Consumer acceptance of high pressure processed beef-based chilled ready meals: the mediating role of food-related lifestyle factors

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Abstract

The overall aim of this research was to investigate the effects of high pressure processing (HPP) on consumer acceptance for chilled ready meals manufactured using a low-value beef cut. Three hundred consumers evaluated chilled ready meals subjected to 4 pressure treatments and a non-treated control monadically on a 9-point scale for liking for beef tenderness and juiciness, overall flavour, overall liking, and purchase intent. Data were also collected on consumers' food consumption patterns, their attitudes towards food by means of the reduced food-related lifestyle (FRL) instrument, and socio-demographics. The results indicated that a pressure treatment of 200MPa was acceptable to most consumers. K-means cluster analysis identified 4 consumer groups with similar preferences, and the optimal pressure treatments acceptable to specific consumer groups were identified for those firms that would wish to target attitudinally differentiated consumer segments.

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1. Introduction

The phenomenal growth of the chilled ready meals category in recent years, in terms of both value sales and shelf-space allocation, has been partially attributed to the high levels of innovation and new product development (NPD) activities within the industry in response to changes in consumers' eating behaviours and lifestyles (Mescam, 2008; Datamonitor, 2007). While international cuisine and premium line extensions have come to represent an important strategic orientation across ready meal categories, the introduction of 'traffic light' labelling by some of the major multiple retailers, and an ever-increasing emphasis on 'clean labelling' alludes to the emergence of new ready meals positioned on a more wholesome, fresh and naturalness platform (Mintel, 2008; Bowery, 2007). However, the development of minimally processed foods presents challenges to companies in terms of optimising product formulations without compromising on the shelf life and sensory quality (Mescam, 2008). In that context, non-thermal food preservation processes represent an alternative to existing process technologies that can potentially meet market requirements for minimally processed foods.

High pressure processing (HPP) is one such non-thermal processing technology that involves the application of hydrostatic pressure to inactivate micro-organisms and extend

the shelf life of foods with minimal affects on nutritional and sensory quality (Rubio *et al*., 2007; Hugas *et al*., 2002). More so, the primary focus of this research was to determine whether HPP could also improve the eating quality of a chilled ready meal manufactured using a low-value beef cut, namely beef brisket. In that context, the attraction of utilising HPP on beef brisket would clearly lie in reducing costs, while improving the acceptability and eating quality of low-value beef for use in value-added products such as chilled ready meals. In light of the economic downturn across developed economies, coupled with the energy intensive nature of the meat processing industry and increased pressure from retailers to keep costs down, non-thermal technologies such as HPP that can improve manufacturers' cost competitiveness and margins would be clearly beneficial to the meat industry.

While novel process technologies such as HPP could be potentially rewarding for manufacturers and retailers, they also represent the riskiest form of NPD activity. Indeed, a large body of research has examined consumers' attitudes and concerns with regard to novel process technologies including HPP, and these studies have identified a myriad of factors that influence consumers' perceptions and acceptance of novel products and processes (Sorenson and Henchion, 2009; Christoph *et al*., 2008; Cox and Evans, 2008; Evans and Cox, 2006; Onyango *et al*., 2006; O' Connor *et al*., 2005; Bruhn, 2003; Cardello, 2003; Fortin and Renton, 2003; Scholderer and Frewer, 2003; Lassen *et al*., 2002; Grunert *et al*., 2001). Similarly, the effects of increasing magnitude of pressure on the physicochemical quality of fresh and processed meat have been well documented. In the context of this study, HPP has been shown to reduce juiciness but improve tenderness

in fresh beef and beef-based foods in comparison to control samples (Ludikhuyze and Hendrickx, 2001). Low pressure treatments in the region of 150MPa have been shown to lead to colour changes similar to cooked meat, with an increasing magnitude of pressure above 300MPa giving rise to a gradual darkening in colour (Hugas *et al*., 2002; Carlez *et al*., 1995). Ludikhuyze and Hendrickx (2001) therefore concluded that HPP was a viable process that could be applied to fresh meat when accompanied by a sauce and cooked prior to consumption as in the case of prepared foods and ready meals. However, there has been a paucity of research studying the effects of HPP on consumer acceptability of value-added prepared foods produced using novel process technologies (Cardello, 2003). Indeed, while HPP systems have been applied successfully to the commercialisation of pressure treated sauces and condiments, fruit-based foods and beverages, and cured and cooked meat, its application to multi-component foods such as ready meal solutions remains limited to date (Lau and Turek, 2007; Hogan *et al*., 2005).

The overall aim of this research was to investigate the effects of HPP on consumer acceptance for chilled ready meals manufactured using a low-value beef cut. More specifically, the authors wished to determine whether HPP could play a role in reducing the cost of a chilled ready meal by improving the texture and overall acceptability of a low-value beef cut used as the main ingredient. The findings presented in this timely study illustrate how the integration of marketing and sensory research techniques can provide for a better understanding of consumers' preferences, their perceptions of quality, and the requirements of the marketplace in terms of product offerings. This consumer-driven approach to product development can in turn assist companies to maximise their

technological capabilities and ultimately improve the market competitiveness of foods produced using novel process technologies such as HPP. The research presented in this paper formed part of a larger multi-disciplinary NPD project that investigated the technical and commercial feasibility of high pressure processed chilled ready meals with high levels of added value and consumer satisfaction. This specific study was conducted by researchers from the Food Marketing Research Unit and the Meat Technology Department at Ashtown Food Research Centre (AFRC), Teagasc, Dublin, Ireland.

2. Materials and methods

2.1 High pressure processing and ready meal assembly

Beef *M. pectoralis profundus* muscles from 12 crossbred heifers slaughtered at less than 24 months of age were obtained from a local Irish distributor. Each muscle (medial region) was cut into 2 × 2cm cubes. The diced beef was mixed, randomly distributed into 5 batches and vacuum packed in pre-labelled polyamide polyethylene bags. The pre-labelled vacuum packed samples were then treated in an Avure Quintus 35l high pressure press (Avure Technologies, Västerås, Sweden). The pressure transmission fluid was potable water. The time to reach the desired pressure level was approximately 20–25s per 100 MPa, and the pressure release time was approximately 10-15s depending on the pressure level applied. Meat batches were treated at 4 different pressure levels (200, 300, 400 and 500 MPa) at 20°C for 20min. A non-treated meat batch was kept as a control (Table 1).

Assembly of the meal components was done the day after high pressure processing. Ready meal units of approximately 300g portions were obtained by mixing 60% of diced beef and 40% of gravy sauce directly into pre-labelled polyamide polyethylene vacuum shrink bags (Food Processing Technology Ltd., Dublin, Ireland). The sauce was prepared with beef stock, tomato paste, flour and margarine. Roux beef bouillon was also added to achieve the desired consistency. After vacuum packaging, the bags were dipped in hot water at 90ºC for 30s to shrink the bags around the beef and sauce. This was done to strengthen the packaging material and to avoid the possible formation of air pockets during cooking. The samples were then stored at 4°C until they were cooked in a steam oven (MIC 2500, Jugema, Środa Wlkp, Poland). The cooking programme was as follows: step 1: chamber was set at 95ºC until a core temperature of 85ºC was reached; step 2: core temperature and chamber maintained at 85ºC for 5 hours; step 3: chamber temperature reduced to 4ºC by showering with cold water for 40 minutes. Thermocouples inserted through the cooking bag into the geometric centre of the beef pieces monitored the internal core product temperature throughout the cooking process. After cooling, the packs were stored at 4ºC for subsequent consumer evaluation.

2.2 Consumer acceptance testing

A sample of 300 consumers of chilled ready meals was recruited through a fieldwork agency and through local sports clubs and societies. They were asked to take part in an acceptance test for 5 different beef-based chilled ready meals (Table 2). Respondents were recruited by means of a non-probability sampling method, namely purposive sampling. Three screening questions were asked to ensure participants were part of the

target groupings of interest to this study. First, only respondents aged between 18 and 44 years were eligible for participation in the study. This decision was taken on the basis of the high penetration levels for chilled ready meals amongst these consumers (Datamonitor, 2007; Mintel, 2008: 2006). Second, potential respondents had to consume chilled ready meals at least 1 to 3 times every month (light users) on average. Finally, given the multi-component nature of chilled ready meals and the fact that consumers would blind taste all 5 chilled ready meals, respondents that were intolerant or allergic to any foods or food components were excluded from the study.

The acceptance testing was held at the conference facilities of a publicly funded research centre in Dublin, Ireland. Each day of assessment consisted of 1 to 2 sessions on weekdays, and up to 4 sessions on weekends, with up to 30 consumers in each session. In total, 12 tasting sessions were conducted between the 27th January 2010 and the 4th February 2010. In each session, consumers evaluated the chilled ready meals monadically (one at a time) over 5 rounds. The samples presented for evaluation were blind tasted and therefore were not identified to consumers as HPP chilled ready meals. Samples of the chilled ready meals were removed from chilled storage immediately prior to each scheduled session, and were stored in insulated cool boxes for the duration of each session. The samples were individually reheated in identical microwave ovens at 800W for 3.5min, and allowed to stand for 1min. The reheating procedure had been pre-tested to ensure that the core temperature of the beef pieces reached a minimum of 76°C. The chilled ready meal samples were then served immediately to consumers, and this process was repeated for each round.

Consumers evaluated the 5 chilled ready meal samples at individual workstations, in a controlled environment, under white lighting and a temperature of 21°C. Approximately 50g samples consisting of 2 cubes of beef in gravy were presented to participants in polystyrene cups with lids. Each chilled ready meal was assigned a different randomly generated three-digit code and the presentation order was balanced and randomised to minimise first order and carry-over effects (Table 1) (MacFie *et al*., 1989). Consumers were asked to evaluate each sample monadically on a 9-point scale, ranging from dislike extremely (1) to like extremely (9), for each of the following descriptors: liking for beef tenderness and juiciness, overall flavour, and overall liking. Consumers were also asked to indicate their likely purchase intent using a 9-point scale ranging from most definitely will not purchase (1) to most definitely will purchase (9). Consumers were provided with water and crackers and were encouraged to cleanse their palate between sampling the different chilled ready meals.

Socio-demographic information was also collected in addition to information on consumers chilled ready meal consumption patterns, and their attitudes towards food shopping, preparation and consumption using a reduced version of the original FRL instrument. The original FRL instrument is based on the notion that food-related lifestyles are a means by which people use food to achieve their personal life values, and has been used successfully to explain consumers' behaviours towards food purchases (Buckley *et al*., 2007; Kennedy *et al*., 2005; Lea and Worsley, 2005; O' Sullivan *et al*., 2005; Brunso *et al*., 2004; Bredahl and Grunert, 1998). It constitutes 69 statements

measuring 23 dimensions across 5 domains: ways of shopping, quality aspects, cooking methods, consumption situations and purchasing motives (Hoek *et al*., 2004). A reduced version of the original FRL instrument, which consists of 23 statements across the 5 FRL domains, was chosen for inclusion in this study to reduce the likelihood of respondent fatigue from completing both the sensory acceptance testing and the supplementary market research questionnaire. Consumers were asked to evaluate each of the 23 statements using a 7-point scale ranging from strongly disagree (1) to strongly agree (7). The reduced FRL instrument has been validated, and shown to be comparable to the original FRL instrument in terms of its ability to accurately distinguish between segments within the Irish and UK prepared foods market (Wycherley *et al*., 2008; Buckley *et al*., 2007; de Boer *et al*., 2004: 2003).

2.3 Data analysis

The sensory and marketing data was analysed using SPSS (Version 14.0, SPSS, Chicago, IL, USA). Hierarchical cluster analysis by Squared Euclidean Distance was employed initially to determine the desired number of clusters in order to reflect the variation in consumers' preferences that might exist in the marketplace. This preliminary segmentation process suggested a 4-cluster solution based on observation of the agglomeration schedule and dendogram. K-means cluster analysis was then used to segment respondents into 4 distinct clusters with similar overall liking scores for the 5 treatments. A Principal Component Analysis (PCA) on the consumer overall liking data was carried out using The Unscrambler (Version 9.8, CAMO, Trondheim, Norway) to yield internal preference maps at both the individual and group level (MacFie, 2006).

A PCA with varimax rotation was applied to the 23 reduced FRL statements, which helped further distinguish between segments. Reliability analysis using Cronbachs alpha was conducted to test the reliability and internal consistency of the reduced FRL measures, and the coefficients ranged from 0.58 to 0.654, which were within the limits of acceptability (Hair *et al*., 1998). The PCA and observation of the scree plot revealed the presence of 4 components with Eigen values greater than 1.5, and the first 4 principal components (PCs) accounted for 47% of the explained variation. Table 3 illustrates the loadings of each of the statements onto the 4 PCs.

The FRL domains 'ways of shopping' and 'quality aspects' constituted the statements with the greatest loadings on PC1. Specifically, PC1 had high loadings onto statements related to the influence of information and advertising on food purchases, willingness to purchase organic food and to experiment with ethnic cuisines, and the importance of both a planned shopping list and product freshness on food choice. PC2 primarily concerned the FRL domain 'cooking methods' such as the increasingly important role of men in meal provision, and enjoyment in cooking and recipe experimentation in the kitchen. This second component also included elements of 'ways of shopping', which related to interest and involvement in the purchase decision-making process and the use of speciality food stores. Convenience-oriented elements of both the 'cooking methods' and the 'consumption situations' domains loaded strongly onto PC3. In addition, the statement from the 'ways of shopping' domain that stressed the relevance of unplanned food purchasing behaviours loaded onto this component also. PC4 primarily concerned

the social and hedonistic-oriented elements of the FRL domains 'purchasing motives' and 'quality aspects' respectively.

Analysis of variance (ANOVA) was carried out on both the overall liking scores and factor scores, to determine whether significant differences in sensory acceptance, and attitudes towards food purchasing, preparation and consumption, existed between consumer segments respectively. The chi-square test of independence was also applied to determine whether socio-demographic and consumption related categorical variables might explain cluster membership.

3. Results and discussion

3.1 Overall consumer acceptability

The results of the internal preference mapping illustrate the heterogeneity in consumer acceptance for the 5 treatments (Fig. 1). In Figure 1 the numbers represent consumer preferences, and the intensity and direction of consumers' preferences from the midpoint of the map determine the position of the pressure treatments relative to each other. Those treatments close to one another are perceived as similar in terms of sensory acceptance. The first two PCs accounted for 63% of the explained variation in consumer acceptability. The direction of preference was towards the chilled ready meal treated at 200MPa (mean overall liking score 6.22 out of 9). Overall, the least liked products were the chilled ready meal treated at 500MPa (mean overall liking score 5.31 out of 9) and the non-treated chilled ready meal (mean overall liking score 5.45 out of 9), which was

illustrated by the low consumer numbers in those areas of sensory space (Fig. 1). These products also received the lowest mean scores for liking for beef tenderness and juiciness, and overall flavour (Table 4).

However, further analysis of the mean scores for overall liking suggested that an increase in pressure above 200MPa did not necessarily result in a decrease in overall liking by consumers. Specifically, although the internal preference map suggested that the chilled ready meals treated at 200MPa and 300MPa might be similar given their proximity in terms of sensory space, the chilled ready meal treated at 400MPa was the second most liked product (mean overall liking score 5.91 out of 9). Indeed, while the chilled ready meals treated at 300MPa and 400MPa scored similar on liking for beef tenderness, the latter scored higher on both liking for beef juiciness and flavour of the chilled ready meal (Table 4). These findings suggested the existence of consumer groups with differing preferences among the 5 treatments.

3.2 Cluster preferences and typologies

K-means cluster analysis grouped respondents into 4 distinct clusters with similar preferences for the 5 treatments. The averaged consumer liking and purchase intent scores are presented in Table 5 with the highest scores in bold and the lowest scores in italics for each cluster. The socio-demographic and chilled ready meal consumption profiles of each segment are presented in Table 6. Overall, the profiles of Clusters 1 to 3 were relatively similar across socio-demographic variables. In contrast, Cluster 4 contained a higher proportion of females, those well educated, married, and living in

dual-income households relative to the other 3 segments. However the chi-square analysis revealed no significant relationship between any of the socio-demographic variables and cluster membership. Importantly, further analysis revealed that consumption frequency of chilled ready meals and food-related lifestyle factors rather than socio-demographic factors influenced sensory liking and acceptability, and helped explain cluster membership (Tables 6 and 7).

Clusters 1 and 3 appeared to exhibit relatively similar preferences for the 5 treatments. For example, Clusters 1 and 3 most liked the chilled ready meal treated at 200MPa with mean overall liking scores of 6.61 (out of 9) and 7.38 (out of 9) respectively. Analysis of the data showed that overall liking scores appeared to decease with an increase in pressure over 200MPa for both segments, and these consumer groups least liked the chilled ready meal treated at 500MPa (Table 5). This trend was also consistent for liking for beef tenderness and juiciness, overall flavour and purchase intent. However, while HPP treatments between 200MPa and 400MPa were more liked than the non-treated control by Cluster 1, Cluster 3 gave almost equal overall liking scores to both the non-treated control and the chilled ready meal treated at 400MPa. Indeed, Cluster 3 appeared the least discerning of the 4 segments taking into account the relatively high overall liking scores given for all 5 treatments, and its position on the internal preference map relative to the other 3 segments (Fig. 2). This initially suggested that Cluster 3 might represent those consumers that lack the sensory acuity to distinguish between products. However, the negative reduced FRL factor values across all 4 PCs coupled with the high level of acceptance for all 5 treatments suggested that Cluster 3 actually represented

consumers with extremely low levels of interest and involvement with regard to the purchase, preparation and consumption of food (Table 7).

Cluster 2 exhibited differing preferences for the 5 treatments in comparison to the other 3 segments. While the chilled ready meal treated at 200MPa performed well for both liking for beef tenderness and juiciness, it was less acceptable to this consumer group in terms of liking for the ready meal flavour and overall liking (Table 5). Instead, this cluster most liked the chilled ready meal treated at 400MPa (mean score 6.41 out of 9), and this was more preferred ($p \leq 0.05$) by Cluster 2 than Clusters 1 or 4. Cluster 2 also exhibited differing perceptions of eating quality given that the chilled ready meal treated at 500MPa, as well as the non-treated control, were preferred to the chilled ready meals treated at the lower pressure levels. It was therefore interesting to find the cluster that rated higher pressure levels more acceptable than lower pressure treatment levels was also the most convenience-driven in its attitudes towards food preparation and consumption. This assessment was based upon their strong rating scores for statements concerning the importance of convenience food solutions, the relevance of unplanned food purchasing behaviours, and the resultant high positive factor score loading onto PC3 (Table 7).

The findings from this study suggested that the intrinsic characteristics of brisket were not acceptable to Cluster 4 based upon the low mean scores for both overall liking and purchase intent for all 5 treatments. Interestingly, this most discerning consumer group contained the highest proportion of light consumers of chilled ready meals, and overall

consumption frequency was found to significantly ($p \leq 0.05$) discriminate Cluster 4 from the other 3 segments (Table 6). In addition, this consumer group scored strongly for statements concerning the importance of product information and planned shopping on food choice, as well as an interest in food experimentation and organic foods on PC1, and the social aspects of food consumption on PC4. More so, the positive factor score on PC2 suggested that an interest and involvement in food shopping and preparation was also important to this consumer group, and significantly ($p \leq 0.05$) discriminated Cluster 4 from the other 3 consumer groups. In contrast, convenience was of less importance to this segment, which was evident by the negative factor score loading onto PC3 (Table 7).

On that basis, further research examining the effects of HPP on other low-value beef cuts and/or other tenderising strategies would be necessary in order to develop chilled ready meals utilising low-value beef cuts, which would garner high levels of acceptance by this most discerning consumer group. In addition, given that a significant ($p \leq 0.05$) proportion of Cluster 4 were light consumers of chilled ready meals, perhaps a different chilled ready meal concept might elicit greater appeal amongst these consumers. For example, further consumer research could possibly evaluate various home dinner kit concepts utilising high pressure treated fresh meat, in order to appeal to those consumer groups, like Cluster 4, that enjoy cooking and experimenting with new recipes, and are seeking a fresher or more natural 'convenience' meal experience.

In this study the process by which the beef-based chilled ready meals were produced deviated from the more established practice of high pressure processing the final

packaged product. On that basis, further consumer research should investigate whether the improvements to the eating quality of a ready meal using low-value meat could also be achieved by pressurising the final packaged product. While the findings from this study allude to market opportunities for suppliers of pressurised meat components, further research should also investigate whether pressurising the meat components would meet with industry acceptability in terms of normative manufacturing practices.

It is also important to note that the results of this study were based on consumers blind tasting the 5 chilled ready meals, and that the introduction of information on the beef cut chosen, production process or HPP technology might have affected their perceptions, sensory preferences, and purchase intent. The authors also acknowledge that the analysis and interpretation of the consumer acceptance data could have been strengthened by the inclusion of both physicochemical and descriptive sensory analysis. This was particularly true given that HPP not only contributed towards improved consumer acceptability in terms of beef tenderness, but also in terms of liking for overall flavour. These further analyses would therefore have provided for a better understanding of the effects of HPP on the individual ready meal components, and most importantly, the intrinsic attributes driving consumers' preferences for the final chilled ready meals.

4. Conclusion

The findings from this study showed the potential of HPP to improve the eating quality of chilled ready meals manufactured using a low-value beef cut. The overall result from the

300 consumers acceptance test indicated that a pressure treatment of 200MPa was most acceptable to the majority of consumers. However, an increase in pressure above 200MPa did not always elicit lower acceptance scores, and 4 consumer groups were identified with differing perceptions of eating quality and different thresholds of acceptability for the 5 treatments. Importantly, this study showed that the 4 consumer segments held different attitudes towards the purchase, preparation and consumption of food that could be related to their sensory acceptance for the 5 treatments. The segments most accepting of pressure treatments above 400MPa were more likely to be either convenience-driven (Cluster 2) or uninvolved (Cluster 3) with regard to the food purchase decision-making process. This information would be of most value to those firms that might benefit from using higher pressure levels in order to extend the shelf life further for example. Overall, the findings from this study illustrate the value of integrating marketing and sensory techniques into the NPD process in terms of more accurately identifying and targeting cognitively and attitudinally differentiated market segments, in order to leverage a superior competitive advantage in the marketplace.

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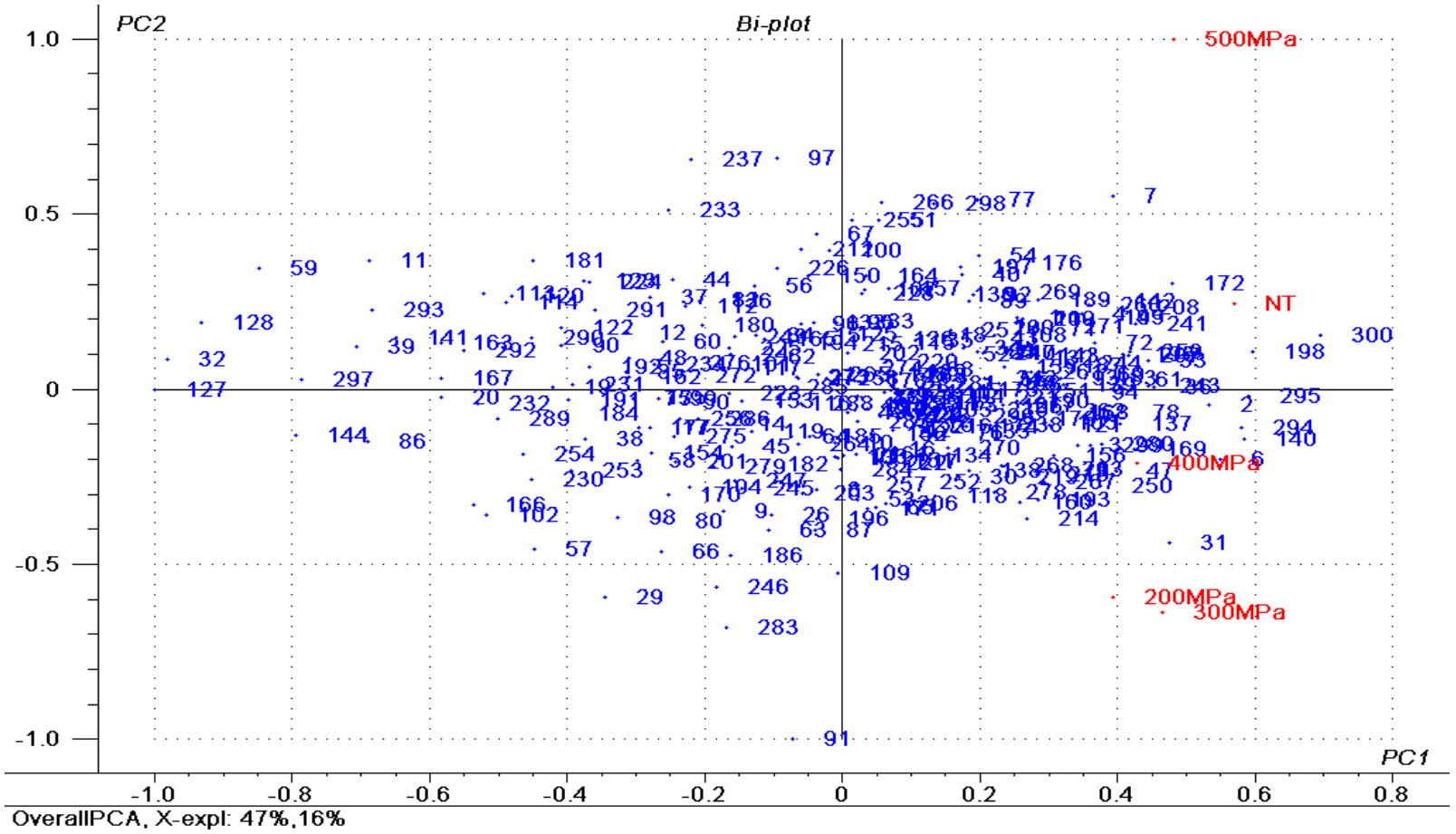

Fig.1. Internal preference mapping of consumer mean overall liking scores for the five treatments

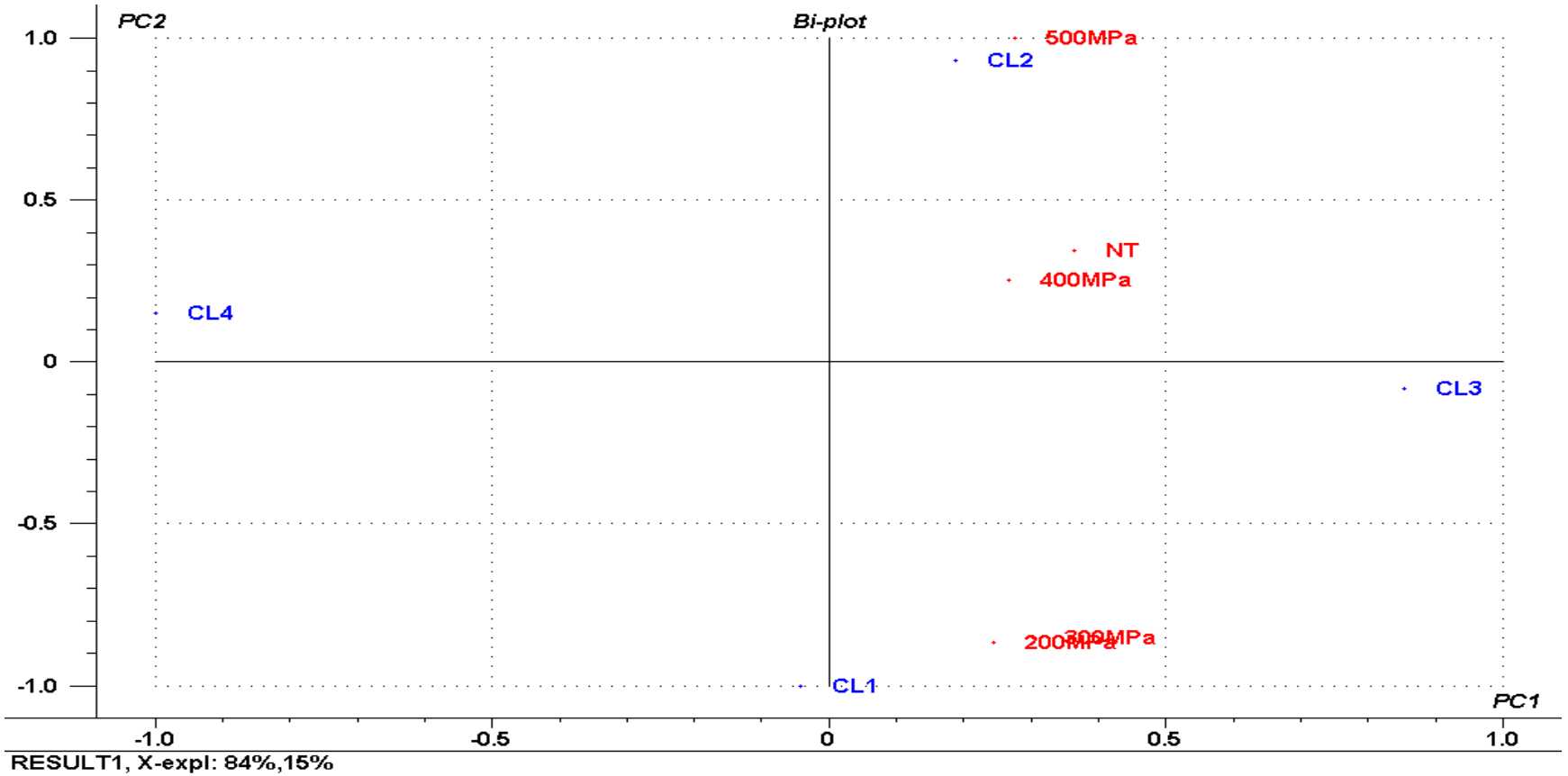

Fig. 2. Internal preference mapping of the cluster mean overall liking scores for the five treatments

Table 1
Product codes and corresponding treatments selected for consumer evaluation

Product Code	3-digit Code	Treatment
NT	357	Non-treated
200MPa	180	200MPa at 20^0C for 20mins
300MPa	521	300MPa at 20^0C for 20mins
400MPa	903	400MPa at 20^0C for 20mins
500MPa	448	500MPa at 20^0C for 20mins

Table 2

Socio-demographic and chilled ready meal consumption profile

Variable	Category	N	%
Sample Size	-	300	100
Gender	Male	150	50.0
	Female	150	50.0
Age Group	18-24yrs	79	26.3
	25-34yrs	110	36.7
	35-44yrs	111	37.0
Highest Education Level Attained	Primary Level	3	1.0
	Intermediate Certificate	22	7.3
	Leaving Certificate	81	27.0
	Certificate/Diploma	93	31.0
	Primary Degree	67	22.3
	Postgraduate Degree	34	11.3
Marital Status	Single	123	41.0
	Married	100	33.3
	Separated/Divorced	9	3.0
	Cohabiting	67	22.3
	Widowed	1	0.3
Life Stage	Pre-family	156	52.0
	Family	144	48.0
Social Class	ABC1	161	53.7
	C2DE	139	46.3
Number in Employment in Household	None	12	4.0
	1 Worker	138	46.0
	2 Workers	110	36.7
	More than 2 Workers	40	13.3
Ready Meal Consumption Frequency	Light (less than once per week)	142	47.3
	Medium (once per week)	84	28.0
	Heavy (more than once per week)	74	24.7

Table 3

Final factor loadings from principal component analysis with varimax rotation for the reduced FRL statements

	Principal Components			
	PC 1	PC2	PC3	PC4
I compare product information labels to decide which brand to buy	0.715			
I make a point of using organic food products	0.699			
To me product information is of high importance, I need to know what the food product contains	0.623			
I don't mind paying a premium for organic products	0.580			
Information from advertising helps me to make better buying decisions	0.544			
I make a shopping list to guide my food purchases	0.507			
I love to try recipes from foreign countries	0.423			
I prefer to buy meat and vegetables fresh rather than frozen/canned	0.368			
The responsibility for shopping & cooking ought to lie just as much with the husband as with the wife		0.664		
It is the woman's responsibility to keep the family healthy by serving a nutritious diet		-0.657		
Shopping for food doesn't interest me at all		-0.623		
I like to try out new recipes		0.593		
I don't see any reason to shop in specialty food stores		-0.583		
Cooking is a task that is best over and done with		-0.559		
Recipes and articles on food from other culinary traditions make me experiment in the kitchen		0.543		
Shopping for food is like a game to me			0.575	
What we are going to have for supper is very often a last minute decision			0.568	
I eat whenever I feel the slightest bit hungry			0.563	
We use a lot of ready-to-eat food in our household			0.548	
I use a lot of mixes, for instance baking mixes and powder soups			0.515	
I enjoy a good meal				0.835
Enjoying the taste of a food is important to me when I am eating				0.776
Over a meal one may have a lovely chat				0.560

Table 4

Mean scores for liking and purchase intent for the five treatments

	NT	200MPa	300MPa	400MPa	500MPa
Overall Liking	5.45	6.22	5.81	5.91	5.31
Liking for Tenderness	5.34	6.68	6.18	6.18	5.01
Liking for Juiciness	5.18	6.29	5.77	5.89	5.12
Liking for Flavour	5.44	6.24	5.83	5.87	5.22
Purchase Intent	4.72	5.74	5.35	5.39	4.57

Table 5

Mean scores for liking and purchase intent for the five treatments across cluster groupings

Variable	Product Code	Cluster 1 (mean score out of 9)	Cluster 2 (mean score out of 9)	Cluster 3 (mean score out of 9)	Cluster 4 (mean score out of 9)
Cluster Size		74	73	106	47
Overall Liking	NT	4.77	5.95	6.75	*2.79*
	200MPa	**6.61**	5.30	**7.38**	**4.40**
	300MPa	6.16	*4.96*	7.16	3.55
	400MPa	5.53	**6.41**	6.74	3.87
	500MPa	*3.73*	5.99	*6.66*	3.70
Liking for Tenderness	NT	4.66	5.71	6.40	*3.42*
	200MPa	**7.09**	6.24	**7.39**	**5.06**
	300MPa	6.22	*5.42*	7.27	4.82
	400MPa	6.22	**6.31**	6.77	4.53
	500MPa	*3.74*	5.63	*6.00*	3.82
Liking for Juiciness	NT	4.62	5.58	6.16	*3.17*
	200MPa	**6.51**	5.75	**7.16**	**4.80**
	300MPa	5.94	*5.00*	6.75	4.44
	400MPa	5.85	**6.41**	6.34	4.10
	500MPa	*4.02*	5.69	*5.96*	4.02
Liking for Flavour	NT	4.93	6.05	6.58	*2.72*
	200MPa	**6.48**	5.60	**7.33**	**4.40**
	300MPa	6.14	*5.24*	6.90	3.80
	400MPa	5.70	**6.30**	6.65	3.68
	500MPa	*4.06*	5.89	*6.25*	3.65
Purchase Intent	NT	3.93	5.34	6.02	*2.02*
	200MPa	**6.09**	4.93	**7.00**	**3.59**
	300MPa	5.51	*4.43*	6.80	3.25
	400MPa	5.13	**5.80**	6.28	3.10
	500MPa	*2.97*	5.36	*5.86*	2.91

Table 6

Consumer socio-demographic and chilled ready meal consumption profiles across cluster groupings

Variable	Level	Cluster 1 (%)	Cluster 2 (%)	Cluster 3 (%)	Cluster 4 (%)
Gender	Male	51.4	53.4	54.7	31.9
	Female	48.6	46.6	45.3	68.1
Age Group	18-24yrs	28.4	31.5	25.5	17.0
	25-34yrs	33.8	38.4	35.8	40.4
	35-44yrs	37.8	30.1	38.7	42.6
Highest Education Level Attained	Primary Level	-	1.4	1.9	-
	Intermediate Certificate	4.1	12.3	9.4	-
	Leaving Certificate	32.4	21.9	26.4	27.7
	Certificate/Diploma	27.0	32.9	30.2	36.2
	Primary Degree	28.4	23.3	19.8	17.0
	Postgraduate Degree	8.1	8.2	12.3	19.1
Marital Status	Single	41.9	46.6	43.4	25.5
	Married	32.4	26.0	34.0	44.7
	Seperated/Divorced	4.1	-	3.8	4.3
	Cohabiting	20.3	27.4	18.9	25.5
	Widowed	1.4	-	-	-
Life Stage	Pre-family	45.9	52.1	48.1	44.7
	Family	54.1	47.9	51.9	55.3
Social Class	ABC1	54.1	53.4	50.9	59.6
	C2DE	45.9	46.6	49.1	40.4
Number in Employment in Household	None	4.1	5.5	3.8	2.1
	One Worker	52.7	47.9	46.2	31.9
	Two Workers	28.4	38.4	34.9	51.1
	More than Two Workers	14.9	8.2	15.1	14.9
Overall Ready Meal Consumption Frequency	Light (less than once per week)	45.9	42.5	40.6	72.3
	Medium (once per week)	27.0	34.2	31.1	12.8
	Heavy (more than once per week)	27.0	23.3	28.3	14.9

Table 7

Average factor scores for the reduced FRL statements across cluster groupings

	Cluster 1	**Cluster 2**	**Cluster 3**	**Cluster 4**
Reduced FRL PC1	-0.060	-0.040	-0.030	**0.226**
Reduced FRL PC2	-0.173	**0.008**	-0.058	**0.391**
Reduced FRL PC3	**0.018**	**0.108**	-0.031	-0.126
Reduced FRL PC4	**0.024**	-0.170	-0.005	**0.238**