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Consumer evaluations of processed meat products reformulated to be healthier – a conjoint analysis study

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Abstract

Recent innovations in processed meats focus on healthier reformulations through reducing negative constituents and/or adding health beneficial ingredients. This study explored the influence of base meat product (ham, sausages, beef burger), salt and/or fat content (reduced or not), healthy ingredients (omega 3, vitamin E, none), and price (average or higher than average) on consumers' purchase intention and quality judgement of processed meats. A survey (n=481) using conjoint methodology and cluster analysis was conducted. Price and base meat product were most important for consumers' purchase intention, followed by healthy ingredient and salt and/or fat content. In reformulation, consumers had a preference for ham and sausages over beef burgers, and for reduced salt and/or fat over non reduction. In relation to healthy ingredients, omega 3 was preferred over none, and vitamin E was least preferred. Healthier reformulations improved the perceived healthiness of processed meats. Cluster analyses identified three consumer segments with different product preferences.

Keywords: processed meat, health, consumer, conjoint analysis, consumer segmentation

1. Introduction

Processed meat refers to meat that has been transformed through salting, curing, smoking or other processes to enhance flavour or extend shelf-life (Bouvard et al., 2015). This food category encompasses a wide range of products that differ from each other in terms of meat type, salt and fat content, the processing method applied, and eating occasions (e.g. daily consumption *vs* occasional consumption) (Chizzolini, Zanardi, Dorigoni, & Ghidini, 1999; Desmond, 2006; FAO, 2008; Grunert, Verbeke, Kugler, Saeed, & Scholderer, 2011). Processed meat is a dietary source of protein, B-type vitamins, iron and zinc (Decker & Park, 2010). Health effects associated with processed meat consumption are product and consumption amount dependent, and the evidence is yet equivocal (De Smet & Vossen, 2016; Grasso, Brunton, Lyng, Lalor, & Monahan, 2014). Epidemiological studies show that the high consumption of some processed meat products can increase the risk of coronary heart disease, type-2 diabetes and colorectal cancer (Boada, Henriquez-Hernandez, & Luzardo, 2016; WHO International Agency for Research on Cancer, 2015). However, the mechanisms by which these deleterious effects are exerted, especially the processed meat-cancer link, are still far from being fully understood (De Smet & Vossen, 2016). Consumer concerns about the health characteristics of processed meats have increased in recent years (Tobin, O'Sullivan, Hamill, & Kerry, 2014). Despite this, consumer demand for convenience and good taste has ensured that processed meat retains a stable place in consumer diets (Grunert, 2006). This suggests a potential role for ‘healthier’ processed meat, which could offer benefits for both public health and the meat industry, but only if such products are accepted by consumers (Hung, de Kok, & Verbeke, 2016a). It is commonly accepted that the failure rate for innovative products on the food market is very high, likely due to the tendency to postpone the generation of consumer insight until a later stage – the stage when physical prototypes are available (Grunert, Bredahl, & Brunso, 2004; Grunert et al., 2011). Thus, it is crucial to understand and consider consumer acceptance at the early stage of new product development (van Kleef, van Trijp, & Luning, 2005). Consumer acceptance of healthier reformulated food products is complex and influenced by product−related factors (e.g. product attributes, sensory qualities, production methods) and consumer−related factors (e.g. psychological factors, demographic characteristics, food choice habits) (Lahteenmaki, 2013; van der Zanden, van Kleef, de Wijk, & van Trijp, 2014a). The current study aims to explore how product attributes or features influence consumer purchase intention and quality judgement for ‘healthier’ processed meat. A companion paper, using a different consumer cohort, investigates how consumer−related factors can shape consumer acceptability of such product (Shan et al., 2017a).

Many current innovations in the processed meat field focus on healthier reformulations, namely improving the nutritional quality and reducing adverse effects of processed meat consumption. Given that processed meat is a significant contributor to consumers' intake of salt and saturated fat, nutrients which are consumed in excess of the recommended level in many developed countries, one strategy is to reduce salt and/or fat content of those processed products with particularly high salt or fat content (Bolger, Brunton, Lyng, & Monahan, 2017; Desmond, 2006; Irish Universities Nutrition Alliance, 2011). This can be done by, for instance, directly lowering the amount of salt and fat in the recipe, using a salt substitute (e.g. potassium chloride or herbs), or by using animal fat replacements (e.g. starch or oil from non-animal sources). Another strategy involves the incorporation of healthy ingredients (e.g. vitamins and minerals, omega 3 fatty acids, probiotics, co-enzyme Q10, dietary fibre, etc.) into processed meat (Decker & Park, 2010; Grasso et al., 2016; Hathwar, Rai, Modi, & Narayan, 2012). These ingredients can be introduced indirectly through animal feeding or directly during processing. A third strategy involves reducing or replacing chemical-based preservatives, such as nitrites/nitrates (Sindelar, Cordray, Olson, Sebranek, & Love, 2007).

Health-oriented reformulations of processed meat are promising in terms of addressing increasing public health concerns regarding this food category; however, consumer acceptance cannot be taken for granted. For instance, a qualitative study has shown that different processed meat products are not equally perceived by consumers as suitable for healthier reformulations (Shan et al., 2017b). In relation to reformulation strategies, consumers are generally positive towards salt and fat reduction, and the replacement of nitrite with non-chemical preservatives; however, they were uncertain and skeptical about adding healthy ingredients into processed meat (Guardia et al., 2006; Haugaard et al., 2014; Hung, et al., 2016a; Shan et al., 2014). Cost is another factor that can influence consumer acceptance of healthier processed meat (Hung et al., 2016b; Shan et al., 2014).

By using conjoint analysis, the first objective of the current study was to understand how the base meat product, price, and healthier reformulation strategies, in particular, shape consumers' purchase intention and quality perception of processed meats. Based on the aforementioned literature, four hypotheses were made: price increase would have a negative impact on the purchase intention (**H1**); healthier reformulations would have a positive impact on the perceived healthiness (**H2**); consumer judgement of product healthiness would depend on the base meat product (**H3**); healthier reformulations would negatively influence the taste expectation (**H4**).

In developed countries, recognition of the heterogeneity of consumer needs and preferences is required for the success of products including processed meats; therefore consumer segmentation has become an essential element of product design and marketing, and traditional demographic traits are no longer enough to serve as a basis for meaningful consumer segmentation (Wedel & Kamakura, 2000; Yankelovich & Meer, 2006). In comparison, product-level segmentation based on, for instance, preferences for product attributes, can provide actionable suggestions for targeted product design and marketing (Yankelovich & Meer, 2006; van der Zanden et al., 2014). It has been suggested that, for meat products, attributes are not of equal value to all consumers (Henchion et al., 2014). The second objective of this study was to identify consumer segments reflecting different product preferences.

It is expected that consumer insights obtained from this study will reduce ambiguity and uncertainty in developing healthier processed meat. This study will also deepen the understanding of a wider topic: how consumers value healthy reformulations of food categories perceived as unhealthy.

2. Research methods

2.1. Data collection

A cross-sectional internet based survey was carried out in March, 2016 with a sample of 481 participants from the Republic of Ireland. With the assistance of a market research agency, participants were recruited from a national online research panel using a quota sampling procedure, where the quota control variables were age, gender and region. An eligible participant was considered an adult who had lived in Ireland for the past three years, who purchases ham, sausage and beef burger products. Participants filled out an online questionnaire using their own electronic device such as computer, tablet, or mobile phone. Informed consent was obtained from all participants on page 1 of the survey prior to the introduction of the main questions.

In relation to the research instrument, apart from the conjoint study, the questionnaire included 15 questions concerning: consumption habits of processed meat, use of functional food (i.e. food products enriched with healthy ingredients) and dietary supplements; general food choice motives; strategies for improving the health profile of processed meat; and socio-demographics. To examine consumers' general food choice motives, especially their interest in healthy food and convenience food, scales from an adapted version of the validated food choice questionnaire were used (Naughton, McCarthy, & McCarthy, 2015; Steptoe, Pollard, & Wardle, 1995) (Supplemental Table 1). A pilot test was carried out with a total of 16 volunteers recruited from University College Dublin (UCD) to ensure that questions were easily understood, the experimental design of the conjoint study was user-friendly, all information on the product conceptual cards received equal attention, and the survey was performed correctly on different electronic devices. The study qualified for and received ethical exemption from UCD's research ethics committee.

2.2. Conjoint analysis design

To fulfil the study objectives, a conjoint study was conducted. The term 'conjoint' originates from two words 'considered jointly', which illustrates the fundamental idea behind this technique: consumers consider products as bundles of attributes and trade off one for another (McCullough, 2001). By presenting a set of 'complete' products described by a group of attributes (product features), conjoint analysis uncovers the essential trade-offs consumers consciously or unconsciously make when judging and purchasing products. Conjoint analysis is generally considered to be suitable for assessing consumer acceptance of and preferences for novel food products, and it has been widely applied in healthier food and functional food related consumer studies (Annunziata & Vecchio, 2013; Ares & Gambaro, 2007; Ares, Gimenez, & Gambaro, 2009; Bech-Larsen & Grunert, 2003; Cox et al., 2011; Hailu et al., 2009; Sorenson & Bogue, 2005; Yu & Bogue, 2013).

There are a few different approaches doing conjoint analysis The full-profile rating (or ranking) based conjoint analysis is the traditional approach, where the task format involves the presentation of product profiles one by one for respondent rating (Green & Srinivasan, 1990; Green, Krieger & Wind, 2001). This approach has the advantage of providing detailed estimates at individual respondent level, which is desirable for further analysis such as consumer segmentation (Rao, 2014). Choice-based conjoint analysis is another popular approach. In this approach, respondents are presented with a few sets of profiles. For each set of profiles, respondents either pick the preferred profile or alternatively allocate 100 points across the set of profiles (Green, Krieger & Wind, 2001). Choice-based conjoint analysis has the unique advantage of mimicking the actual marketplace choices, however it normally generates results at an aggregate level (i.e. for the sample as a whole or for subgroups), and can be time-consuming for respondents (Rao, 2014, Green, Krieger & Wind, 2001). The current study selected the rating-based conjoint analysis for two reasons. First, this method can generate utility scores at the individual-level, which was desirable for the subsequent consumer segmentation. In addition, since the study involved an early stage in the development of healthier processed meat, it focused on the broad product concept, by including multiple types of processed meats, rather than on a particular type of product. In comparison with choice-based conjoint analysis, traditional rating-based conjoint analysis allowed us to address multiple types of processed meats without making the questionnaire too long.

The first step in designing the conjoint analysis study involved the identification of attributes and attribute levels for compiling product profiles. Based on the research questions and literature, four attributes were selected (Table 1). With reference to the first attribute – 'base meat product', three meat products that are popular in many western countries (ham, sausages and beef burgers) were selected due to the high consumption level and familiarity among the population of interest (Cosgrove, Flynn, & Kiely, 2005; Verbeke, Perez-Cueto, de Barcellos, Krystallis, & Grunert, 2010). These products include examples of a cured meat, a comminuted meat product (i.e. sausage type meat products containing a mixture of semi-lean meat and non-meat ingredients) and include two meat species (i.e. beef and pork) (FAO, 2008).

Salt and fat reduction and enrichment with healthy ingredients were selected as examples of reformulation strategies because they can be applied to most processed meat products. For the attribute 'salt and/or fat content', two levels were specified. Given that the base meat products included in this study differed in the content of these nutrients (Bolger et al., 2017; Pereira & Vicente, 2013), the 'reduced' claim was adapted for each meat product. For instance, for sausage products, the claim was introduced as ‘reduced fat, reduced salt’; for ham products ‘reduced salt’; and for beef burger ‘reduced fat’.

With regard to the attribute ‘healthy ingredients’, omega 3 and vitamin E were selected based on the fact that they were among the most common ingredients in the functional food market (Lalor, Kennedy, Flynn, & Wall, 2010) and technically they can be incorporated into meat products (Decker & Park, 2010). The third attribute level ‘none’ was included to allow comparison of products with and without additional healthy ingredients.

In line with previous studies, ‘price’ was adopted as the fourth and final attribute (Annunziata & Vecchio, 2013; Bech-Larsen & Grunert, 2003; Cox, Evans, & Lease, 2007; Teagasc, 2012). There are two common approaches to setting appropriate price levels. The first approach involves the specification of an exact price (Annunziata & Vecchio, 2013; Bech-Larsen & Grunert, 2003; Cox et al., 2007; Sorenson & Bogue, 2005; Teagasc, 2012). This approach was not employed, because the current study involved three different meat products with different price ranges, e.g. a price perceived as cheap for beef burgers may be considered rather expensive for ham products and therefore would not be comparable. In addition, for processed meat products, researchers may have to clarify the portion size while stating the price – this would have added unnecessary complexity to study. The second approach of setting price levels focuses on the additional cost resulting from product improvement. This has successfully been employed in studies exploring innovative food products, such as omega 3 enriched foods (Bech-Larsen & Grunert, 2003; Cox et al., 2007, 2011). In line with this approach, three levels were specified in the current study: average price, average price + 10% and average price + 20%. A lower price was not considered, because healthier reformulations will likely increase the price of the product (Bolger et al., 2017; Colmenero, 2000; Grasso et al., 2014).

In total, 54 product profiles were generated from the full-profile design. In order to reduce respondent burden, a fractional factorial orthogonal design was performed using the Statistical Package for the Social Sciences version 20 (SPSS Inc., Chicago, IL, USA). Hypothetical product profiles generated were listed in Table 2.

Product profiles were presented to respondents as conceptual cards (see Fig.1 for example) in random order. Respondents were asked to evaluate each product profile by answering three questions: “How likely or unlikely are you to buy this product?” (1=“not at all likely to buy”, 7="very likely to buy"); "How healthy or unhealthy do you perceive this product to be?" (1="not at all healthy", 7="very healthy"); and "How tasty or not tasty do you perceive this product to be?" (1="not at all tasty", 7="very tasty"). The selection of these three dependent variables, the wording of these questions, and the measurement scales were based on our research objectives and published conjoint studies in relation to healthier reformulated food products (Ares & Gambaro, 2007; Ares et al., 2009; Bech-Larsen & Grunert, 2003; Cox et al., 2011; Orquin & Scholderer, 2015).

2.3. Data analysis

Statistical analysis was undertaken using SPSS. To interpret data from the conjoint analysis study, the part-worth utilities and relative importance of attributes were estimated using ordinary least square regression, which is considered appropriate for analysing rating-based conjoint analysis data (Jaeger, Mielby, Heymann, Jia, & Frost, 2013; Garcia-Torres, Lopez-Gajardo, & Mesias, 2016). A one-way repeated measures ANOVA with the post-hoc Bonferroni test was applied to compare attributes in terms of their relative importance, and to compare attribute levels in terms of their utilities.

Hierarchical cluster analysis (Ward's method) of part-worth utilities was employed to identify distinct clusters that reflected respondents' different product preferences. Compared to alternative cluster analysis approaches, hierarchical clustering is suitable when the sample contains fewer than 500 respondents, and the researcher has no prior knowledge or expectation of the number of clusters (Sarstedt & Mooi, 2014), which was the situation of the present study. Ward's method was employed because it can generate consumer groups with the best within-group homogeneity (Punj & Stewart, 1983). To determine the number of clusters, a dendrogram (i.e. a tree map that shows how respondents are gradually merged into clusters) was inspected (Ketchen & Shook, 1996). A one-way ANOVA with post-hoc tests was conducted to examine between-cluster differences in the part-worth utilities, and food choice motivations. Chi-square tests were employed to examine between-cluster differences in socio-demographic and food consumption habits.

3. Results

Of the 503 participants who completed the online study, 21 respondents were excluded from the analysis because of their unrealistically short time for completion and careless responses (i.e. consistent patterns of answers to every question). This yielded a final sample of 481 respondents. The social demographic background information and processed meat consumption habits of the final sample is summarised in Tables 3 and 4. A comparison of the sample with the national population is presented for some socio-demographic characteristics in Table 3.

The final sample included 202 male (42%) and 279 female participants (58%) across different age groups throughout Ireland. It was not a perfectly representative sample of the Irish population but, this was expected given that the study focused on a specific subset of behaviours and only those who bought processed meats for themselves or their families were recruited. A majority of respondents were regular consumers of functional foods (71%), dietary supplements (64%), and food products that were low salt or low fat alternatives (76%). All respondents purchased or consumed the indicated processed meat products. The proportions of frequent eaters (at least once a week) were 76% for ham, 51% for pork sausages, and 26% for beef burgers.

3.1. Conjoint analysis results

Part-worth utilities of attribute levels (i.e. the relative preference score computed for each attribute level), and the relative importance of attributes were estimated for each respondent, and the mean values are summarised in Table 5. The high values observed for Pearson's R and Kendall's tau suggest that the conjoint analysis outcomes fit the data well. The differences between attributes and between levels under each attribute were examined using a series of one-way repeated measures ANOVA with Bonferroni's post-hoc test.

Results indicated that base meat product, salt and/or fat content, healthy ingredients and price all influenced consumer intention to purchase processed meats. Among these four attributes, price (30%) and base meat product (27%) were the most important, followed by healthy ingredient (24%), and then salt and/or fat content (19%) ($p<0.001$). A close inspection of the utility scores of attribute levels showed that a lower price was significantly preferred over a higher price

(p<0.001), therefore hypothesis 1 was supported. It is worth noting that the decrease in purchase intention with price was not linear; i.e., the impact of a 20% price increase was three times the impact of a 10% price increase. Ham and sausage products were significantly preferred over beef burgers (p<0.001), and salt and/or fat reduced was significantly preferred over normal (p<0.001). In relation to healthy ingredients, omega 3 was preferred over none, but the difference between these two (none *vs* omega 3) was not significant (p=0.306). Of the three ingredient options (omega 3, vitamin E, none) vitamin E was least preferred, with a negative utility score.

In relation to perceived healthiness, base meat product (27%), healthy ingredient (26%) and price (25%) demonstrated almost equal importance, while salt/fat content (22%) was deemed significantly less important (p<0.001). Further inspection using Bonferroni's test confirmed the lack of significant difference between base meat product and healthy ingredient (p=1.000) and between base meat product and price (p=0.511) therefore hypothesis 3 stating the dominant role of base meat product in the healthiness judgement was rejected. On closer examination of the attribute levels, processed meats with additional healthy ingredients were perceived as significantly healthier than conventional products (p<0.001), as were salt and/or fat reduced products (p<0.001). This confirmed hypothesis 2 which stated that healthier reformulations can positively impact the evaluation of product healthiness.

In terms of taste expectation, base meat product had the highest relative importance (32%), followed by healthy ingredient (26%) and price (25%) and then salt fat content (17%). Vitamin E and omega 3, to different extents, negatively influenced the taste expectation. Products with reduced salt and/or fat were perceived as less tasty as normal products, but the difference was not significant (p=0.064). Together, this indicates healthier reformulations would not necessarily suggest taste compromise to consumers; therefore, hypothesis 4 was not fully supported.

3.2. Consumer segmentation

Based on part-worth utilities derived from the conjoint analysis using purchase intention as the dependent variable, three clusters of respondents were identified as shown in Table 6. A one-way ANOVA showed that all clusters differed significantly from each other with respect to the relative importance of attributes and preferences of attribute levels. Cluster 1 included 28% of respondents. Compared to the other two clusters, this consumer segment assigned a much higher importance on base meat product (36%) and a much lower importance on salt and/or fat content (14%). Cluster 1 preferred sausages over ham and beef burgers and preferred conventional products over reformulated products, which was reflected in the negative utility scores associated with salt and/or fat reduction and the addition of either omega 3 or vitamin E. Cluster 1 was designated as 'uninterested in reformulations'. Clusters 2 and 3, grouping 39% and 33% of respondents, respectively, were similar in terms of their preference patterns. Both clusters were in favour of salt and/or fat reduction, and the addition omega 3. Furthermore, both clusters preferred ham over sausages and beef burgers. What differentiated these clusters was that cluster 2 assigned a higher mean relative importance towards healthy ingredients (27%). In comparison, cluster 3 assigned a higher mean relative importance towards price (37%) and a higher utility score for salt and/or fat reduction. Cluster 2 was designated as 'reformulation supporters', and cluster 3 'price-sensitive reformulation supporters'.

Clusters were then profiled in terms of social-demographic characteristics, food consumption habits and food choice orientations. Between-cluster differences were examined using chi-squares tests and one-way ANOVA tests (Table 7). Significant differences were found for the variables age 18-34 ($p<0.01$), age 55 and above ($p<0.05$) and obesity ($p<0.05$). It is clear that cluster 1 had the lowest proportion of obese consumers, whereas cluster 2 included fewer young consumers and more mid-aged and elderly consumers. Cluster 3 was characterised by the opposite age distribution (i.e. more young consumers and fewer mid-aged and elderly consumers) and a higher proportion of consumers who reported their weight as in the obese category.

4. Discussion

Healthier reformulation of processed meat is at an early stage, with significant efforts underway, but only a small number of products have actually been launched on the market (Desmond, 2006; Grasso et al., 2014; Toldra & Reig, 2011). It is important to understand consumer interest and preferences at this early stage. From this study, it is evident that among four product attributes, price and the base meat product had more influence than healthy ingredient and salt and/or fat content on consumers' purchase intention. This finding is in line with a recognition that the carrier food usually has a larger impact than other product attributes on consumer acceptance of functional foods (Annunziata & Vecchio, 2013; Ares & Gambaro, 2007; Cox, Evans, & Lease, 2011; Hailu, Boecker, Henson, & Cranfield, 2009).

With respect to salt and/or fat reduction, in line with the positivity reflected in previous studies (Guardia et al., 2006; Shan et al., 2014), processed meats with reduced salt and/or fat were rated higher for both purchase intention and health perception. Surprisingly, respondents did not infer significant undesirable taste change derived from such reformulation, probably because some consumers had gained uncompromised sensory experience from other types of 'reduced' food, such as reduced salt ready meals (Mitchell, Brunton, & Wilkinson, 2011).

In relation to the strategy of adding healthy ingredients, the current study shows that consumer did not demonstrate unconditional acceptance of this strategy. Their purchase intention depends on the type of ingredient that is to be added. Omega 3 was preferred over vitamin E, perhaps because omega 3 was perceived to be more associated with animal-based foods such as meat products. This is consistent with the general recognition that the perceived fit of combinations of the carrier food and the healthy ingredient is crucial to the acceptance of enriched foods (Krutulyte et al., 2011). Qualitative studies suggest that consumers are unsure about the impact of healthy ingredients on the overall health characteristics of processed meat (Hung et al., 2016b; Shan et al., 2016). Indeed with regard to nutritionally-poor food categories more generally, there has been debate about whether or not the healthy ingredients would create a 'magic bullet' or 'halo' effect (Cornish, 2012; Orquin, 2014). Using processed meat as an example, the current study has demonstrated that healthy ingredients did significantly improve the health perception; however, base meat product was considered equally important.

Cluster analysis based on the utility scores of product attribute levels resulted in three clusters with different preference patterns. This confirmed that the preference for conventional and reformulated processed meats is not homogeneous across consumers. Cluster 1 was reluctant to accept any healthier reformulations. Their preference for sausages (rated the most tasty product by respondents) and their lower than average use of dietary supplements revealed that for this cluster, taste (as opposed to health) was their main purchase motivation for processed meat. Cluster 2 and 3 expressed preference for salt and/or fat reduction and for the addition of omega 3, which indicates that either reformulation strategy would be of interest to them. Considering cluster 2 assigned more importance on the healthy ingredient attribute, the 'adding' strategy is likely to be more effective for this cluster. In comparison, the reduction strategy combined with an average price is likely to be more effective for cluster 3 given their significantly higher utility of the attribute level 'reduced' and their significantly higher sensitivity to the extra cost introduced by the addition of healthy ingredients. While the three clusters were well differentiated by product preferences, there were only minor differences in terms of social demographics. Reflecting previous research (Miklavec, Pravst, Grunert, Klopcic, & Pohar, 2015; van der Zanden, van Kleef, de Wijk, & van Trijp, 2014), this leads us to conclude that demographics generally do not account for much variation in actual food choice and preference.

From the cluster analysis results, a very interesting finding is the alignment between the two reformulation strategies. Consumers (Cluster 1) who were negative about the 'reducing' strategy were also negative about the 'adding' strategy. On the other hand, consumers (Cluster 2 & 3) who expressed interest in one strategy were also interested in the other strategy. This is different from our original thought that supporters of the 'reducing' strategy and the supporters of the 'adding' strategy would not be the same group of people. This is based on our assumption that consumers who opt for salt and/or fat reduction may expect to see meat products being made closer to 'pure' meats; in other words, they might be reluctant to accept more ingredients being added to meat (Korzen, Sandoe, & Lassen, 2011).

The present study is not free from limitations. The consumer survey was not combined with sensory tests of actual products because the physical prototypes of products were not yet available. There are two types of consumer insights that are important for new product development (Grunert et al., 2011). The first type refers to consumers' product perception and purchase intention before the first trial purchase. At this stage, consumers have not gained sensory experience of the product, and they would exclusively depend on their perceptions and expectations to direct the purchase decision. The current study was focused on this type of consumer insights, which are valuable because the first trial purchase will be the first hurdle of innovative processed meat products. The second type of consumer insights refers to consumers' adjusted quality perception and purchase intention after they have experienced the product (Grunert et al., 2011). It has been suggested that taste is the main determinant of consumer satisfaction with meat products and consumers were reluctant to compromise on sensory qualities for healthier reformulations (Henchion, McCarthy, Resconi, & Troy, 2014; Hung, Verbeke, & de Kok, 2016; Resano et al., 2011). However, sensory perception is context dependent − information on healthier reformulations may influence consumers' sensory evaluation. For instance, the disclosure of claims regarding plant sterol enrichment of deli turkey products and the disclosure of a 'salt reduction' claim on ham products can significantly influence consumers' sensory perception of these product (Grasso, Monahan, Hutchings, & Brunton, 2017; Henrique, Deliza, & Rosenthal, 2015). For future research in relation to healthier processed meat, consumer surveys should be combined with sensory tests, and conventional processed meat products available in the market should be included, so that consumer willingness to choose healthier processed meat products can be more accurately predicted.

5. Conclusions

The results of this study indicate that consumer purchase intention for processed meat products are more influenced by price and base meat product than the reformulations applied. Salt and/or fat reduction positively influenced purchase intention and health perception, and surprisingly, the negative impact of this reformulation on taste expectation is not significant. Healthy ingredient enrichment can improve the health image of processed meat; however the type of ingredient should be carefully selected to maximise the chance of consumer purchase. Processed meat consumers differ significantly in their openness to reformulations. Consumers who are positive (or negative) about salt and/or fat reduction are also positive (or negative) about healthy ingredient enrichment; however the extent of the influence of reformulation strategy depends on the consumer segments.

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Table 1

Product attributes and levels identified for conjoint analysis.

Attributes	Levels
Base meat product	Ham, sausages, beef burgers
Salt and/or fat content	Reduced, normal
Healthy ingredients	Omega 3, vitamin E, none
Price	Average price, average price + 10%, average price + 20%

Table 2

Hypothetical processed meat product profiles obtained from the fractional factorial orthogonal design.

Base meat product	[a]Salt and/or fat content	Healthy ingredient	Price
Ham	Reduced salt	None	Average price
	Normal	Omega 3	Average price + 10%
	Reduced salt	Vitamin E	Average price + 20%
Sausages	Normal	None	Average price + 20%
	Reduced fat, reduced salt	Vitamin E	Average price + 10%
	Reduced fat, reduced salt	Omega 3	Average price
Beef burgers	Reduced fat	Omega 3	Average price + 20%
	Normal	Vitamin E	Average price
	Reduced fat	None	Average price + 10%

[a]The attribute level – 'reduced' is dependent on the base meat product (i.e. which ingredient the base meat product commonly has a high level of)

Table 3

Characteristics of the sample of Irish processed meat consumers.

	n	%	Irish population[a] %
Gender			
Male	202	42.0	49.5
Female	279	58.0	50.5
Age group			
18-24	39	8.1	13.5
25-34	107	22.2	21.6
35-44	126	26.2	19.9
45-54	99	20.6	16.6
55-64	78	16.2	13.2
65+	32	6.7	15.3
Region			
Dublin	134	27.9	26.8
Leinster (excluding Dublin)	133	27.7	27.7
Munster	136	28.3	27.2
Connaught/Ulster	78	16.2	18.2
Education			
No formal education	2	0.4	
Primary	4	0.8	
Secondary	132	27.4	
Third level (non-degree)	151	31.4	
Third level (degree or higher)	192	39.9	
Employment status			
Work full-time	243	50.5	
Work part-time	69	14.3	
Self-employed	23	4.8	
Student	31	6.4	
Looking after home/family full-time	41	8.5	
Retired	41	8.5	
Unemployed and looking for work	18	3.7	
Unable to work	15	3.1	
Number of children under 13 years old			
0	320	66.5	
1	65	13.5	
2	68	14.1	
3 or more	28	5.8	
Health condition			
High cholesterol	68	14.1	

High blood pressure	71	14.8
Heart disease	6	1.2
Cancer	8	1.7
Diabetes	24	5.0
Obesity	46	9.6
None of the above	318	66.1
Regular consumer of functional foods (e.g. fortified milk, probiotic yogurt, cholesterol lowing spread and drinks, omega 3 eggs, etc.)	342	71.1
Regular consumer of dietary supplement tablets or capsules	308	64.0
Regular consumer of food products with low/reduced salt and/or fat content (e.g. light cheese, low fat milk and spread, reduced fat biscuits, lightly salted crisps, etc.)	368	76.5

[a]CSO(Central Statistics Office) data 2011.

Table 4

Purchase and consumption frequency of processed meats.

	Purchase frequency %					Consumption frequency %					
	Never	< once a month	Once a month	Every 2-3 weeks	≥ once a week	Never	< once a month	1-3 times per month	Once a week	2-6 times per week	≥ once a day
Ham slices	0	5.9	11.4	23.9	58.8	1.5	6.0	16.6	29.3	37.8	8.7
Pork sausages	0	13.9	20.0	31.8	34.3	1.2	12.3	35.1	35.6	12.5	3.3
Beef burgers	0	35.4	28.5	23.9	12.3	1.2	31.8	40.5	20.2	4.6	1.7

Table 5

The part-worth utilities of attribute levels, relative importance of attributes, and significant effects in a one-way repeated measures ANOVA.

Attribute	Attribute level	Purchase intention		Perceived healthiness		Taste expectation	
		Mean part-worth utility	Mean relative importance	Mean part-worth utility	Mean relative importance	Mean part-worth utility	Mean relative importance
Base meat product	Ham	0.117[b]	27%[c]	0.231[b]	27%[b]	-0.040[b]	32%[c]
	Sausage	0.096[b]		-0.097[a]		0.196[c]	
	Beef burger	-0.214[a]		-0.134[a]		-0.156[a]	
Salt and/or fat content	Normal	-0.311[a]	19%[a]	-0.342[a]	22%[a]	0.031[a]	17%[a]
	Reduced	0.311[b]		0.342[b]		-0.031[a]	
Healthy ingredient	None	0.015[b]	24%[b]	-0.261[a]	26%[b]	0.125[c]	26%[b]
	Omega 3	0.094[b]		0.202[c]		-0.022[b]	
	Vitamin E	-0.109[a]		0.058[b]		-0.102[a]	
Price	Average price	0.388[c]	30%[c]	0.173[b]	25%[b]	0.056[b]	25%[b]
	Average price + 10%	0.102[b]		0.140[b]		-0.077[a]	
	Average price + 20%	-0.490[a]		-0.313[a]		0.021[b]	
Constant		3.937		3.930		4.450	
Goodness of fit of conjoint analysis*		Pearson's *R* = 0.982 Kendall's Tau = 0.904 (*n*=476)		Pearson's *R* = 0.980 Kendall's Tau = 0.885 (*n*=473)		Pearson's *R* = 0.979 Kendall's Tau = 0.887 (*n*=470)	

Values within one column (and within one attribute) with different superscripts are significantly different according to Bonferroni's test ($p<0.05$).

*Sample sizes varied for each column because respondents who provided equal scores on all product profiles cannot be included in the analysis.

Table 6

Cluster analysis base on the pattern of individual utilities in relation to purchase intention.

Attribute	Attribute level	Cluster 1: uninterested in reformulations (n=131, 28%)	Cluster 2: reformulation supporters (n=187, 39%)	Cluster 3: price sensitive reformulation supporters (n=158, 33%)	ANOVA *p*-value
Base meat product	Ham	$-0.103^{a,(1)}$	$0.216^{b,(2)}$	$0.184^{b,(2)}$	<0.001
	Sausage	$0.518^{b,(2)}$	$-0.050^{a,(1)}$	$-0.080^{a,(1)}$	<0.001
	Beef burger	$-0.416^{a,(1)}$	$-0.166^{a,(2)}$	$-0.103^{a,(2)}$	<0.01
	Mean relative importance	$36\%^{c,(3)}$	$26\%^{b,(2)}$	$21\%^{a,(1)}$	<0.001
Salt and/or fat content	Normal	$0.011^{a,(3)}$	$-0.253^{a,(2)}$	$-0.646^{a,(1)}$	<0.001
	Reduced	$-0.011^{a,(1)}$	$0.253^{b,(2)}$	$0.646^{b,(3)}$	<0.001
	Mean relative importance	$14\%^{a,(1)}$	$20\%^{a,(2)}$	$22\%^{a,(2)}$	<0.001
Healthy ingredient	None	$0.452^{b,(2)}$	$-0.084^{a,(1)}$	$-0.230^{a,(1)}$	<0.001
	Omega 3	$-0.128^{a,(1)}$	$0.119^{b,(2)}$	$0.247^{c,(2)}$	<0.001
	Vitamin E	$-0.324^{a,(1)}$	$-0.036^{a,(2)}$	$-0.017^{b,(2)}$	<0.001
	Mean relative importance	$26\%^{b,(2)}$	$27\%^{b,(2)}$	$20\%^{a,(1)}$	<0.001
Price	Average price	$-0.006^{a,(1)}$	$0.225^{c,(2)}$	$0.907^{c,(3)}$	<0.001
	Average price + 10%	$-0.011^{a,(1)}$	$0.041^{b,(1)}$	$0.268^{b,(2)}$	<0.001
	Average price + 20%	$0.017^{a,(3)}$	$-0.266^{a,(2)}$	$-1.175^{a,(1)}$	<0.001
	Mean relative importance	$24\%^{b,(1)}$	$27\%^{b,(1)}$	$37\%^{b,(2)}$	<0.001

Values within in one column (and within one attribute) with different superscript letters are significantly different according to Bonferroni's test ($p<0.05$). Values within one row with different superscript numbers are significantly different according to Bonferroni's test ($p<0.05$).

Table 7

Demographics and food habits of three clusters.

	Cluster 1: uninterested in reformulations	Cluster 2: reformulation supporters	Cluster 3: price sensitive reformulation supporters	*p*-Value
Gender-male (%)	41.2	43.3	41.1	0.899
Age group (%)				
18-34	33.6	21.4	39.2	0.001
35-54	42.0	50.8	44.9	0.270
55 and above	24.4	27.8	15.9	0.027
Education – bachelor degree or higher (%)	40.5	44.9	34.2	0.127
Employment – employed (%)	70.2	73.3	63.9	0.167
Presence of child(ren) under 13 years old (%)	36.6	28.9	36.1	0.241
Health condition (%)				
High cholesterol	14.5	16.0	11.4	0.459
High blood pressure	10.7	17.1	15.2	0.275
Diabetes	6.1	3.2	6.3	0.338
Obesity	3.8	9.6	13.3	0.021
None of the above	70.2	65.2	63.9	0.498
Regular consumer of functional foods (%)	73.3	71.7	69.6	0.787
Regular consumer of dietary supplements (%)	56.5	67.9	66.5	0.088
Regular consumer of food products with low/reduced salt and/or fat content (%)	74.8	75.4	80.4	0.441
Frequent consumers (≥ once a week) (%)				
Frequent consumers of ham	75.6	75.9	76.6	0.979
Frequent consumers of pork sausages	58.8	48.7	49.4	0.160
Frequent consumers of beef burgers	26.7	23.5	29.7	0.426
General food choice orientation				
Health	3.66	3.72	3.76	0.257
Convenience	3.75	3.74	3.70	0.831

Supplementary Table 1

Scales and items used for measuring respondents' food choice motivations.

Scales	Items	Cronbach's alpha
Health	I always follow a healthy and balanced diet I eat what I like and do not worry about healthiness of food (R) The healthiness of food has little impact on my food choices (R) It is important to me that the food I eat on a typical day …contains vitamins and minerals …is good for my appearance (skin/teeth/hair/nails/etc.) …is nutritious …keeps me healthy …is high in fibre	0.82
Convenience	It is important to me that the food I eat on a typical day …can be cooked very simply …is easy to prepare …takes no time to prepare ...is easily available in shops and supermarkets	0.77

(R) indicated negatively worded items, of which the score was reversed prior to data analysis

Items were measured on a 5-point Likert scales: 1=strongly disagree; 2=disagree; 3=neither agree nor disagree; 4=agree; 5=strongly agree