5.3	4.4	13.6	12.7	1.5	11.6
F(3,76)	0.1	49.7^	162.3*	115.9*	22.8^	49.7^

* P<0.001 with Bonferroni post hoc tests revealing significant differences between each pair of clusters (P < 0.05), ^ P < 0.001 with Bonferroni post hoc tests revealing significant differences between each pair of clusters (P < 0.05) except clusters 2 and 4 (P > 0.05).

Cluster 1 was characterised by a preference for low flavour and aroma. Cluster 2 was characterised by a preference for high flavour and aroma. Larger differences in the sensory qualities were required to influence the acceptance of products by cluster 3 and cluster 4 had the largest increase in acceptance per unit increase in sensory quality. Product acceptance improved with added salt for clusters 2, 3 and 4. However, cluster 1 showed an increased acceptance with decreasing salt content, although the rate of increase in product acceptance per unit salt removed was lower than the rate of increase in product acceptance per unit salt added for the other 3 clusters. Figure 1 shows the relationship between quantity of salt and product acceptance for products of mean sensory quality (PC2 = 0.0 and PC3 = 0.0).

Figure 1: The effect of salt on product acceptance.



The development of such predictive models may help food manufacturers reduce salt content effectively in processed food and enhance product positioning strategies. Further work is however required to validate the model for a greater range of product types.

References

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