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MARKETING | RESEARCH ARTICLE

Testing for consumer preferences of smoked asian sea bass (Barramundi) filet products in Hungary

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Abstract: The present paper discusses the findings of primary research related to the development of smoked fish filet made of the barramundi into a functional food, including product tasting. The study sought to provide information for the target audience, in our case, for consumers in hypermarkets on (1) about their certain fish consumption habits, (2) their attitudes towards conscious fish consumption, (3) the reputation of the barramundi brought to the domestic market recently and the related considerations of consumers and (4) consumers' perceptions of the latest product development, smoked barramundi enriched with substances of positive nutritional benefits (e.g. vitamin complex, pumpkin seed oil, Ginkgo Biloba extract, *Sylibum marianum* oil, etc.). On the basis of the research, it can be concluded that product development is on the right track, it fulfils all the habits, expectations and demands of the target audience for fish consumption.

Subjects: Aquaculture; Food Science & Technology; Marketing Research

Keywords: functional food; Barramundi filet; consumer preferences

1. Introduction

1.1. Role of fish in health and nutrition awareness

Due to the sharp increase in the global demand for food, the global importance of food industry is getting a new perspective today. The main problem is not so much to do with overproduction in food

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PUBLIC INTEREST STATEMENT

Barramundi (Asian sea bass) is a commercially important aquaculture species of Australia and South-East Asia. Due to the high quality and mild flavour of the flesh, the demand of farmed barramundi is increasing worldwide. Although Barramundi is a warm water fish species, based on the geothermal potentiality of Hungary it can be produced economically. After the introduction of the fish into the Hungarian market, a primary, non-representative research was carried out in order to test a new, functional food product family originated from this species. The key objective of the survey was to get a better understanding of potential customer attitude towards this products. The results showed that consumers' perceptions of Barramundi were positive and the product development was well received by consumers. It can be concluded that the smoked filet, as a functional food fulfils all the habits, expectations and demands of the target audience for fish consumption.



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industry, but instead, food security has become the crucial issue. Adverse weather conditions, global warming and epidemics impose threats for food production, making it difficult to keep pace with the increased demand (Puska, Waxman, & Porter, 2003). In the past years, global consumer demand saw a change created by the growing tide of civilization diseases, as the number of Type II diabetes, cardiovascular and various food allergy patients is steadily increasing. Together, they are posing new challenges for the food industry, as there is a particular need to develop new products to slow down the spread of diseases, improve physical and mental welfare and they might even provide complementary cure for certain patients due to their health value (Menrad, 2003).

The rise of health-conscious consumer behaviour has encouraged the food industry to produce food products that not only having pleasant taste during consumption but also offer health benefits, such as reduction of fat content, the omitting sugar and the consumption of food products rich in certain minerals (Szakály, 1994). The food sector defined these food products as functional foods, and as the literature suggests: “A functional food means all the/or any natural or industrially produced foods containing one or more so-called bioactive (increasingly health-protective) substance(s) beyond their basic nutritional functions” (Szakály & Schäffer, 2006). The market share of functional foods shows a year-to-year increase, and they are becoming the key products of the food industry (Menrad, 2003; Piskóti, Nagy, & Kovács, 2006). The reason behind the development is that people tend to recognize the direct contribution of food consumed to the maintenance and improvement of their health status (Barna, 2007; Mendis, Puska, & Norrving, 2011; Mollet & Rowlés, 2002; Young, 2000).

Fish is regularly consumed by those who are conscious in healthy eating, as fish has various essential nutrients, a high proportion of full-value protein, it is easily digestible, and contains almost all the vitamins. Due to its favourable protein and oil content, fish is one of the key healthy food products, and its significant bioactive component content contributes to its functionality. Fish can be enriched with substances of favourable nutritional value during processing phase, which may improve consumer perceptions, especially among health-conscious consumers (Careche, 2010).

Healthy eating has been promoted heavily by governments and the EU. Despite the trend towards healthier eating, however, the consumption of one product widely known as a healthy food option has decreased or stagnated. It is well known, the fish is low in saturated fats, high in nutrients, readily available. But, while it is second only to chicken as a source of protein, it is still not regularly consumed by some of the population. While meat and fish/seafood are the two main sources of protein, meat is more popular than fish, in spite of general consumer beliefs to the effect that red meat, in particular, may have unhealthy properties (Foxall & Haskins, 1986).

Communicating about the health effects of fish and seafood may potentially result in a conflict situation: increasing intake is desirable because of health and nutritional benefits, but higher consumption may also lead to an increased intake of potentially harmful environmental contaminants (Verbeke et al., 2008). It is important to point out that these negative effects mainly concern fish caught in the sea and inland waters and secondarily fish produced in aquaculture. Of course, aquaculture can also be used to pollute water during fish production, and in this respect, marine cage systems are not really good either. In our view, fish that came from the aquaculture, especially from the intensive aquaculture, are generally safer food than captured fish/seafood.

Based on data provided by the Food and Agriculture Organization of the United Nations (FAO) in 2012, the global volume of fish and aquaculture was 158 million tons, where fishery and aquaculture represents 60 and 40%, respectively. App. 86% of total fish and aquaculture production (136.2 million tons) was used for human consumption, mostly as fresh, unprocessed products, whereas the remaining 14% (21.7 million tons) were used as non-food, primarily for the production of fish meal and oil for animal feed (FAO, 2014).

Aquaculture is crucially important in Asia since approximately 70% of the total production originated from here in 2012. Leading countries in aquaculture output are China, Indonesia, the United States of America, India and Peru. As for fisheries, Norway and Iceland are regarded to be the top countries with the highest catch in Europe, as the total capture in these areas exceeds 1 million tons on an annual basis. By contrast, fish catches in the member states of the European Union typically decreased. In 2012, this volume was approximately 5 million tons, caught mostly from the Nordic coasts. Thirty-seven per cent of total fish catches and aquaculture production amounting to 129.2 billion USD were exported in 2012. By far the largest exporters are China, followed by Norway, Thailand and Vietnam. In export, the most significant areas are the developed countries, such as the United States of America, Japan and the European Union (FAO, 2014).

The other way to renew the European aquaculture is the diversification of fish products. The nutritional value of fish and other fishery products have been well recognized in the last few decades, since these foods are rich in several valuable nutrients and other useful components (Menon & Lele, 2015). Although the fish are inherently functional and has numerous health benefits, a number of examples can be found in the scientific literature when aquatic products are enriched with different functional ingredients in order to improve their nutritional value (Gromley, 2013).

Gormley, Neumann, and Fagan (2007) enriched yellowfin tuna (*Thunnus albacares*) cubes with an aqueous solution of taurine which has a positive effect on cardiovascular health. The results showed, that tumbling in a taurine/phosphate solution was a suitable procedure for adding taurine to fish cubes and the taurine content of the product indicated a good level of uptake and retention. The sensory acceptability of the product was not affected by addition of taurine while among three cooking methods, grilling gave the best results concerning the retention of the amino acid.

Although the prevalence of Selenium (Se) deficiency is unknown, it can be assumed that most Europeans may be deficient in this micronutrient since the recommended daily intakes are not achieved (Ivory & Nicoletti, 2017). African catfish was successfully enriched with selenium by feed. The dietary intake of 8.5 mg/kg functional selenium resulted in a total selenium concentration of 9 mg/kg in the fish fillet. The diet of hybrid striped bass was supplemented with organically and inorganically derived selenium. The results of the study showed that the use of micro-element enriched dry feed is suitable for raising fillet selenium content to nutritionally meaningful levels (Cotter, Craig, & Mclean, 2008). In addition to the trace mineral supplementation, fish products were successfully enriched with dietary fibres, antioxidant dietary fibres or prebiotics (Gromley, 2013).

1.2. Consumption of fish and fishery products

At present, more than 146 million tons of fish and other aquatic product are intended for human consumption. It is estimated that by the year of 2050, a global population expected to reach 9.7 billion people. If the current level of fish consumption will not change considerably, additional 35 million tons of fish will be required (FAO, 2016a). This excess must be wholly obtained in aquaculture.

In 2014, the world per capita fish consumption reached a record of 20 kg. Based on this data, it can be stated that fisheries and aquaculture remain important food source in the twenty-first century. In the last two decades, the importance of aquaculture in human consumption was increasing and reached a milestone in 2014, when the contribution of farmed species to human consumption surpassed the proportion of wild fish for the first time.

There is a huge difference between certain European member states in the per capita fish and fishery product consumption, including aquaculture products. Traditionally in countries with traditions of sea fishing, this value is high, but it has to be noted that it is not the same in case of each country with extensive coastal zones. Values under 15 kg/person/year are mostly typical of landlocked central-middle European countries, but interestingly, they also show significant differences. Northwestern European countries tend to have 15 to 30 kg/person/year values and these are even exceeded by southern European countries and e.g. the southern provinces of France. Portugal and

Spain are outstanding with their consumption above 40 kg/person/year fish and fishery product consumption within the European Union, while in the same comparison Hungary, Bulgaria and Romania are lagging behind with values less than or barely exceeding 5 kg/person/year (EC DG MAF, 2016a).

In the European Union, the consumption of fish per capita has increased in recent years. Notwithstanding this trend, in Central EU the per capita consumption slightly decreased or stagnated. Based on the data of European Market Observatory for Fisheries and Aquaculture Products (EUMOFA), in 2014 the tuna and the cod was the most preferred products among the EU consumers. Both of them are wild-caught fish and derived from fisheries. Regarding the farmed species, salmon, freshwater catfish and trout proved the most important species (EC DG MAF, 2016b).

Although the self-sufficiency of EU improved between 2013 and 2014, the trade balance deficit of 2015 was the largest ever, confirming the EU as a net importer of fisheries and aquaculture products (EC DG MAF, 2016b). In order to reduce the import dependence of EU, the European inland aquaculture must be renewed by the domestication of new species and the diversification of products (Fontaine, 2009).

Despite scientific evidence on the positive effects of fish/seafood consumption on human health, the consumption of fish remains below the recommended intake levels for the majority of Europeans. European consumers had a very strong belief that eating fish is healthy. Consumers' belief that eating fish is healthy, their interest in healthy eating and objective fish-related nutrition knowledge, positively, but only weakly, influenced fish consumption frequency. Subjective knowledge was found to be a stronger predictor of fish consumption than the previously noted factors. Age and education contributed, both directly and indirectly through knowledge, to explain fish consumption behaviour. Marketing communication should focus on health-related benefits other than fish consumption alone. Communicating that eating fish is healthy and stressing the health benefits of fish alone, as is still commonly performed (e.g. in generic promotion and other types of public information campaigns) will be insufficient to achieve higher levels of compliance with fish consumption recommendations (Pieniak, Verbeke, & Scholderer, 2010).

The first comprehensive study on food consumption in Hungary was published in the 1880s. In 1889, Károly Keleti wrote in his work "Food statistics of the Hungarian population on a psychological basis" that the annual fish consumption in the country was roughly 1.5 kg per capita in the second half of the previous century. This consumption originated mainly from inland waters, and aquaculture amounted to merely an insignificant proportion. Over this period, fish played a significant role in providing food for the population, as it represented one of the cheapest meat types for certain social groups.

Data provided by the Hungarian Central Statistical Office (HCSO) suggest that the growth of per capita supply of fish and fishery products showed a slow but steady growth over the past 10 years in Hungary, and the last 3 years in this period indicated stagnation. Per capita, fish consumption varied between 3.5–3.7 kg/person/year¹ which accounted for about 5.0–5.5% of our total meat consumption for bone-in meat (HCSO, 2013). This amount includes both domestically produced, and imported fish and fishery products. Domestic production consumed primarily as live fish, whereas import as processed food (e.g. preserved products, deep-frozen, convenience foods, deep-frozen filet or fish in brine, etc.). The main consumption period (accounting for approximately the one-third of our 3.7–3.9 kg/person/year) is the pre-Christmas period. The preparation of fish dishes and their regular consumption vary in different areas, due to fish is an everyday food for certain counties and cities. For example, experts estimate that an average citizen in Baja consumes approximately 40.0–45.0 kg of fish per year, and this amount is nearly tenfold of Hungarian average consumption (MAHAL, 2015).

Today, the annual consumption of fish and fishery products in European Union (EU-28) is approximately 24.0 kg/person, and Hungarian consumption is well below the European average. From nutrition-physiological viewpoint, it has been estimated that fish consumption of minimum 10 kg/

person/year would be the recommended amount, as our global ranking of cardiovascular diseases is extremely high.

When comparing the high volume of global fish consumption with that of Hungary, it is observed that the fish consumption of the Hungarians is extremely low, due to aquaculture is not widely practised. FAO data reveal that per capita global fish consumption in 2010 was 18.4 kg on an annual basis, whereas in Hungary it was merely 5.1 kg/person/year. Given this quantity, Hungary is ranked the last but one on the list of fish consumers among European countries (FAO, 2014).

The introduction of Barramundi (*Lates calcarifer*) to the Hungarian aquaculture contributes to the achievement of that objective. Although Barramundi is a warm water fish species native in South-East Asia and Australia, based on the geothermal potentiality of Hungary it can be produced economically (Stündl, Fehér, Juhász, & Bársony, 2013).

Barramundi or Asian sea bass is a commercially important aquaculture species of Australia and South-East Asia. The production of these fish in this region has steadily increased for the past decades and this trend is expected to continue (Boonyaratpalin & Williams, 2002). The species has the enviable position of already being well recognized in the Australian market (Lawley, 2010) while the demand of farmed and wild barramundi is increasing in the United States, China and other countries.

A market survey by the Australian Barramundi Industry highlighted the strengths of the Australian barramundi products. Among these strengths, the most important are the firm white flesh, the succulent, fine grained texture and mild flavour of the fish. The texture of the flesh makes the fish versatile and suited to all methods of cookery. Barramundi is low in fat, high in protein, low in cholesterol and contains the Omega 3 and Omega 6 fatty acids (Lawley, 2010).

1.3. Research theme and objectives

The fish and fishery product consumption in a country is affected by several factors with varying relative significance. The general, indirect factors that influence the most vital tendencies in the countries of the European Union, including Hungary, are the followings: (1) demand for safe food products; (2) demand for healthy food; (3) demand for quality; (4) demand for convenience products; (5) demand for natural (bio/eco) products; (6) religion and traditions; (7) geographical origin. Consumer habits and consumer behaviour develop in a multi-factor, complex system. The fact is that habits of fish consumption are built by the combined effect of several macro and micro-level factors. The most significant direct influences are the followings: (1) prices; (2) traditions; (3) public visibility/general popularity; (4) fashion; (5) taste; (6) availability; (7) personal factors; (8) advertisements; (9) packaging; (10) family customs/traditions (Panyor, 2007).

To introduce new fish species on a given market and to present it to potential consumers are not simple tasks, because the production has to be of high quality and it has to be accessible for consumers in each case. In our case, Barramundi, the premium fish species widely known and popular in Asia, Australia and western Europe, has been made available by Jászakiséri Halas Ltd. for domestic consumers since 2011. Once the fish species in question had been introduced to the market, a product innovation programme has been initiated in 2013. Smoked fish products considered as potentially functional was manufactured in cooperation with the staff of Debrecen University and UNIO-Seafood Ltd.² containing not only spices, but also various herbal extracts and oils with positive physiological benefits.

A primary customer satisfaction survey and simultaneous product tasting were carried out via standardized questionnaires to explore the general consumer perception of the newly developed smoked fish product line.

The key objective of this research was to test a new, potentially functional food product family among buyers. The concept of the product development was to include the active substances of food supplements available in pharmacies and drugstores (e.g. Ginkgo Biloba extract, Grapola-oil, Pumpkin seed oil, Q10;vitamin complex, etc.) into the smoked Barramundi filet to contain 50% of the recommended daily amount for adults in a “palm-size” piece of smoked filet. In our experiments, the watery/oily solution was applied to the surface of the approximately 45–50°C filet after warm smoking, which was absorbed by the filet rapidly during desiccation/rest. After the pilot phase of production, the product was tested by consumers and the most important objective was to get a better understanding of potential customer attitude towards this product family.

2. Materials and methods

After the introduction of the Barramundi species into the Hungarian market in 2011, a primary, non-representative study was carried out by quantitative methods and using standardized questionnaires.

The basic population in the questionnaire survey were represented by fish eaters and buyers, segmented by the tasting itself and its location and also the first question enquiring about the frequency of fish consumption. On the basis of the latter, responders in the “I never eat fish” category were automatically excluded from the survey (five cases) similarly to responses in our earlier researches.

The questionnaire responses were completed with the assistance of interviewers (students) in two locations, in the European-wide well-known Auchan hypermarkets—the branch of the French international retail group—in the capital city and the largest provincial town in Hungary. The tasting provided an opportunity for the persons questioned to taste the prototype functional food of smoked Barramundi, prior commercialization. Responders could score their perceptions by giving answers to the questionnaire items. In the survey, 209 questionnaires were completed, after data recording 202 pieces (capital city: 127 pieces; largest provincial town: 75 pieces) could be assessed.³ The questionnaires were evaluated by the SPSS 13.0 statistical package.

Data recording was followed by the process of data cleansing to filter the errors (outliers) in data entries using basic descriptive statistical methods (minimum, maximum, average, standard deviation and distribution).

The respondents were segmented to refer to multiple criteria to complete the significance tests. First, responders were asked segmentation questions at the end of the questionnaire survey; second, certain items of the questionnaire sheet were suitable to create groups, and through this, to explore correlations. However, it should be noted that in the majority of segmentation questions (those with four or more variables), those categories of the questionnaire, were combined which received low scores (these are highlighted in the description of the certain segmentation questions). The reason for combining these groups was that the comparison of a sample population with too many variables would fragment the sample, resulting low populations, and this would significantly distort the research results.

Broken down by gender, 59.9% of the respondents were females, and 40.1% males. Based on the highest educational attainment of the respondents, four groups were formed: 4.3% of the interviewees had only elementary, 7.6% intermediate education (skilled worker), 37.8% intermediate (technical secondary school, secondary grammar school) and 50.3% higher education.

As for status and main activity, the respondents were divided into four groups: 15.6% active manual workers, 52.2% active clericals, 18.8% pensioners and 13.4% other (mothers on maternity leave, housewives, students, unemployed persons, others).

Three groups were formed according to age: 15% of the respondents belonged to the age group under 30, 44.4% to the group of 30 to 50 years and 40.6% were above 50 years.

The last segmentation question of the questionnaire asked into which per capita net income and lifestyle category the interviewees included themselves: (significantly below average, somewhat below average, above average, significantly above average). There were segments that represented only an insignificant number of persons, therefore they were combined. In this way, two categories were identified by net income and lifestyle: 75.0% claimed to belong to the average income group, and 25% above the average. The categories including below average (9 out of 202) and “I don’t know/no response” answers (10 out of 202) were excluded from significance testing.

In addition to the special, segmentation questions of the questionnaire, further two questions were also used for segmentation purposes. The first was about the towns where the interviews were conducted (the capital city and the largest provincial town of Hungary) and the second about the frequency of fish consumption. When the variables were aggregated, the results showed that 61.4% of the respondents eat fish rarely, while 38.8% reported regular fish consumption. These aggregated data were used for the significance testing of the present study.

3. Results and discussion

The survey included 28 questions (Q1–Q28) altogether, 23 enquired fish consumption habits and requested the evaluation of tasted fish foods, whereas 5 were of segmentation types. The description of the evaluation for all the questions is beyond the extent of this study, therefore we selected them.

The processed form of a new product is of key significance when a fish species is introduced into the market so one of the questions asked the form of the fish product in one piece or in filet (illustrated by a visual aid, a Barramundi image). (Q3: *Would you buy the fish species (Barramundi) in the picture in one piece (if roasted, the portion is one fish per person, just like trout lined up on the counter) or would you rather prefer the fish filet?*) From the viewpoint of product development, the answers were regarded favourable, as 77.1% of the respondents would willingly buy Barramundi filet, and merely 16.9% would prefer it in one piece. As a result of grouping by employment as presented in Table 1, we drew the conclusion that approximately 40% of active manual workers (41.4%) would rather purchase Barramundi in portions, and 52% the filet. In contrast, interviewees in other employment groups (active manual workers, pensioners and others) would opt for portioned fish (below 20%) and filet (above 70%) (Pearson’s χ^2 test, $p = 0.006$).

We were interested whether any of the respondents had ever met the “asc” logo (Figure 1) and if yes, what is it for (“Have you ever seen the logo below on any products?”) (“If yes, do you know what does it mean?”) It is important, as certain retail chains expect suppliers to have this certificate for their fish products.

Table 1. Buying preferences regarding the presentation of the fish segmented by the main status of the respondents

Denomination	Active manual workers		Active clericals		Pensioners		Other		Total	
	N	Per cent	N	Per cent	N	Per cent	N	Per cent	N	Per cent
In one piece	12	41.4	13	13.5	6	17.1	1	4.0	32	17.3
In filet	15	51.7	79	82.3	26	74.3	21	84.0	141	76.2
Don’t know	2	6.9	4	4.2	3	8.6	3	12.0	12	6.5
Total	29	100.0	96	100.0	35	100.0	25	100.0	185	100.0

Source: Own calculation/construction.

Figure 1. Logo of the Aquaculture Stewardship Council (asc).

Source: <http://www.asc-aqua.org/>.



The mission of the Aquaculture Stewardship Council (“asc”) is the establishment of environmentally and socially sustainable aquacultures. On a time horizon of some years, “asc” has worked out the world’s leading certification and labelling programme for responsibly farmed fish. The aims of the asc to increase the market availability of sustainably and responsibly produced aquaculture products. Products with the “asc” label, i.e. the “asc” logos send the message to consumers that the production of these products meets the requirements of “asc” standards. The “asc” logo indicates sustainably produced fish and fishery products from responsibly operating fish farms. The “asc” logo targets the segment of consumers where there is an increasing need for consciously and responsibly produced fish and fishery products.

The “asc” logo awareness was very low among the respondents, as 87.2% answered in the negative and merely 7% had already seen the label on some products, whereas 5.9% neither agreed nor disagreed, i.e. were uncertain about seeing it. The number of replies to the next question “If yes, do you know what it a certificate is of?” was merely 5. Four persons claimed to have insufficient information on what it certified and one person stated “it provided information about the product quality”.

The product prototype was tested by tasting. The first related question sought to find out whether the respondent had ever tasted smoked fish. (Q18: “Have you ever tasted smoked fish?”). 86.6% of the respondents had already tasted smoked fish, but 12.8% never. This means that this type (smoked fish) will be familiar for the target group of potential customers when the developed product is available, but the question remains what impression the smoked fish tested earlier made on the interviewees. Based on the segmentation of the respondents by their highest educational attainment (Pearson’s χ^2 test, $p = 0.003$) we found that educational attainment increased in line with the proportion of respondents who had already tasted smoked fish earlier (Table 2). The next question is significant for the product to be placed on the market, since we asked the respondents about their impressions (taste, surface and texture, etc.) supposing they had already tasted smoked fish. (Q18: *If yes, what was your impression (taste, surface and texture, etc.)?*) Answers to the questions verified our hypothesis claiming that smoked fish was tasty since 93.8% of the respondents replied: “I found the tasted smoked fish tasty”. Merely 2.5% of the respondents claimed “I did not like” this food, and 3.8% could neither agree nor disagree.

Table 2. The responses segmented by the highest education of the respondents to whether they have ever tasted smoked fish

Denomination	Elementary education		Skilled workers		Technical secondary/ grammar school		Higher education		Total	
	N	Per cent	N	Per cent	N	Per cent	N	Per cent	N	Per cent
Positive	5	62.5	10	71.4	62	88.6	85	91.4	162	87.6
Negative	3	37.5	3	21.4	8	11.4	8	8.6	22	11.9
Don’t know	0	0.0	1	7.1	0	0.0	0	0.0	1	0.5
Total	8	100.0	14	100.0	70	100.0	93	100.0	185	100.0

Source: Own calculation/construction.

One of the questionnaire items inquired about respondents' willingness to buy smoked fish which is a functional food as well (Q20: "Would you like to buy smoked fish with health enhancing, preventive characteristics since, in addition to spices it also includes components with physiological benefits to maintain and improve health, strengthen the immune system mechanisms, contribute to lower risk of certain diseases and improve one's physical status"). The findings were, that 88.6% would like to purchase functional foods, i.e. smoked fish, whereas 8.6% would not, and 2.7% could neither agree nor disagree. Significant differences were not detected in the segmentation process in any case.

To survey consumer perceptions of product development towards functional foods, four statements were listed and the respondents were asked to score them on a scale of 1–5, i.e. to what extent do they agree with the statements (1: *does not agree at all*, 5: *fully agrees*, 0: *neither agree, nor disagree*). The statements sought to find out whether respondents found the fact that smoked fish contained not only spices but herbal extracts, beneficial oils and other favourable physiological components to be a right product development concept.

Table 3 presents the mean value of individual consumer perceptions. The Table illustrates that in addition to seasoning, the respondents (4.29) preferred "dietary oils of positive effects" and this result is verified by the lowest standard deviation value (1.37). The application of herbal extracts had the lowest score (3.66) of approvals from the respondents; however, it did not imply the complete lack of approvals, as standard deviation values were the highest here.

Respondents gave positive answers to the question "Would you buy a functional food, i.e. smoked fish?", as these people will be the potential purchasers of product development. The packaging of the product is marked with a sticker/logo to call the customers' attention to the type of food components included in the given smoked fish product and to its special health value. Questioners showed altogether 12 different logos to the respondents (Figure 2).

We requested the respondents to indicate the sequence of the three preferred products out of the ones marked with the logos. With this questionnaire item—besides calculating how many times the respondents opted for certain logos—their sequence was also considered (how they ranked it from the potential three). Their ranking was introduced by evaluating primarily the number (*N*) of markings and secondarily the mean values.

Table 3. Judgement of the product development concept

Statements	Statistical indicators						
	N	NTE	ΣN	Min.	Max.	Mean*	Std. dev.*
The concept of product development can be considered right, if the smoked fish is not only seasoned, but also contains herbal extracts	180	3	183	1	5	3.66	1.68
The concept of product development can be considered right, if the smoked fish is not only seasoned, but also contains vitamins	181	2	183	1	5	3.92	1.62
The concept of product development can be considered right, if the smoked fish is not only seasoned, but also contains dietary oils of positive effects	181	2	183	1	5	4.29	1.37
The concept of product development can be considered right, if the smoked fish is not only seasoned, but also contains other components of physiologically favourable effects (e.g. minerals, microelements, etc.)	178	4	182	1	5	3.99	1.57

Source: Own calculation/construction.

*On the basis of *N* sample size (*N* = failed to answer the question). NTE = neither agree nor disagree.

Figure 2. Functional food components logos on prototypes.

Source: Own construction.



The figures set out in Table 4 suggest that the respondents ranked L1 (for healthy heart) first, L10 (for healthy eyes) second and L12 (for our mental health) third out of the marked fish products. Significance testing yielded the following result as presented in Figure 3:

- Women (14.8%) chose L2 (*For beautiful healthy hair and nails*) most, bearing out our hypothesis, in contrast to men (3.5%) (Pearson's χ^2 test $p = 0.030$).
- L3 (*For healthy digestion*) was opted for by 25% of the residents of the capital city of Hungary, whereas 10% of those of the largest provincial town (Pearson's χ^2 test, $p = 0.025$).
- L6 (*For our healthy immune system*) was primarily chosen by active manual workers (36.4%) and it was the least preferred by those in other occupations (5%) (Pearson's χ^2 test $p = 0.018$).
- L7 (*For healthy joints*) was chosen by 60% of skilled workers and by 0% of those with elementary education (Pearson's χ^2 test, $p = 0.012$).

The question related to product packaging was the following: "What is your overall impression of the packaging for the new product prototypes?" As it was an open question, the respondents provided various answers, but for space limit, not all are shown in the present paper. Four categories were constructed from the responses. This type of breakdown allowed the significance test for the open

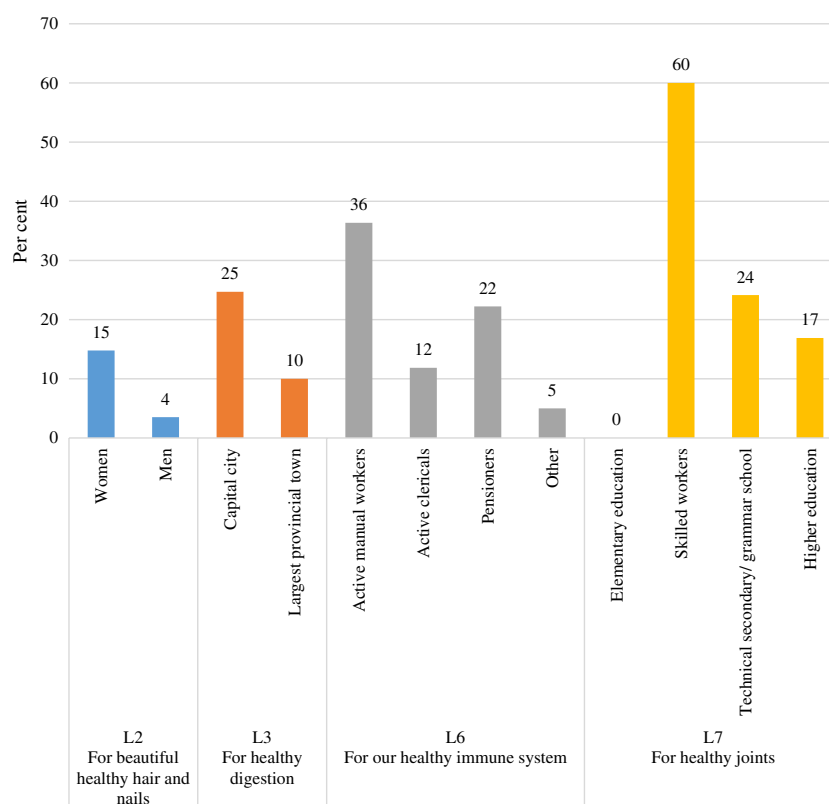
Table 4. Consumer preferences of products marked with logo

Category	Persons (N)	%	Min.	Max.	Mean	Std. dev.
L1 for healthy heart	89	20.60	1	3	1.69	0.81
L10 for the health of our eyes	60	13.89	1	3	2.08	0.83
L12 for good mental performance	59	13.66	1	3	2.15	0.78
L5 for the healthy development of our children	39	9.03	1	3	1.85	0.84
L11 for healthy blood sugar level	32	7.41	1	3	2.06	0.76
L7 for the healthy joints	32	7.41	1	3	2.19	0.78
L3 for the healthy digestion	27	6.25	1	3	2.07	0.83
L6 for the health of our immune system	24	5.56	1	3	2.00	0.78
L4 for men's health	21	4.86	1	3	1.95	0.86
L8 for liver health	19	4.40	1	3	2.00	0.67
L2 for the beautiful healthy hair and nails	15	3.47	1	3	2.07	0.96
L9 for the protection of our cells	15	3.47	1	3	2.33	0.72
Total	432	100.00	-	-	-	-

Source: Own calculation/construction.

Figure 3. Significantly different consumer choices regarding the three most important type of food components included in the given smoked fish product.

Source: Own calculation/construction.



questions. The responses were broken down into groups by subjective assessment during the processing of the questionnaire. The groups (illustrated by some examples) were the following:

- Positive (*inspiring confidence, decorative, good, nice, I like it, attractive, etc.*);
- positive with some criticism (*elegant, but it should not increase the price; it is good that the product is visible, Omega 3 should be indicated; I like it, but not all the logos are attractive, etc.*);
- negative (*it should be more simple, it could be more colourful, it is not awareness-raising, too dark, too many logos, etc.*);
- Neutral (*there is room enough for two, medium*).

Respondents' overall experience (76.5%) with product packaging was clearly positive mostly. Some of them expressed their criticism (10.8%) in addition to their positive statements. The proportion of respondents who answered in the negative was merely 11.4 and 1% took a neutral stance. It has to be noted, that almost all the "positive, but critical" opinions implied that nice packaging "should not raise the price". In other words, these respondents were concerned about the increasing effect of design on prices.

Segmentation by age groups and by Pearson's χ^2 test showed a significant difference at the probability level of $p = 0.031$. The younger the respondents were, the more they tended to be negatively critical (21.7%) without "beating around the bush". Elder respondents were less prone to clearly express their dismay; however, "positive but critical" opinions were increasingly expressed (Figure 4). In fact, these were diplomatic, so-called "hidden" criticisms.

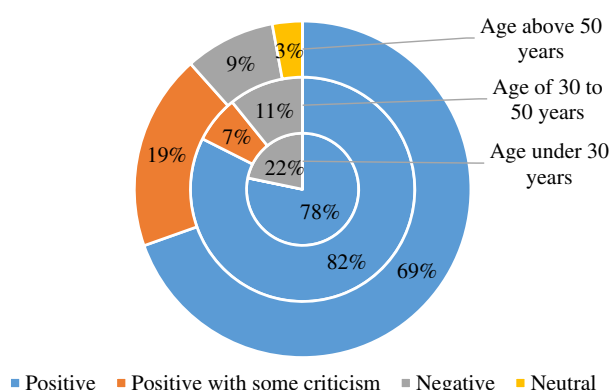
Our research followed with the survey of respondents' general opinion of product development (new product prototypes). (*What is your general opinion on the product development presented (new product prototypes)?*). Similarly, the one discussed above, this was also an open question, so its evaluation was carried out by the method described above. The four groups were created in a similar way as in the case of the previous item:

- Positive (*good, tasty, good idea, attractive, I like it, etc.*);
- positive, but critical (*tasty, but peppery; good, but expensive; I like it, it is fine, it should be sold at a good price, etc.*);
- negative (*I do not agree with it, unnecessary, suspicious, not good, poison, artificial, etc.*);
- neutral (*interesting, not harmful, uncertain, has no opinion, etc.*).

The majority of the respondents had positive evaluation (72.5%) of the product development, 13.7% expressed negative opinions, 7.2% had positive perceptions, but in a critical manner and 6.5% were neutral.

Figure 4 The respondents' segmented responses to their overall impression of the packaging of the new product prototypes (N = 166).

Source: Own calculation/
construction.



The last step of the questionnaire survey was product tasting where the respondents were given an opportunity to taste smoked Barramundi and then evaluate it on the basis of their impressions. The evaluation were based on various statements related to the odour, surface, texture and taste of the product, and the responses were collected on a 5-point scale 1–5 (1: strongly disagree; 5: strongly agree; 0: neither agree, nor disagree) and were scored.

Data-set out in Table 5 suggest that smoked Barramundi was attractive to the persons questioned and responded to their taste. It is also clear that merely a low proportion of the respondents were uncertain with one or two questionnaire items (column: “Neither agree nor disagree”). These were excluded from the calculation of the average as it would have distorted the results.

At first, responses were asked to indicate their impressions about the odour of the product. We listed affirmative and negative statements in the survey and the answerers were asked to indicate the extent of their agreement with them on the scale described above. The respondents strongly agreed that the odour of the tasted fish product was typically that of smoked fish and it was just right (4.65%) and unanimously disagreed that it was too smoky (1.37%) or perhaps it had an unpleasant side-smell (1.16). Standard deviation was slightly higher for the statement “Its odour is too spicy” (1.04), which in turn lead to the mean value of 1.5, i.e. the respondents failed to agree with it to some extents, but their disagreement was not strong.

For the first three statements (*Its odour is typically that of smoked fish, it is just right; Its odour is too smoky; Its odour has an unpleasant side-smell*) significance testing indicated a significant difference between groups by employment and age. Labour market (employment) segmentation by the Kruskal–Wallis test showed a significant difference at the probability levels of $p = 0.029$, $p = 0.0008$ and $p = 0.0043$. The segments where disagreements were considered outstanding were identified by

Table 5. The respondents’ assessment of smoked barramundi filet after tasting

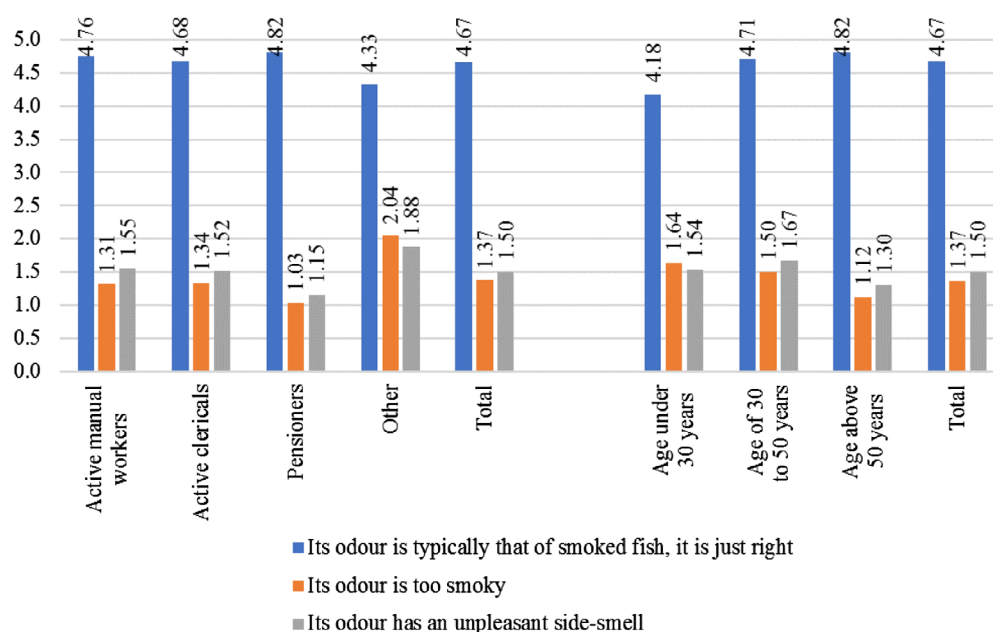
Statements	Statistical indicators						
	N	NTE	ΣN	Min.	Max.	Mean*	Std. dev.*
Its odour is typically that of smoked fish, it is just right	184	1	185	1	5	4.67	0.75
Its odour is too smoky	184	1	185	1	5	1.37	0.93
Its odour is too spicy	184	1	185	1	5	1.50	1.04
Its odour has an unpleasant side-smell (not typical of the product)	184	1	185	1	5	1.16	0.59
The surface and texture of the meat are nice and attractive	185	0	185	1	5	4.65	0.83
Its colour meets the general requirements of smoked fish products	179	4	183	1	5	4.76	0.70
It tastes mostly SALTY	183	1	184	1	5	2.33.	1.59.
It tastes mostly SWEET	185	0	185	1	5	1.46	1.01
It tastes mostly SOUR	185	0	185	1	5	1.16	0.66
It tastes mostly BITTER	185	0	185	1	5	1.11	0.54
It is VERY SPICY	183	0	183	1	5	1.80	1.25
It is VERY SMOKY	185	0	185	1	5	1.56	1.00
It is spiced harmoniously with the typical feature of the fish	176	8	184	1	5	4.76	0.73
After the tasting, I would be glad to try the product and recommend it to others	185	0	185	1	5	4.90	0.44

Source: Own calculation/construction.

*On the basis of N sample size (N = failed to answer the question). NTE = neither agree nor disagree.

Figure 5. The result of labour market and age segmentation regarding the evaluation of fragrance-related impressions (N = 185).

Source: Own calculation/
construction.



pairwise comparisons. For the statement “Its odour is typically that of smoked fish, it is just right”. the assessments by active clericals and those in other statuses (Mann–Whitney test, $p = 0.021$), pensioners and those in other statuses (Mann–Whitney test, $p = 0.006$) revealed a significant difference. This statement was agreed with by pensioners to the greatest extent, and persons in other statuses to the lowest extent. Significant disagreements have been observed for the statement “Its odour is too spicy” with pairwise comparisons from responses of active manual workers and persons in other statuses (Mann–Whitney test, $p = 0.004$), active clericals and those in other statuses (Mann–Whitney test, $p = 0.0008$), pensioners and persons in other statuses (Mann–Whitney test, $p = 0.0001$). Pensioners disagreed to the lowest extent with this statement, whereas persons in other statuses to the highest one. Significant difference have been revealed for the statement “Its odour is too spicy” with the assessments of active clericals and those in other statuses (Mann–Whitney test, $p = 0.025$), pensioners and those in other statuses (Mann–Whitney test, $p = 0.004$). Similarly, pensioners’ disagreement was the strongest at this item (Figure 5).

Segmentation by age group and by the Kruskal–Wallis test revealed a significant difference at the probability levels of $p = 0.001$, $p = 0.001$ and $p = 0.030$. The assessment of the statement “Its odour is typically that of smoked fish, it is just right”. varied considerably in the responses of persons under 30 and 30 to 50 years (Mann–Whitney test, $p = 0.011$) and also in the group of under 30, above 50 years (Mann–Whitney test, $p = 0.0002$). We demonstrate that while scores by responders under 30 tended to be 4 (they agreed with it to some extent), the other two age groups strongly agreed with it. Respondents’ assessments of the statement “Its smell is too smoky” varied significantly in the age groups of under 30 and above 50 (Mann–Whitney test, $p = 0.0004$); 30–50 and above 50 years (Mann–Whitney test, $p = 0.002$). This is due to the fact that the odour impact assessment by the age group of above 50 on the “too smoky character” of the product was at the lowest level. In the case of the statement “Its odour is too spicy” answers varied significantly in the age group of 30 to 50 years and above 50 (Mann–Whitney test, $p = 0.008$). Respondents above 50 were the ones to find the odour of the tasted fish the least spicy, whereas the age group of 30 to 50 the spiciest (Figure 5). This finding indicates that organs of sense weaken and we smell odours less intensively above a certain age.

The next step in tasting was the collection of responses in terms of surface and texture, i.e. the evaluation of the colour and texture of the product. Two related statements were prepared: “The

surface and texture of the meat are nice and attractive”. and “Its colour meets the general requirements of smoked fish products”. Respondents expressed their full agreement, with the average values of 4.65 and 4.76%, for both statements, respectively. Standard deviation was low in the case of both statements, therefore significant differences were not detectable.

Following this, “taste” assessments were examined, focusing on the potential dominance of the four basic tastes (salty, sweet, sour and bitter) in addition to spicy and smoky characteristics. The respondents’ sensation was the strongest in the case of salty (2.33), spicy (1.80) and smoky (1.56), whereas the weakest for sweet (1.46), sour (1.16) and bitter tastes (1.11) as stated in Table 5. The results of segmentation being significantly different are the followings (as presented in Table 6):

Table 6. Significantly different assessment of smoked barramundi filet after tasting by the different groups of respondents

Segmenting categories		N	Minimum	Maximum	Mean	Std. dev.
<i>It tastes mostly SALTY</i>						
Age	Age under 30 years	28	1	5	2.79	1.64
	Age of 30 to 50 years	81	1	5	2.48	1.64
	Age above 50 years	74	1	5	1.99	1.46
<i>It tastes mostly SWEET</i>						
Gender	Females	110	1	5	1.30	0.86
	Males	75	1	5	1.69	1.16
Frequency of fish consumption	Occasional fish consumers	112	1	5	1.61	1.16
	Regular fish consumers	73	1	4	1.23	0.68
<i>It tastes mostly SOUR</i>						
Gender	Females	110	1	5	1.05	0.42
	Males	75	1	5	1.32	0.89
<i>It tastes mostly BITTER</i>						
Frequency of fish consumption	Occasional fish consumers	112	1	5	1.19	0.69
	Regular fish consumers	73	1	1	1.00	0.00
<i>It is VERY SPICY</i>						
Age	Age under 30 years	28	1	5	1.79	1.26
	Age of 30 to 50 years	82	1	5	2.10	1.37
	Age above 50 years	73	1	5	1.47	1.03
<i>It is VERY SMOKY</i>						
Age	Age under 30 years	28	1	3	1.68	0.94
	Age of 30 to 50 years	82	1	5	1.79	1.17
	Age above 50 years	75	1	4	1.27	0.72
Income and lifestyle	Average income	125	1	5	1.50	0.97
	Above the average income	42	1	5	1.83	1.15
<i>It is spiced harmoniously with the typical feature of the fish</i>						
Gender	Females	105	1	5	4.88	0.51
	Males	71	1	5	4.58	0.94
Frequency of fish consumption	Occasional fish consumers	110	1	5	4.66	0.82
	Regular fish consumers	66	1	5	4.91	0.52

Source: Own calculation/construction.

The segmentation of the “It tastes mostly salty” statement by age groups and by the Kruskal–Wallis test, given the probability of error $p = 0.034$, revealed a significant difference. Pair-wise tests resulted in the following: the under 30 and above 50 (Mann–Whitney test, $p = 0.018$), the 30 to 50 and the above 50 age groups (Mann–Whitney test, $p = 0.045$) varied considerably. Similarly to odour assessment findings, typically respondents above 50 accounted for less intensive taste sensation and their assessment of saltiness received much lower scores (1.99).

The analysis of the statements “Its taste is mostly sweet” (Mann–Whitney test, $p = 0.003$) and the frequency of fish consumption (Mann–Whitney test, $p = 0.025$) by gender resulted in significant differences. Men found the tasted fish product a bit sweeter (1.7) than women (1.3), similarly to occasional fish eaters (1.61), in contrast to regular fish consumers (1.23). Combined segmentation shows an outstanding, substantial difference in the case of occasional male fish eaters set against the other segments.

Male respondents found the tasted product prototype *rather more sour* (1.32) than females (1.05) (Mann–Whitney test, $p = 0.002$). *Bitter taste sensation* was mostly typical of occasional fish eaters (1.19), since nobody in the group of regular fish consumers gave higher scores than 1 (Mann–Whitney test, $p = 0.013$).

The sensation of a *spicy taste* was more intensive in the age group of 30 to 50 (2.1) and the lowest for those above 50 (1.47) (Mann–Whitney test, $p = 0.001$) (segmentation by age group and by the Kruskal–Wallis test, given the probability level of $p = 0.006$, revealed a significant difference).

The analysis of the statement “Its taste is too smoky” by age groups (Kruskal–Wallis test, $p = 0.002$) and in respect of the earnings of the respondents (Mann–Whitney test, $p = 0.038$) yielded significant differences. Pair-wise tests and segmentation by age groups resulted in the following: under 30 and above 50 (Mann–Whitney test, $p = 0.013$), 30 to 50 and the above 50 age groups (Mann–Whitney test, $p = 0.0004$) varied considerably. In this case, similarly to earlier findings, respondents above 50 found the product the least smoky (1.27). Segmentation by earnings showed that respondents in self-reportedly high-income categories found the tasted product rather smokier (1.83), in contrast to those from average income categories (1.5).

The last but one statement goes somewhat beyond the simple taste sensation since the item was set out like this: “It is spiced harmoniously with the typical feature of the fish”. This statement puzzled some respondents (8 persons), but all of them fully agreed with it (4.76). Segmentation for this statement by genre carried out by the Mann–Whitney test given the error probability of $p = 0.002$ also revealed significant differences. The mean value was 4.88 for females whereas it was 4.58 for males. Based on the frequency of fish consumption, grouping (Mann–Whitney test, $p = 0.005$) confirmed that regular fish eaters agreed with the above statement more (4.9) than occasional fish consumers (4.66).

Finally: the statement “After the tasting, I would be glad to try the product and recommend it to others”. closed the tasting event. Data in Table 5 represent that average results were the highest in the case of this statement (4.9), whereas standard deviation was the lowest (0.4) here.

4. Conclusions

Most of the sample population in our market research consists of occasional fish consumers who prefer buying fresh marine fish as “filet” and one of their most relevant motives is that the fish to be bone-free. Their expectations towards the tasted fish filet is that it should have a clean surface and should be slime-free without a fishy odour. Typically, the survey population had higher qualifications (*this layer is made of customers who bought fish at fish selling points in hypermarkets*), therefore they are more health conscious when it comes to buying food. Their outstanding motives are the tastiness and domestic origin of the fish and fishery products. Unfortunately, customer awareness practically lacks the notion of sustainable fish farming/aquaculture—even among regular fish eaters.

Our survey respondents had no understanding of related certificates and organizations whatsoever.

The product development, i.e. the smoked Barramundi filet, as a functional food was received well by consumers.

- The target audience had already tasted smoked fish earlier, and they were satisfied with its taste.
- When they buy or consume smoked Barramundi, they mostly prefer it as filet.
- Consumers have no knowledge on the precise interpretation of “functional food”, nevertheless they agreed with the given direction of product development especially the application of dietary oils of positive effects besides seasoning. They mostly appreciated the components of functional foods with positive and preventive effects on heart, eye and mental health.
- They accepted the presented prototype positively, both in terms of packaging and taste. However, the older the respondents were, they tended to be less critical. More precisely, both in case of packaging and taste significant differences could be established the most after segmenting the respondents by their age. In the same time, the sense of taste of women and men was significantly different in case of sweet and sour flavours.

Our findings suggest that consumers’ perceptions of the Barramundi were positive as they positioned this fish species as an attractive, premium category product. The product development, i.e. the smoked barramundi filet, as a functional food, was well received by consumers. The target audience had already tasted smoked fish earlier, and they were satisfied with the taste of the new premium product. It is important to stress that the respondents had no thorough understanding of the meaning of “functional foods”; however, they agreed with such kind of product developments. They mostly appreciated the components of functional foods with positive and preventive effects on heart and eye health.

Overall, it can be concluded that product development is on the right track, it fulfils all the habits, expectations and demands of the target audience for fish consumption. Customers’ awareness of the expression “functional fish” should be raised. Customers should receive substantial information about its technical background if the objective is to obtain the sustainable fish farm (asc) certificate.

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Notes

1. Net mass/weight shall apply, whereas the nomenclature of the EU and FAO relates gross, i.e. live fish mass in its statistics, therefore domestic data represent 5.8–6.2 kg/person/year according to their statistical calculations.
2. This work was implemented by the support of NTP TECH_09-A3-2009-0235 Project Complex Development of Production Technology for Tradable fish species (Barramundi, Red Drum).
3. As we the survey aimed at obtaining as much information as possible about the fish consumption habits of the target population, the fact that responders failed to

answer certain questions, or the questionnaires were not fully completed, was not regarded as a disqualifying factor. It was indicated with numbers (N) for each questionnaire item.

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