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Decision factors for consumer acceptability of new fish-based products enriched with vegetables

Abstract

In the current work three new fish-based products, in form of burgers and sausages enriched with tomato or pepper flour, were judged by a sample of 150 respondents, to evaluate their acceptability and to identify groups of subjects with similar food preferences, using Multiple Correspondence Analysis and Cluster Analysis. In addition, the Conjoint Analysis was applied to study their preferences for product and levels of price (low and regular) through full factorial design profiles, in each cluster. A two-stage method of clustering based on the hierarchical method revealed three customer segments significantly different, mainly characterized by gender and socio-demographic variables. The common choice in all the segments was represented by the fish-burger with tomato flour, while fish-sausage and fish-burger with pepper flour may be focused to precise niche segments. Conjoint Analysis showed that the price is the most important attribute in determining consumer's purchasing decisions in each cluster analyzed. Thus, premium price would be paid only with proper advertising about new product characteristics in terms of benefits for human health. Therefore, the findings of the present study can have important implications in the fish sector regarding the need for delivering functional products with specific formulation and size, in addition to good sensory properties.

Keywords: functional food, fish, consumer acceptability, conjoint analysis, cluster analysis, multiple correspondence analysis

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Introduction

The human body has evolved over thousands of years to adapt the anatomy and physiology to a lifestyle completely different from that of modern society. The result of this process has led to a continuous increase in the incidence of many diseases such as hypertension, obesity, diabetes and their complications with repercussions on arising social costs. Numerous studies have shown that diet can alter the prevalence and progression of certain diseases and constitutes the cornerstone of prevention and/or treatment of their chronic forms.[1–3] Mediterranean diet was first considered by Keys[4] as a low saturated lipids diet that was conveying protection against coronary heart disease by lowering plasma cholesterol levels. The high consumption of olive oil, fruit and vegetables, as the Mediterranean diet is characterized, are the elements that play a crucial role for generation of beneficial effects on human body. As reported by La Vecchia,[5] the consumption of fish also constitutes a favorable diet indicator. In fact, fish is characterized by protein composition of high biological value (even up to 20% by weight), consistent supply of vitamins (especially vitamins B1, B2, B12 and PP), mineral salts (iodine, calcium, phosphorus, copper, magnesium, iron, selenium and sodium) and a composition particularly rich in polyunsaturated fatty acids, in particular omega-3. The possibility to combine diet elements to give food products with functional properties today represents one the most promising approach for next generations.[6] As a fact, a food can be regarded as functional if is satisfactorily demonstrate to affect beneficially one or more target functions in the body, beyond adequate nutritional effects, in a way which is relevant to either the state of well-being and health or the reduction of risk disease.[7] Consumer demand for foods with more beneficial effects on health has prompted the food industry to increase the research and production of a growing number of functional foods that represent a significant share of novel foods.[8–10] In this context, it is possible to highlight that seafood industry in particular has not yet been affected to a significant extent by this new generation of foodstuffs. The reason could be ascribed to the consideration that even though fish is perceived by consumers as a valid food, it is generally discriminated due to the long preparation time.[11] Differently, the ready meals based on fish are chosen for easy of preparation and short time to be cooked. Lifestyle and consumer habits increasingly demand ready meals with high quality standards and minimum handling.[12] Since actually on the market there is only a small number of seafood,[13] the opportunity to obtain ready-to-cook fish-based products enriched with selected functional ingredients (olive oil, vegetables), could boost fish consumption.

Before any new market launch it is necessary to know consumer acceptability preferences, as key factor for the product success.[14] Consumer preferences of specific food are strictly related to the sensory properties (appearance, aroma, flavor, taste etc.)[15] and to product price.[16] Therefore, the main aim of the current work was to study not only the impact of the sensory characteristics on human preferences but also consider what consumers are willing to pay for these new types of fish-products, and what prices they are unwilling to pay. To the aim of the work, a consumer-test was first carried out[17–19] and then results were elaborated by the conjoint analysis.

Materials and methods

Raw materials

Aquaculture shade-fish (*Argyrosomus regius*) caught in the Mediterranean sea was purchased from a local farm (Lepore Mare, Fasano, Italy). Fish were slaughtered by immersion in ice-cold water

(hypothermia) then decapitated, cleaned and filleted. Then, they were packed in insulated polystyrene boxes with ice and delivered to the laboratory within 2h from the moment of harvest. Once at the laboratory, fish were skinned and minced for the fish burgers or sausages preparation.

Fish burgers and sausages enriched with tomato or pepper flour

Mincing of skin-off fillets were performed by a domestic food processor (Multiquick 5, Braun, Germany). To prepare burger with tomato flour (hereinafter named product A), the flour (4g) (Fiordelisi, Foggia, Italy) was hydrated with sterile water (10g) to eliminate the excess of salt and then added to the minced fish (25g) containing salt (0.2), parsley (0.4g), basil (0.4g), oregano (0.04g), cappers (1.2g) and potatoes starch (2g). Moreover, a whey protein-based foam (1.5g) (Farmalabor, Canosa di Puglia, Italy), prepared according to a previous work of Conte et al.,[6] was soaked with extra-virgin olive oil (6mL) and added to the formulation. The ingredients were homogenized in a bowl mixer (Multichef, Ariete, Firenze, Italy) with a spiral dough hook for 5min. Fish burgers were prepared by hand (40g, 30-40mm diameter) and steam cooked in electric oven (15min at 240°C). For the sausages preparation (hereinafter named product B) the same ingredients used to obtain the above mentioned burgers were used. The minced fish was bagged with a sausages tool (O.M.R.A., Rimini, Italy) into a gut of lamb. For burgers with yellow pepper flour (hereinafter named product C), the flour (4g) (Farris, Foggia, Italy) was added to the minced fish (25g) and the same other ingredients utilized for the product A were also adopted. Burgers and sausages were all steam cooked in an electric oven for 15min at 240°C.

Data collection

In this study, the evaluation of the acceptability of three new products (A, B, C) through a sample of 150 consumers was performed. The 150 participants, recruited through random sampling in the province of Foggia, all above the age of 18, are selected on the basis of sex and age, in order to ensure an appropriate composition of the final sample. A filter question whether the interviewed generally eats fish was used to recruit participants. Data collection was conducted from October to December 2014 in the laboratory of the Services Center of Applied Research of the University of Foggia (Italy), where the three products were subjected to the respondents, after proper cooking.

Respondents tasted the three products offered to them in random order and completed a questionnaire properly developed. The questionnaire consisted of a total of 45 questions, divided into six sections:

i. Socio-demographic
ii. Eating Habits
iii. Evaluation of product A,
iv. Evaluation Product B,
v. Evaluation Product C,
vi. Overall judgment and intention to purchase.

The section Socio-demographic was aimed to collect demographic and social information: sex, age, marital status, educational level (primary school, middle school, high school and university), job and house-hold composition. The section Eating Habits was aimed to detect attitudes toward health, nutrition and habits of fish consumption. The three sections relating to the products concerned their quality characteristics: appearance, smell, taste, and consistency during mastication. These characteristics were evaluated with a 4-point Likert scale (not at all good, not so good, good enough, very good). The choice of adopting the stairs with an even number of elements has been made to avoid the escape routes through the central positions of the stairs odd. In the section Overall judgment and intention to purchase after testing, to the interviewee was asked the product evaluation in terms of innovation on a 4-point Likert scale (for nothing innovative, little innovative, innovative, very innovative) and in terms of product preference, from the most liked to the least liked product. The intent of purchase was evaluated by the question "At what price would buy a pack of 200grams with 2 products?". Once again we used a 4-point scale (not buy it, € 2.5-€ 4 (low price); € 4.1-€ 6 (regular price); I do not know).

Statistical analysis

Scale reliabilities: We used the α coefficient of Cronbach to test the accuracy of the scales, the coherence between the different voices and the predictability of the results obtained, so that the elements of scale measure the same construct, in this case, the satisfaction. The α coefficient of Cronbach indicates the percentage of variance shared by each item with respect to the total variability of the observed phenomenon. A commonly accepted rule for describing internal accuracy and coherence using the Cronbach coefficient is the following: $\alpha \geq 0.9$: Excellent; $0.7 \leq \alpha < 0.9$: Good; $0.6 \leq \alpha < 0.7$: Acceptable; $0.5 \leq \alpha < 0.6$: Poor;$\alpha < 0.5$: Unacceptable.

Data analysis: The interactions of demographic characteristics with product trials were estimated by the Chi square test. In order to understand if the attributes judgment (smell, taste, consistency and innovation) assumed different values with respect to the products, the Anova test is performed.

Multiple correspondence analysis: In order to study the association between socio-demographic characteristics (gender and educational level) and the favorite product, a Multiple Correspondence Analysis (MCA) was also run. MCA allows data reduction (with graphical representation of dissimilarities) for categorical variables and provides the same scaling for different variables. In this way their relationships can be observed together in a joint graphical display when plotted on relevant eigenvector axes (or dimension) that explain the variability of the original variables.

Cluster analysis: A two-stage method of clustering like BIRCH,[20] based on the hierarchical method, was applied to identify segments of respondents who indicated similar rankings based on the preferences of the three products, in order to show the differences between consumer groups and to connect the characteristics of the consumers with the preferences expressed. The cluster analysis was applied only to potential consumers that expressed not only the satisfaction but also the intention to buy the product, indicating also the preferred price.

Conjoint analysis: Conjoint analysis is considered to be a useful method for assessing consumer acceptance of novel foods and it is a method used to evaluate the importance that individuals assign to different characteristics of a product. Therefore, conjoint analysis gives information about consumer preferences, which are obtained from their judgment of a set of alternative combination of levels of different attributes of product, defined as profiles. In this study, after the cluster analysis, a conjoint analysis was also applied to segments

of potential buyers, on the basis of the preference expressed for the products and for the price at which they are willing to buy them. Important values (or part-worth in conjoint analysis) are obtained at the individual level, according to the direct rating of product attributes. The conjoint design employed the following traditional additive part-worth model, with no interaction effects among factors:

$$Yj = \sum(X_i)+c$$

In the above model, the part-worth Xi derived from the attributes selected for inclusion in the conjoint experiment (in this case, i=1…5); *c* is a constant term; *Y* is the overall evaluation (or total utility) of the combination of specific levels of attributes. Therefore, the analysis was based on a full factorial design of 6 profiles (three products crossed with two price levels (€ 2.5-€ 4; € 4.1-€ 6), for the potential buyers of A, B, C. The combination was generated through an orthogonal design procedure. Orthogonality was perfect, assuming no correlation between the *Xi*.

Two statistics, Pearson's r ($-1 \leq r \leq +1$; -1: perfect negative correlation; +1: perfect positive correlation) and Kendall's tau ($-1 \leq \tau \leq +1$; -1: perfect negative association, +1 perfect positive association), that provide measures of the correlation between the observed and estimated preferences, were also calculated. All statistical analyses were conducted with the SPSS, Statistical Package for the Social Sciences Program[21]).

Results and Discussion

Scale reliabilities: The value of the α coefficient of Cronbach is equal to 0.817, obtained using 12-item of the judgment on the products, i.e. the items that showed the route of response with a Likert 4-point scale. Therefore, the level of internal accuracy of the instrument of measurement is good, since it ranged between 0.7 and 0.9.

Descriptive analysis: The sample included 150participants (44.0% male and 56.0% female). Among consumers, females predominantly take care of the food shopping for house-hold (Chi square=24.326, p<0.001). Considering occupation, 45.3% of the respondents were employees, followed by 23.3% of students. A 13.3% was represented by unemployed/looking for their first job. With regard to eating habits, most of the respondents (48.8%) believe that it is very important to eat fish, and for the 47.3% is important enough, thus confirming the consumer consciousness of fish relevance.[6] Only the 0.7% believes that it is not at all important. As regards the consumption frequency of fresh fish, the 36.0% of respondents said they eat fresh fish once a week, 24.7% twice a week and 21.3% once every 15days. The 11.3% rarely consume fresh fish. This recorded modest consumption frequency of fresh fish, compared to the above great importance that consumers gave to fish, justifies the offer on the market of ready-to cook fish products.[11,22] With regard to the attention to the product at the time of purchase, 39.3% of respondents when buy a food product always checks the label (ingredients, origin, etc.), 35.6% often controls it, while the 3.4% never controls the label. The 38.0% of respondents when buy a food rarely checks the various types of quality certifications (bio, no GMO, etc.), the 32.7% often controls and the 13.3% never checks them. These findings probably demonstrate that, even though scientific literature focuses attention on specific ingredients to improve food quality,[23,24] consumer is not yet aware of the potential benefits that could derive from a correct eating.[25] In the section of the Overall judgment and intention to purchase after the test, the interviewers were asked to rank the three products from the most liked to the least liked one. Table 1 indicates the percentage frequency for ranking. The most frequent ranking is A, B, C (38.7%), i.e. the product A is at the top of the list (most liked) and the product C in the third place on the list (least liked). Follows the ranking C, A, B (20.7%). The ranking B, C, A is the less frequent (4.0%). The 2.7% of respondents indicated no preference. Table 2 shows the mean and standard deviation obtained by the evaluation that the respondents gave for the four sensory attributes (appearance, smell, taste, and consistency) and respect to the degree of innovation, for each product. As can be seen, all the products in all the attributes taken into account were judged positively, even though ANOVA results highlighted that judgment of sensory parameters assumed different values by changing the product. As a fact, Table 3 shows very significant differences in judge of appearance, taste and consistency (p-value<0.001), significant for smell (p-value<0.05), not significant for innovation level (p-value>0.05). To sum up, all the new products were judged innovative and acceptable but with significant sensory differences among them, thus confirming the importance of consumer's perception as a tool to discriminate between similar products.[15,26]

Table 1 Customer's ranking of products A,B,C

Ranking	Absolute frequency	Percentage frequency
ABC	58	38.7
CAB	31	20.7
ACB	19	12.7
BAC	19	12.7
CBA	13	8.7
BCA	6	4
Expressed no preference	4	2.7
Total	150	100

Table 2 Mean and standard deviation by evaluation four sensory attributes (appearance, smell, taste, and consistency to the mastication) and degree of innovation, for each product

Attributes	Product A	Product B	Product C
	μ±σ	μ±σ	μ±σ
Appearance (a)	3.38±0.64	3.31±0.80	2.99±0.84
Amell (a)	3.27±0.68	3.20±0.71	3.03±0.89
Taste(a)	3.23±0.76	2.99±0.81	2.88±0.94
Consistency (a)	3.35±0.63	2.99±0.82	3.12±0.76
Innovation (taste, shape, etc.) (b)	3.07±0.60	3.23±0.79	3.10±0.67

a) Evaluated on 4-point likert scale (1=not at all good, 2=not so good, 3=good enough, 4= very good).

b) Evaluated on the 4-point likert scale (1=for nothing innovative 2=little innovative 3=innovative 4=very innovative)

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Table 3 ANOVA results for attributes respect to products

Attributes	Source of variation	Sum square	df	Mean square	F-Value	p-Value
Appearance	between groups	13.293	2	6.647	11.445	.000
	within groups	259.587	447	0.581		
Smell	between groups	4.538	2	2.269	3.891	.021
	within groups	260.627	447	0.583		
Taste	between groups	9.853	2	4.927	6.999	.001
	within groups	314.647	447	0.704		
Consistence	between groups	10.004	2	5.002	9.123	.000
	within groups	245.107	447	0.548		
	total	255.111	449			
Innovation (taste, shape, etc.)	between groups	10.004	2	5.002	2.123	.121
	within groups	245.107	447	0.548		

Multiple correspondence analysis: The MCA for the categorical variables favorite product, gender and educational level led to the extraction of two dimensions: the first one explained 43.3% of the variance, and the second dimension 37.6% of the variance. The two dimensions collectively explained 80.8% of the total variance of the originals variables. Therefore, MCA allows plotting in a common space the three variables (Figure 1). The graph shows, by its proximity, that fish burger containing pepper flour (product C) is preferred by male, instead the female prefer more the product A with tomato flour, most probably due to different preferences of food taste between male and female. Product B is not particularly close to any of the two genders. In addition, the graph shows that respondents with lower educational level (elementary school and middle school) do not have specific and accentuated preferences, while consumers with the highest education level are very interested to a specific new product (product A), thus confirming that consumers more cultured have better capacity to discriminate among food.[27]

Cluster analysis: As reported before, the cluster analysis was applied only to potential buyers (45.0% of the entire sample), who expressed not only the satisfaction but also the intention to buy the product. Three clusters were derived using a two-stage method of clustering like BIRCH:[20] cluster 1 and 2 (potential buyers of A; B; C), and cluster 3 (potential buyers of A; B). The size and socio-demographic characteristics of each cluster are listed in Table 4, according to the decreasing predictive importance in the cluster formation, thus giving the gende*r* as the most important variable. Cluster 1 was composed of 19.4% of the potential buyers and it was the smallest segment. Consumers of this cluster would buy all the three products. It's worth noting that this cluster was composed entirely of women. Also the consumers of Cluster 2 would buy all the three products, but the main difference with clusters 1 was that cluster 2 consists entirely of males. In addition, a high percentage (92.3%) of consumers in cluster 1 belongs to families with children under 18. In cluster 2 this percentage drops to 59.1%. In the first segment, the 84.6% of the respondents said that they always cook for the family, while the second group declared that sometimes they cook for the family (54.5%). In both groups 1 and 2, the most frequent marital status is civil married/cohabiting (84.6% and 81.8%, respectively). In cluster 1, the 76.9% of interviewed consumers said that they often take care food shopping for the family instead in cluster 2 the highest percentage was rarely involved in food shopping (54.5%). The cluster 2 is younger than cluster 1. Consumers of cluster 3 would not buy the product C, showing the will to purchase only A and B. Cluster 3 includes nearly half of potential buyers (47.8%). In this segment, regarding the socio-demographic characteristics, the consumers are predominantly women (65.6%). In addition, this segment consists of a high percentage of respondents in whose family there are not children under 18 years old (87.5%) and the buyers are mostly bachelors/spinsters (65.6%), and it is the youngest group, with a prevalence of age between 26 and 35years (59.4%). These results from cluster analysis confirmed what reported in MCA analysis, i.e. purchasing of product C is not taken into account where female are predominant.

Conjoint analysis: A conjoint analysis applied to potential buyers of A, B, C (cluster 1 and 2) was also performed. Table 5 shows the utility (part-worth) scores and their standard errors for each factor level. Higher utility values indicate greater preference. As expected, there is an inverse relationship between price and utility, with higher price corresponding to lower utility (larger negative values mean lower utility). Since the utilities are all expressed in a common unit, they can be added together to give the total utility of any combination. For example, the total utility of the product A crossed with the low price is:

Total utility (A*lowed price)=utility(product A)+utility(price low)+constant==0.125+1.036+3.500=4.661

Therefore, the conjoint analysis for the potential buyers of A, B, C (Pearson's R=0.998; $p<0.001$ Kendall's tau=0.867, $p<0.01$) shows that in terms of attribute levels, the most positive evaluation was for

"Product A" crossed with "low price" (rank 1) followed by "Product C" crossed with "low price" (rank 2). The lowest evaluation resulted for "Product B" crossed with "regular price" (rank 6), preceded from "Product C" crossed with" regular price" (Table 6).

Considering the mean part-worths, it is possible to conclude that the low priced product positively contributed to consumer intention to purchase the new fish food. Price is considered a non-sensory attribute that is very influential on the product decision-making process. This result is similar to those reported by Della et al.[16] & Ferrarezi et al.,[28] who demonstrated consumer preference for foods with low price.

Table 4 Profiles of each cluster

	Cluster 1	Cluster 2	Cluster 3
Dimension	19.4%	32.8%	47.8%
Purchasable product	A,B,C	A,B,C	A,B
Gender	female(100.0%)	male(100.0%)	female(65.6%)
There are people under 18 years in your family	yes(92.3%)	yes(59.1%)	no(87.5%)
Take care you to cook for your family	always(84.6%)	rarely(54.5%)	rarely(46.9%)
Number people under 18 years in family	1.69	1.18	0.16
Marital status	married/ cohabiting(84.5%)	married/ cohabiting(81.8%)	bachelor/ maiden(65.6%)
Take care you food shopping for your family	always(76.9%)	rarely(54.5%)	rarely(46.9%)
Occupation	employee(38.5%)	self employed(36.4%)	employee(59.4%)
Educational level	bachelor's degree (92.3%)	diploma (54.5%)	bachelor's degree (81.2%)
Age	36-45 (69.2%)	26-35 (36.4%)	26-35 (59.4%)
When buy a food checks the quality certifications of various types (such as bio, no GMO, etc.)	often(76.9%)	rarely(54.5%)	often(43.8%)

For continuous fields, the mean value is displayed.

For categorical fields, the mode is displayed. The mode is the category with the largest number of customer.

Table 5 Partial utilities (a) of each attribute level

Attribute level		Estimated utility	Std error
Product	A	0.125	0.067
	B	-0.214	0.067
	C	0.089	0.067
Price	low	1.036	0.047
	regular	-1.036	0.047
Constant		3.500	0.047

a) partial utilities in table are the averages of all the individual part-worths utility

Table 6 Preference ranking for cluster 1 and 2

Product	Price	Total utility	Rank
Product A		4.661	1
Product C	low price	4.447	2
Product B		4.322	3
Product A		2.589	4
Product C	regular price	2.375	5
Product B		2.250	6

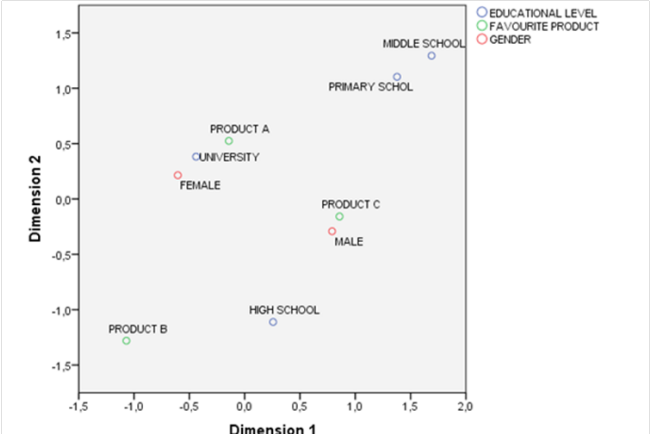

Figure 1 Multiple correspondence analysis plot of dimension 1 and 2 for product, gender and educational level.

Conclusion

In general, the findings recorded in this study may imply that the three new developed fish-based products may have success in the market. However, the more precise knowledge of consumer acceptance carried out in the current study highlighted specific information on each of them. In particular, three customer segments of potential buyers can be underlined, mainly characterized by different gender and socio-demographic variables. The common choice in all the segments is represented by product A, thus meaning the fish-burger with tomato flour, much better than the fish-sausage and fish-burger with pepper flour, fits consumer preferences and intention to purchase. Therefore, the findings of the present study can have important implications in the fish sector regarding the need for delivering nutritious products with specific formulation and size, in addition to good sensory properties. Product B and C may be focused to precise niche segments. In addition, results from conjoint analysis demonstrated that among product attributes, price is the most important determining consumer preferences. It was also found that only some groups of consumers are willing to pay a higher price for the preferred food, thus suggesting the need for the fish industry to promote a better advertising about new product characteristics in terms of benefits for human health.

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Conflict of interest

The author declares no conflict of interest.

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