

Insights for the development of a functional fish product: drivers and barriers, acceptance, and communication of health benefits

Article

Accepted Version

De Devitiis, B., Carlucci, D., Nocella, G. ORCID: <https://orcid.org/0000-0001-9625-6315>, Viscecchia, R., Bimbo, F. and Nardone, G. (2018) Insights for the development of a functional fish product: drivers and barriers, acceptance, and communication of health benefits. *Journal of Aquatic Food Product Technology*, 27 (4). pp. 430-445. ISSN 1547-0636 doi: 10.1080/10498850.2018.1447059 Available at <https://centaur.reading.ac.uk/75945/>

It is advisable to refer to the publisher's version if you intend to cite from the work. See [Guidance on citing](#).

To link to this article DOI: <http://dx.doi.org/10.1080/10498850.2018.1447059>

Publisher: Taylor & Francis

All outputs in CentAUR are protected by Intellectual Property Rights law, including copyright law. Copyright and IPR is retained by the creators or other copyright holders. Terms and conditions for use of this material are defined in

the [End User Agreement](#).

www.reading.ac.uk/centaur

CentAUR

Central Archive at the University of Reading

Reading's research outputs online

1 Insights for the development of a functional fish product: drivers and barriers, acceptance and
2 communication of health benefits

3

4

5 Biagia De Devitiis^a, Domenico Carlucci^b, Giuseppe Nocella^c, Rosaria Viscecchia^a, Francesco

6 Bimbo^d, and Gianluca Nardone^a

7

8 ^{a)} *Department of Agricultural, Food and Environmental Sciences, University of Foggia, Italy*

9 ^{b)} *Department of Agricultural and Environmental Sciences, University of Bari "Aldo Moro",*
10 *Bari, Italy*

11 ^{c)} *School of Agriculture, Policy and Development, University of Reading, Reading, UK*

12 ^{d)} *Business Economics Group, Department of Social Sciences, Wageningen University,*
13 *Wageningen, The Netherland*

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53

Abstract

This study aims to explore consumers' acceptance of a new functional fish burger by using a qualitative approach based on four focus group discussions conducted in selected major Italian cities. Results show that the development of functional fish products may bypass fish consumption barriers combining convenience and health benefits delivered by functional ingredients. The acceptance of new functional fish products seems to be influenced positively by the enrichment of functional ingredients naturally present in fish, particularly Omega-3 fatty acids. Consumers' acceptance of this new product is also influenced by the use of different nutritional and health claims. Implications for marketers, policy makers and insights for further research are discussed in the conclusions.

Key words: Functional fish, Focus group, Consumer acceptance, Omega-3, Health claims

54 **Introduction and Background**

55 The term “functional food” is used generally to communicate either that this is food
56 that may provide health benefits beyond those delivered by traditional nutrients or foods that
57 have potentially disease-preventing and health-promoting properties (Milner, 2000, Griffiths
58 et al., 2009). The demand for these products is growing rapidly and a recent economic report
59 (Research and Markets, 2014) estimates the global market for functional foods to be around
60 \$168 billion in 2013, while it is forecast to exceed \$300 billion by 2020. This growth is
61 fuelled by increasing consumer health-consciousness, particularly in Western societies,
62 technological innovation and the development of new products (Granato et al., 2010).

63 Functional foods are mostly enclosed in the industry of dairy, confectionery, soft-
64 drinks, bakery and baby-food (Bigliardi & Galati, 2013), while the number of functional
65 foods included in other categories is rather low. Specifically, functional foods in the form of
66 fish and seafood products seem to be little exploited by the food industry for two reasons.
67 First, the food industry has probably not yet invested enough resources on their development
68 and second, fish consumption in general is challenged by several barriers such as high market
69 prices (Birch & Lawley, 2012; Verbeke & Vackier, 2005), lack of convenience (Olsen et al.,
70 2007; Rortveit & Olsen, 2009) and lack of knowledge and skills in selecting and preparing
71 fish (Brunsø et al., 2009; Carlucci et al., 2015)..

72 Despite these barriers, fish and seafood products may have a strong potential as
73 functional foods for several reasons. First, fish and seafood are widely perceived by
74 consumers as healthy foods (; Brunsø et al., 2009; Burger & Gochfeld, 2009;; Pieniak,
75 Verbeke & Scholderer, 2010; Verbeke et al., 2005), and previous studies show that food
76 products that are perceived by consumers as naturally healthy are more suitable carriers for
77 functional ingredients (Annunziata & Vecchio, 2011; Ares, Giménez & Gámbaro, 2008;
78 Bech-Larsen & Grunert, 2003; Hailu et al., 2009; Roe, Levy & Deby, 1999). Second, taste

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

79 matters in the choice of functional foods (Gilbert, 2000; Lyly et al., 2007; Pothoulaki &
80 Chryssochoidis, 2009; Tuorila & Cardello, 2002; Urala & Lähteenmäki, 2003), and
81 consumers are rarely willing to compromise on the taste of functional foods for their health
82 benefits (Cox, Koster & Russell, 2004; Gilbert, 2000; Verbeke, 2006). Considering that
83 several studies show that most consumers consider fish and seafood as tasty foods and the
84 sensory liking of fish as one of the most important drivers of fish consumption (Birch &
85 Lawley, 2012, 2014; Brunso et al., 2009; Carlucci et al., 2015; Neale et al., 2012), this aspect
86 should be an advantage in the development of functional fish products. Finally, consumers'
87 acceptance of functional foods may depend on the specific combination of carrier and
88 functional ingredients and, in particular, perceived healthiness of functional foods is better
89 when the bioactive ingredient is naturally contained in the carrier (e.g. Calcium in the milk)
90 (Cox, Evans & Lease, 2011; Krutulyte et al., 2011; Lampila et al., 2009). Also with regard to
91 this aspect, fish and seafood seem to be ideal carriers for several functional ingredients
92 because they naturally contain many micronutrients such as Omega-3 fatty acids which are
93 very important for human nutrition (FAO/WHO, 2011).

94 However, while a number of studies have analysed consumers' attitudes towards
95 functional foods of various categories such as dairy, meat, bakery, beverages, etc. (Bech-
96 Larsen & Grunert, 2003; Menrad, 2003; Siegrist, Stampfli & Kastenholz, 2008; Sirò et al.,
97 2008; O'Brien et al., 2012), to the authors' knowledge, only Tudoran, Olsen & Dopico (2009)
98 have investigated consumer attitudes towards functional fish products. They explored the
99 effect of health benefit information on individuals' stated health values, attitudes towards
100 functional/enriched foods, and expectations, perceptions, and intentions to purchase a new
101 fibre-enriched fish product. They found that for Spaniards fibre and health information in fish
102 products are not especially effective, and that the market feasibility of a "new fibre-enriched

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

103 fish product” may not differ significantly from the market feasibility of a simple “new
104 processed fish product”.

105 As a result, the present study aims to fill this gap by exploring the marketing
106 opportunity of developing a new functional fish burger that can both overcome barriers and
107 take advantage of aspects regarding fish consumption mentioned previously. In particular, the
108 study will attempt to answer the following research questions: What are consumers’ reactions
109 towards functional fish burgers? What are the main factors positively and negatively affecting
110 consumers’ acceptance of functional fish burgers? What are the most appealing functional
111 ingredients that could be added to fish burgers? What are the product attributes that food
112 scientists and marketers should take into account when developing functional fish burgers?
113 What is the best way to communicate health benefits of functional fish burgers?

114 Fish burgers were considered a good compromise to explore consumers’ acceptance
115 of this functional food category because they may represent a convenient meal option that can
116 be sold on the market at competitive prices. In fact, from an industrial point of view, fish
117 burgers reduce waste because they can be produced using minced flesh (undervalued or
118 undersized fish products) less appreciated by consumers and, in addition, it is easy to
119 incorporate a functional ingredient into this kind of product (Matak, Tahergorabi &
120 Jaczynski, 2015; Tahergorabi, Matak & Jaczynski, 2015). Recent studies have focused on the
121 production of fish burgers from both marine and freshwater fish (Bochi et al., 2008; Branciani
122 et al., 2016; de Quadros et al., 2015; Di Monaco et al., 2009; Haq et al., 2013;
123 Mahmoudzadeh et al., 2010; Taşkaya et al., 2003).

124 This explorative study is also significant because, despite the fact that the fish
125 industry seems to be motivated in developing this product, it is not obvious that functional
126 fish burgers will be well accepted by consumers for several reasons. First, previous studies
127 showed that when fish products undergo increased levels of processing, many consumers

128 seem to perceive the modifications of the characteristics of the original product as a
129 proportional loss of quality, safety, naturalness, healthiness and nutritional value
130 (Altintzoglou et al., 2010; Altintzoglou et al., 2012; Carlucci et al., 2015; Debucquet et al.,
131 2012; Loose, Peschel & Grebitus, 2012). Second, many consumers do not appear to be
132 knowledgeable about the specific health and nutritional benefits of fish (Altintzoglou &
133 Heide, 2016; Carlucci et al., 2015; Pieniak, Verbeke & Scholderer, 2010), while high levels
134 of this knowledge seem to be necessary for the acceptance of functional foods (Ares,
135 Giménez & Gámbaro, 2008; Menrad, 2003; Wansink, Westgren & Cheney, 2005). Last but
136 not least, the communication of health benefits to consumers may not be really effective
137 because health and nutritional claims, compatibly with the constraints imposed by different
138 regulations (for example, EU Regulation No 1924/2006), may not be well understood and/or
139 not well accepted by consumers (Leathwood et al., 2007; Nocella & Kennedy, 2012).

140 Over the next sections, we will illustrate the research design and the methodology
141 used to analyse the data. We then provide and discuss results obtained from the present
142 qualitative research. Finally, marketing and policy implications for product development
143 together with insights for further research will be discussed in the conclusions.

144

145 **Methodology**

146 **Semi structured focus group discussion guide and recruitment**

147 To achieve the stated research objectives, a qualitative approach based on focus group
148 discussions was adopted. The focus group method involves organized discussion with
149 selected groups of individuals to gain information regarding their points of view and
150 experiences on a specific topic of research, where each group is composed of a relatively
151 small number of participants (Powell & Single, 1996). The main purpose of focus group
152 discussions is to draw upon respondents' attitudes, feelings, beliefs, experiences and reactions

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

153 which are difficult to obtain by using other investigation methods such as observation, one-
154 to-one interviewees, or questionnaire surveys (Krueger & Casey, 2014; Morgan, 1998).

155 The recruitment of participants was conducted by a marketing research agency that
156 ran four focus groups in September 2013 in four major cities (Milan, Bologna, Rome and
157 Bari) in order to capture possible differences between the geographic areas of North, central
158 and southern Italy. Each focus group involved eight participants who were the main person
159 responsible for food purchasing in their household and who consumed fish at least once a
160 week.

161 To compare perspectives of different types of consumers, each group was
162 heterogeneous in terms of gender and age (as illustrated in table 1) because research
163 conducted on general health orientation seem to vary systematically as a function of age and
164 gender (Oakes, 2003; Roininen et al., 2001; Verbeke, 2005).

165

Table 1. Location, gender, and age of focus group participants.

	Bari		Roma		Milano		Bologna		Tot
	Female	Male	Female	Male	Female	Male	Female	Male	
18–34 years	1	1	1	2		3	2	1	11
35–54 years	4	1	2	2	4		1	2	16
55–70 years		1	1			1	1	1	5
Tot	5	3	4	4	4	4	4	4	32

166

167

168 Focus group discussions were carried out on the basis a pre-tested protocol that allowed
169 researchers to collect semi-structured data (Table 2). The protocol was developed after
170 having conducted a literature review, two interviews with practitioners working in the Italian
171 fish industry, a pilot focus group and discussions between the authors.

172 The protocol contained four sections. The first section aimed at triggering the
173 discussion on drivers and barriers of fish consumption in general. The second section focused
174 on specific drivers and barriers of conventional fish burger consumption with no reference to
175 any enrichment with functional ingredients. Participants were shown photos of conventional

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

176 fish burgers and were asked to express their attitudes towards attributes of this product. The
177 third section explored participants' acceptance of fish burgers with added functional
178 ingredients that provide health benefits. Participants were asked to specify the functional
179 ingredient that they would like to fortify and discuss attitudes and motivations of their choice.
180 To help participants with this task the moderator distributed a table containing information on
181 functional ingredients that could be added to fish burgers. The selection of these functional
182 ingredients was previously discussed with academic experts in food technology and dietetics.
183 The final section attempted to understand how to communicate health benefits by showing
184 participants selected health and nutritional claims that could be used on the packaging of
185 functional fish burgers. Because the study was conducted in Italy, the discussion focused on
186 consumer understanding of health and nutritional claims released by EFSA (European Food
187 Security Agency) in May 2012 (Reg. No 432/2012). Participants were asked to reflect on the
188 meaning of the various claims, to express their preferences, and to explain the reasons for
189 their choice.
190

Table 2. Focus group protocol.

Stage	Content
Introduction	Clarification of the focus group procedure, written informed consent, and warming-up questions to introduce participants.
Drivers and barriers of fish consumption	Main factors affecting fish and seafood consumption positively and negatively.
Drivers and barriers of fish burger consumption	Reasons to (not) purchase and consume generic fish burgers. Influence of product attributes on participants' acceptance of generic fish burgers.
Acceptance of functional fish burgers	Attitudes toward fish burgers with added selected functional ingredients delivering specific health benefits. Motivational factors of preferred functional ingredients.
Consumer perception of selected health and nutritional claims	Meaning ascribed to various claims available under Regulation 1924/2006 and preference for the claim that they would like to find on the product.

191

192

193 The discussion lasted approximately two hours. Each focus group took place in a

194 conference room and was video recorded with the permission of the participants. The

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

195 discussion was conducted by a moderator and an assistant who started each focus group with
196 a brief overview of the study and with warm-up questions giving participants the opportunity
197 to ask any questions before starting to collect information. Discussion on the identified
198 research topics was triggered by the moderator with open-ended questions while the assistant
199 observed participants taking notes.

200 **Data Analysis**

201 The videotapes and verbatim transcripts were coded and analysed based on a thematic
202 analysis, a method for identifying, analysing and reporting patterns (themes) within text data
203 (Braun & Clarke, 2006).

204 Qualitative data was analysed in three stages. In stage one, the voice recording of
205 focus group discussions were transcribed verbatim into a word document. In stage two, the
206 transcriptions were analysed using thematic analysis to obtain insights about the content of
207 discussion, to identify different themes contained in data, and to create a structured coding
208 system. To minimize subjectivity bias, transcripts were independently analysed by two coders
209 who discussed differences in coding until they agreed on a collection of 54 codes that were
210 combined into broader themes. Accordingly, a total of 29 themes were elaborated: 8 themes
211 about drivers and barriers of fish consumption, 7 themes about drivers and barriers of
212 conventional fish burger consumption, 10 themes about the acceptance of functional fish
213 burgers, and 4 themes about consumer perceptions of health and nutritional claims. In stage
214 three, transcribed data were imported into NVIVO 10 to further reduce researchers'
215 subjectivity in analysing qualitative data. Results of the four focus group discussions are
216 presented by order of themes included in the research protocol and using participants' quotes.
217 Furthermore, the main results are discussed at aggregate level but when substantial
218 differences among participants were found, they are marked appropriately.

219

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

Table 3. Themes of focus group discussions.

Drivers and barriers of fish consumption	Drivers and barriers of fish burger consumption	Acceptance of functional fish burgers	Consumer perception of health and nutritional claims
1. Health beliefs	9. Convenience	16. Healthy food	26. Nutritional claim with the indication of higher content
2. Nutritional knowledge	10. Appealing to children	17. Concern about taste	27. Function claim vs. reduction of disease risk claim
3. Sensory liking of fish	11. Curiosity and desire to vary	18. Truthfulness of functional foods	28. Combination of short nutrition claims and full health claims
4. Price perception	12. Concerns about the taste and texture of fish burgers	19. Carrier and ingredient combinations: natural vs. artificial	29. Visual aids and trustworthiness of claims on functional fish burgers
5. Lack of convenience	13. Concerns about quality and safety of fish burgers	20. Familiarity with omega 3	
6. Concerns about fish consumption process	14. Impact of branding and labeling	21. Usefulness of omega 3 for maintaining good health and well-being	
7. Lack of fish availability	15. Influence of product attributes	22. Prevention vs. curative effects	
8. Lack of trust in information provided by fish sellers		23. Knowledge of omega 3 daily intake	
		24. Medium-low-risk perception of cardiovascular diseases and convenience of functional fish burgers	
		25. High-risk perception of cardiovascular diseases	

220

221

222 **Results and Discussion**

223 **Drivers and Barriers of Fish Consumption**

224 Consistent with the literature (Brunsø et al., 2009; Burger & Gochfeld, 2009; Pieniak,
 225 Verbeke & Scholderer, 2010; Verbeke et al., 2005), all respondents agreed that fish and
 226 seafood are healthy foods and their consumption is useful for a balanced diet. There was also
 227 a common belief that fish contributes to human health and well-being and that it is healthier
 228 than meat. The perception of fish as healthy food was mainly explained by general comments
 229 such as its low fat content, its high content of healthy nutrients (proteins and vitamins), and
 230 its high digestibility which makes fish more suitable than meat for evening meals (theme 1).

231

232 *Fish is low in calories and is easily digestible, and when you eat it you*
 233 *feel light.*

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

234 *I eat fish because it is good for my health and rich in nutrients.*
235 *Fish contains vitamins and proteins which are essential for a balanced*
236 *diet.*
237 *Fish is more easily digestible than meat and good for children's growth ...*
238 *and unlike meat, hormones are not used in the production of fish.*

239

240 However, in line with past studies (Brunsø et al., 2009; Carlucci et al., 2015; Pieniak
241 et al., 2007; Pieniak, Verbeke & Scholderer, 2010), only a few participants (mainly older men
242 and women) really knew about specific nutrients contained in fish and specific health benefits
243 provided by fish consumption. Actually, participants' previous perceived health beliefs
244 regarding fish were reinforced by the wrong credence linked to the popular myth that fish
245 consumption increases intelligence and was not supported by their appropriate knowledge on
246 specific nutrients beneficial to human nutrition (theme 2).

247 *Fish contains proteins ... Calcium is a protein.*
248 *Fish is good for health ... I do not know why, just by word of mouth.*
249 *Fish is brain food.*
250 *The head of the fish is the part of the fish which contains more vitamins.*

251

252 In line with the literature (Birch & Lawley, 2012; Carlucci et al., 2015; Brunsø et al.,
253 2009; Neale et al., 2012), the majority of respondents declared that they were attracted by the
254 sensory properties of fish because they like the taste, the texture and the aroma of fish and, in
255 general, enjoy eating fish (theme 3).

256

257 *I don't look at nutrients, taste is important for me...I eat fish because I like*
258 *the taste.*
259 *Fish is one of the few foods that you can eat without dressing, it tastes*
260 *good plain.*
261 *I love fish for its good taste and its aroma of the sea.*

262

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

263 Conversely, high prices were perceived as a key barrier of fish consumption as
264 reported in other studies (Brunsø et al., 2009; Carlucci et al., 2015; Neale et al., 2012;
265 Verbeke & Vackier, 2005). Participants stated that fish cannot be eaten every day because is
266 a more expensive meal option than meat and seems to be a food product that is consumed
267 more by wealthier people (theme 4).

268

269 *Fish is far more expensive than meat.*

270 *If fish were cheaper I would eat it every day.*

271 *Fresh fish is very expensive...it isn't accessible to everyone...*

272

273 Most participants also agreed that fish consumption, particularly fresh fish, is affected
274 negatively by the time and effort required for its preparation (Birch & Lawley, 2012; Brunsø
275 et al., 2009; Carlucci et al., 2015; Neale et al., 2012; Olsen et al., 2007). Time is also affected
276 by the short shelf-life of fish because consumers must cook fish straight away if they want
277 appreciate the organoleptic characteristics of this product (theme 5).

278 *I would like to just eat fresh fish but I don't have time...*

279 *The preparation of dishes based on fresh fish involve time and care.*

280 *Fresh fish is highly perishable...you have to eat it at once and cannot keep*
281 *it for days in the fridge.*

282

283 An additional important theme that arose within the barriers of fish consumption was
284 the lack of knowledge and skills in selecting and preparing fish (Birch & Lawley, 2012;
285 Carlucci et al., 2015; Neale et al., 2012; Pieniak et al., 2007). Specifically, younger
286 participants declared that they did not feel confident in assessing freshness of fish and
287 cooking it at home (theme 6).

288

289 *Personally, I don't know how to clean or cook fresh fish...the only fish I*
290 *can prepare without difficulty is sole.*

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

291 *It's hard to know when fish is really fresh, I can't tell.*

292

293 Several participants also indicated that fresh fish is not always available in the
294 marketplace (Rortveit & Olsen, 2007; Rortveit & Olsen, 2009) (theme 7). They were also
295 concerned about the origin of fish and this was exacerbated by the lack of trust in information
296 provided by fishmongers (Claret et al, 2012; Pieniak et al., 2017) (theme 8).

297

298 *Fresh fish isn't always available.*

299 *When you buy fresh fish you never know what will be available...it*
300 *depends on the catch.*

301 *Where fish comes from is fundamental ... I don't trust what the fishmonger*
302 *says.*

303

304 **Drivers and Barriers of Fish Burger Consumption**

305 Most respondents expressed a positive attitude towards fish burgers. These
306 respondents (particularly younger participants) agreed to appreciate fish burgers mainly for
307 their convenience. They expressed the desire to save time and effort in the preparation of fish
308 and they perceived fish burgers as a quick and easy meal option, also ideal for “emergency
309 meals” (theme 9).

310

311 *It is convenient to have fish burgers in the freezer that could be used for a*
312 *quick and easy meal option.*

313

314 Some participants (parents of children) also said that fish burgers are an interesting
315 fish product because they are appealing for children who often dislike the taste and smell of
316 fresh fish as well as the presence of bones (Birch & Lawley, 2012; Verbeke & Vackier,
317 2005). They claimed to be continuously engaged in searching for new processed fish products
318 that their children could like (theme 10).

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

319

320 *I buy it so we can give the children a little fish in alternative to what we*
321 *already eat.*

322 *My children hate the smell of fish and its bones...this could be a way to*
323 *convince them to eat fish.*

324

325 Many respondents emphasized that they routinely like to vary the choice of food
326 products available on the market and are attracted by new food products (Kaushik &
327 Rahman, 2014; Olsen et al., 2016). They agreed that fish burgers are a particular fish product
328 that is different from others and could be eaten to break the monotony of this category of
329 food products (theme 11).

330

331 *Fish is a different product you could buy it now and again to ring the*
332 *changes.*

333 *I'd try it out of curiosity.*

334 However, a few respondents (older and more expert in selecting and preparing fish)
335 showed a negative attitude towards fish burgers. They stated that they never would buy fish
336 burgers because they perceived this product as being unappealing in terms of taste and
337 texture. They also emphasized the difficulty of breaking their ingrained habits of buying and
338 consuming fresh fish (Siegrist, Hartmann & Keller, 2013; Carlucci et al., 2015) because of
339 the unique reward that they get when eating this delicious and healthy product (theme 12).

340

341 *I wouldn't buy it...it looks weird...it's not fish to me.*

342 *I'm used to eating only fresh fish...I wouldn't buy anything similar. I don't*
343 *think it would have neither the taste nor the nutritional properties of fish.*

344

345 Concern for this product was also expressed by participants with positive attitudes.
346 They were concerned about the quality and safety attributes of fish burgers. These are credence
347 attributes and, considering that fish burgers are prepared with the minced flesh of fish,

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

348 participants showed a lack of trust towards the production process because they feared that it
349 could be made with waste and by-products of the fish industry (theme 13). These results
350 corroborate previous findings highlighting a on consumers' negative perception over fish
351 processing (Altintzoglou et al.,2010; Debusquet, Cornet, Adam, & Cardinal, 2012).

352

353 *I would be worried that they are made out of fish by products...may be*
354 *polluted fish or fish that has gone off.*

355 *They might be made out of by-products like meatballs...I'd be scared...*

356 *The thing is, you can't see what you are actually eating.*

357

358 They also discussed how to overcome their concerns. They stated that branding and
359 labelling could play an important role to assure consumers in terms of quality and safety
360 (Verbeke, Vermeir & Brunsø, 2007) especially if fish burgers are produced by big food
361 companies with a long-standing brand and trust relationship with consumers in the market
362 place (theme 14).

363

364 *I'd like to see labelling with the characteristics of the fish...I'd like the*
365 *same information on whole fish. It is the only way to stop prejudice.*

366 *Brand is trust...brand is synonymous with quality as it guarantees that it*
367 *hasn't been frozen and defrosted.*

368 *I'd like to see the brand of a big food company then I would feel assured*
369 *regarding quality.*

370

371 Concerning the most important attributes affecting the quality of fish burgers (theme
372 15), almost all respondents agreed to be extremely interested in the species of fish used and
373 they also expressed a preference for salmon and cod with the latter cited particularly for
374 children. The storage method was the second most relevant attribute considered by participants
375 who distinguished between chilled and frozen fish burgers. Most participants claimed to prefer
376 frozen fish burgers for their longer shelf-life and ready availability as "emergency meals"

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

377 (Birch & Lawley, 2012; Claret et al., 2012). Country of origin was another important attribute
378 valued by many participants who also agreed to prefer domestic fish for its superior quality and
379 safety compared to imported fish (especially fish from developing countries) (Carlucci et al.,
380 2015; Claret et al., 2012). Finally, most respondents highlighted that price is a key factor
381 affecting the choice of purchasing fish burgers and they agreed to be willing to purchase fish
382 burgers only if price is lower than that of fresh fish.

383

384 *I look at the type of fish...I'd like it made from salmon.*

385 *.....thinking of my children I'd rather the burgers were made of cod.*

386 *Obviously the burgers would need to be frozen ... otherwise you'd have to*
387 *eat them asap and that would lessen convenience...the flavour of fish, unlike*
388 *meat, changes after a day.*

389 *I'd look at the origin of the fish carefully ... I would obviously prefer*
390 *Italian or Mediterranean fish...I would certainly not buy fish from China as I*
391 *wouldn't trust it.*

392 *Price is fundamental...if the price was the same as fresh fish I wouldn't*
393 *buy it.*

394

395 **Acceptance of Functional Fish Burgers**

396 Most respondents showed a positive attitude towards functional fish burgers mainly
397 because they were perceived as being healthier than generic fish burgers. In particular, older
398 women from Rome and Bologna agreed that the addition of functional ingredients providing
399 health benefits would be a good idea to enhance the quality of this product and differentiate it
400 from conventional fish burgers (theme 16).

401

402 *I like the idea that they contain some healthy ingredients....that's a plus*
403 *with respect to plain fish burgers.*

404 *They're different from the classic fish burgers you find in fast food*
405 *outlets...they're healthier... kill two birds with one stone.*

406

407 However, despite the fact that participants liked the idea of functional fish burgers,
408 some of them (middle-aged men from Rome and Bologna) expressed concerns over the taste
409 that may result altered and/or unnatural after the addition of a particular functional ingredient
410 (theme 17).

411

412 *Adding substances could change the flavour of the fish.*

413 *If you add substances the burger might not have a natural taste.*

414

415 Furthermore, some participants (women below 40) were sceptical about this
416 enrichment because of distrust regarding the utility of functional foods (theme 18). In line
417 with Lalor et al. (2011), the sceptics showed a holistic approach to health and believed that
418 just one product is not enough to improve an individual's health which is instead affected
419 positively by a varied diet. These participants also stated that, instead of consuming
420 functional foods, a Mediterranean diet would be sufficient to maintain good health and well-
421 being.

422

423 *I don't believe in foods that are enriched with other ingredients...often*
424 *these foods don't have the same effect as natural foods.*

425 *Eating an enriched food is not going to improve your health... we have*
426 *our Mediterranean diet that gives us all these nutrients...we don't need to add*
427 *anything.*

428

429 As regards the addition of functional ingredients, in line with other studies (Cox,
430 Evans & Lease, 2011; Krutulyte et al., 2011; Lampila et al., 2009), almost all participants
431 agreed that functional fish burgers should be produced by enriching the content of an
432 ingredient which is already naturally contained in fish (theme 19).

433

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

434 *I'd like the burgers enriched with ingredients that are already present in*
435 *fish...I think it's absurd to add fibre...*

436

437 The most mentioned functional ingredients that would be preferred for enriching fish
438 burgers were Omega-3, Phosphorus, Iron and Calcium. When participants were asked to
439 choose the most preferred nutrient with which to fortify the product, almost all of them
440 agreed on Omega-3. They motivated this choice saying that they were familiar with this
441 nutrient owing to the fact that they heard about it from their family doctors, media and
442 several marketed food products that are already fortified with Omega-3, citing milk and
443 yogurt (theme 20).

444 *There are already lots of foods containing Omega-3...there's milk with*
445 *Omega-3, yogurt with Omega-3.*

446 *I've heard the family doctor talk about Omega-3.*

447 *They talk about it all the time in TV much more than in the past...chefs,*
448 *nutritionist talk about it...*

449 Furthermore, they motivated this choice saying that fish contains this nutrient
450 naturally contrarily to other functional foods like milk or yogurt to which it is conventionally
451 added.

452 *Certainly if I have the choice I would prefer to eat a fish burger enriched*
453 *with Omega-3 rather than milk or yogurt.*

454 However, the omega-3 fatty acid concentration is very low in cod which is one of the
455 most preferred species of fish for consumption and this denotes consumers` lack of
456 nutritional knowledge.

457 .Furthermore, they also admitted to have a limited knowledge of the specific health
458 benefits of Omega-3 but they generally knew that Omega-3 fatty acids are very important for
459 maintaining good health and well-being (theme 21). However, some participants knew that
460 Omega-3 could prevent cardiovascular diseases but that did not have any medicinal effects
461 confirming findings by Krutulyte et al. (2008) (theme 22).

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

462

463 *I don't know precisely what Omega-3 are...I think they can generally*
464 *guarantee better health and can help prevent cardiovascular diseases but*
465 *certainly not cure them ...*

466 *...they help prevent health problems but not cure them.*

467

468 The discussion on Omega-3 also highlighted that an increased intake of fatty fish does
469 not seem to have any effects on consumers. Some participants stated that this pattern could be
470 explained by the fact that consumers do not know the quantity of fish that would provide an
471 optimal intake of Omega-3 and thus they are uncertain about whether they consume enough
472 Omega-3 (theme 23). As a result, these participants argued that the evaluation of the right
473 intake of Omega-3 could be facilitated by functional foods displaying labels, where
474 recommended daily intakes are explicitly indicated..

475

476 *I am predisposed to high blood pressure and I have given up meat and*
477 *increased my fish intake... I have had no positive effects...maybe because I don't*
478 *know how much fish I should eat to get the right amount of Omega-3 ... I would*
479 *like to see the quantity of Omega-3 and recommended intake on burger labels.*

480

481 As regards the link between the consumption of Omega-3 and perceived risk of
482 getting cardiovascular diseases, most participants claimed that they thought that they were
483 exposed to a medium-low risk and thus they were not afraid of developing cardiovascular
484 disease because their diet and lifestyles were sufficiently healthy. These participants also
485 admitted that maintaining a balanced diet is often difficult primarily because of lack
486 of time due to busy lifestyles and thus fish burgers enriched with Omega-3 could be a good
487 surrogate of fatty fish like salmon (theme 24).

488

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

489 *I think I have a low risk of contracting cardiovascular disease....or the*
490 *same risk as others my age...I do sport and watch what I eat...of course I can't*
491 *always eat salmon that is rich in Omega-3...I could eat an Omega-3 enriched*
492 *burger.*

493

494 However, few participants also declared that they felt they were at high risk of
495 cardiovascular diseases and most of them construed their risks as exogenous to their
496 behaviour, i.e. as simple consequence of aging and/or genetic predisposition (high levels of
497 cholesterol and hypertension). These participants strongly chose Omega-3 as their preferred
498 enrichment functional ingredient and thus their motivation to protect themselves against this
499 risk (theme 25).

500

501 *As far as I am concerned, the consumption of these fish burgers can help*
502 *me because I am prone to high levels of cholesterol and therefore I run a high*
503 *risk of developing cardiovascular diseases.*

504

505 **Consumer Perception of Health and Nutritional Claims**

506 Given that Omega-3 was the most preferred functional ingredient to be added to fish
507 burgers, different nutritional and health claims permitted by EU Regulation 1924/2006 and
508 available on the EFSA website for Omega-3 were presented to the participants. In particular,
509 nine front labels were selected with five front labels being nutritional claims and four
510 substantiated health claims. For the five nutritional claims, the noun Omega-3 was preceded
511 by qualifiers which indicated progressive levels of the functional ingredient concentration:

512 *“source of Omega-3”, “contains Omega-3”, “with Omega-3”, “high in Omega-3” and*
513 *“rich in Omega-3”.* As regards health claims, the following two were selected from those
514 approved by EFSA in May 2012 (Reg. No 432/2012) and available on the EFSA website:
515 *“Omega-3 contributes to the maintenance of normal blood cholesterol levels” and “Omega-3*
516 *reduces risk of coronary heart disease”.* Both claims were presented to participants with and

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

517 without the following information: *“This health claim has been approved by EFSA after*
518 *substantiated scientific evidence”*.

519 In line with literature (Mariotti et al., 2010), most participants did not clearly
520 distinguish between different types of nutritional claims. However, results are interesting
521 because the use of qualifiers influenced participants’ attitudes of different nutritional claims.
522 Specifically, when Omega-3 was preceded by the qualifiers *“source of”*, *“contains”* and
523 *“with”*, participants appeared to perceive the communication of the functional ingredient as
524 not being so effective. They appeared to be confused and participants over the age of 40 in all
525 our cities were pointing out that *“source of”* was more natural than *“contains”* and *“with”*
526 because especially *“contains”* gives the idea that something was added to the product. On the
527 other hand, when Omega-3 was preceded by the qualifiers *“high”* and *“rich”*, many
528 participants questioned their meaning in terms of quantity because they wanted to know the
529 right amount of Omega-3 that they had to take daily. Furthermore, participants below the age
530 of 40 preferred the term *“rich”* for its simplicity and its more positive impact than *“high”* on
531 information processing. However, despite these remarks the use of the qualifiers *“high”* and
532 *“rich”* were effectively perceived as communicating a higher content of Omega-3 in
533 comparison to the qualifiers *“source of”*, *“contains”* and *“with”*. Thus, these results seem to
534 indicate that the strength of qualifiers can play a very important role in the communication of
535 nutritional claims. This aspect can be well accepted when the added functional ingredient is
536 already contained naturally in the food products as in the case of fish burgers.

537

538 *I prefer “rich in Omega-3” because it lets me understand that the content*
539 *is higher than what is available naturally...*

540

541 As regards health claims, most participants declared to prefer health claims with a
542 general mention of health benefits (i.e. maintenance of normal blood cholesterol levels)

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

543 incomparison to claims conveying specific information concerning risk reduction of getting
544 coronary heart diseases (theme 27). These results are also confirmed by Kapsak et al. (2008).

545

546 *“Reduces cholesterol” is a simple and direct label.*

547 *In the end I am buying fish burgers... for me reference to cholesterol is*
548 *more than enough.*

549 *I don't like “Reduces risk of cardiovascular disease” at all...horrible and*
550 *inadequate... I am not buying pills... sounds like something I'd buy at the*
551 *chemists`.*

552

553 Moreover, consistent with the literature (Williams, 2005), some participants declared
554 that they preferred a combination of short nutritional claims on the front of the package and
555 full health claims on the back (theme 28).

556

557 *On the front label I prefer “rich in Omega-3” because it's simple, short*
558 *and direct, has an impact... on the back you could say that “Omega-3 reduces*
559 *cholesterol”.*

560

561 Finally, also in this study some participants expressed lack of trust in health and
562 nutritional claims (Kearney, 2010; Grunert, 2010) and they agreed that trust would be higher
563 if the strength of the claims was communicated using visual aids rather than without (Hooker
564 & Teratanavat, 2008; Kapsak et al., 2008) (theme 29).

565

566 *It is not reading Omega-3 on the label that is going to make me see that it*
567 *is something that is good for my health... I don't believe this much...*

568

569 It was also interesting to observe that while the majority of participants felt that claims
570 displaying *“This health claim has been approved by EFSA after substantiated scientific*

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

571 *evidence*” generate a sense of trust towards the properties of the product. , few participants had
572 the opposite feeling.

573

574 *For a new product with a claim I don't know, a reference to the European*
575 *Safety Authority would be an added guarantee.*

576

577 However, a few participants showed a lack of trust towards EFSA especially males who
578 stated being sceptical on reinforcing the strength of scientific evidence with a sentence
579 emphasizing EFSA approval. Some of these participants perceived this type of reinforcement
580 more suitable for a medicinal product approved by a board of medical doctors.

581

582 **Conclusions**

583 In this study, four focus groups were conducted to explore consumers' acceptance of
584 new functional fish burgers and thus findings are not conclusive, and follow-up studies based
585 on larger and representative samples should be conducted to validate consumers' acceptance
586 of these new products. Furthermore, this study provides insights regarding the development
587 of new functional fish products, consumer understanding of nutrition and health claims and
588 for future research, but the study also confirms findings of past studies thanks to the detailed
589 semi-structured focus group research protocol.

590 The study confirms that, in general, fish is widely perceived by consumers as a
591 healthy and tasty food but barriers such as perceived high prices, lack of convenience, lack of
592 knowledge about fish and cooking skills and lack of fish availability limit its consumption.

593 However, in relation to fish burgers the study revealed that most participants showed a
594 positive attitude towards fish burgers because of convenience, the desire of varying fish
595 consumption and the presence of children. Frozen fish burgers were preferred over the
596 alternative fresh product because of convenience and ready availability. These findings as

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

597 well as being interesting to marketers in terms of developing targeted marketing campaigns
598 on aspects mentioned above, they also inform food processors about attributes to consider for
599 product development. Product attributes such as species of fish, type of functional ingredient,
600 freshness and safety, country of origin, price and brands were all considered important by
601 participants. Positive consumer acceptance of functional fish burgers emerging from this
602 qualitative study is also interesting because it should invite food processors and policy
603 makers to think about market opportunities to reduce the post-harvest losses of by-products
604 of the fish industry (FAO, 2016). It is well-known that the fish industry generates large
605 quantities of by-products that contain proteins and lipids which could be a source of nutrients
606 for humans and therefore used in the development of functional fish products designed for
607 human consumption (Tahergorabi, Matak & Jaczynski, 2015).

608 Consumer acceptance of fish burgers can be facilitated by the use of appropriate
609 extrinsic cues conveyed by labels. Labelling is important because consumers seem to be
610 extremely interested in being informed about the species and geographical origin of fish used
611 for making fish burgers. In particular, participants were attracted by fish burgers which could
612 be made using salmon and cod preferably produced domestically because considered of
613 superior quality and safer in comparison to imported fish. The idea of producing functional
614 fish burgers seems to be well appreciated by most participants if the functional ingredient is
615 already naturally present in the fish. Specifically, the most preferred functional ingredient for
616 enriching fish burgers was Omega-3 because it is already naturally contained in fish contrary
617 to other functional foods like milk or yogurt. Furthermore, although consumer knowledge of
618 Omega-3 health effects is limited, participants' familiarity with this functional ingredient
619 considerably affects the acceptance of functional fish burgers because it is believed to
620 improve human health and well-being preventing cardiovascular diseases. However, some
621 participants were concerned about the Omega-3 enrichment effects on the taste of fish

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

622 burgers and were uncertain whether they consumed enough Omega-3. Thus food companies
623 should clearly indicate the recommended daily intake of functional ingredients. Regarding
624 risk perception, the food industry could take into account that participants seemed to be more
625 willing to consume fish burgers fortified with Omega-3 in order to improve their well-being
626 and decrease their risk of getting cardiovascular diseases rather than achieving therapeutic
627 effects.

628 The relatively low price of fish burgers in comparison to more conventional fish
629 products was another attribute positively stimulating consumers' acceptance. Brands can
630 transmit and ensure product quality to consumers, but food companies with a long-standing
631 brand seem to be more trusted than companies that do not have this long market relationship
632 with consumers. The use of nutrition and health claims could add value to brands but their
633 use should be evaluated carefully because participants found it challenging to interpret
634 information conveyed by qualifiers.

635 To qualify the claim of a food products means limiting the property or content of a
636 certain attribute using words like "with" or "contain" or "high" and so on. These words are
637 qualifiers that differentiate a claim from concepts such as "all" or "always". Results indicate
638 that when nutritional claims use strong qualifiers such as "*high*" and "*rich*" in Omega-3 these
639 are better received than weak qualifiers such as "*source of*", "*contains*" and "*with*" Omega-
640 3. In other words one might think that these qualifiers are sort of quantifiers because they give
641 the idea that "high" is more than "contain" and "rich" is more than "high". However, to what
642 extent qualifiers quantify a particular product attribute is difficult to say because they act like
643 an ordinal scale where the magnitude between two points is not exactly quantifiable.

644 Concerning health claims, participants appeared to prefer those conveying general
645 health benefits (e.g. cholesterol reduction) in comparison to claims containing too much
646 specific information on the risk reduction of cardiovascular diseases. Moreover, many

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

647 participants preferred a combination of a short nutritional claim on the front of the package
648 and a full health claim on the back. Trust towards health claims seems generally to be higher
649 when the strength of the claims is substantiated by EFSA and is communicated using visual
650 aids rather than words. Thus, while these results confirm that the strength of qualifiers, the
651 structure of the language and visual aids play an important role in the communication of
652 nutritional and health claims, European legislators find it difficult to provide sufficient
653 guidance on how these different aspects can be used to support the communication of
654 scientific substantiated health claims to consumers (Richardson, 2012). Probably this
655 difficulty lies in the complexity of health claims because from an economic point of view
656 they are information remedies used by the legislator to tackle problems of market failure,
657 while from a linguistic point of view they are complex discursive acts involving both
658 semantic and pragmatic dimensions (Jones, 2014a). Information conveyed by health claims is
659 further complicated by the fact that the communication of claims usually involves modes
660 other than language such as images, font, layout, colour and the texture of packaging material
661 (Jones, 2014b), which requires looking at claims from an information design perspective.

662 So far there is a surprising lack of multidisciplinary research aimed at evaluating how
663 these dimensions interact and influence consumers when they process information conveyed
664 by health claims. The work of the legislator should be supported definitively and urgently by
665 interdisciplinary research involving disciplines such as economics, food science, linguistics,
666 nutrition and typography. This is because qualified health claims are relevant not only to the
667 diversity of European countries but also to other countries because they demonstrate language
668 and communication strategies that may or may not help consumers make informed decisions
669 (Berhaupt-Glickstein et al., 2014).

670

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

671 Finally, the findings of this study should be supported by studies where sensorial
672 analysis is taken into account. A recent study conducted by Branciari et al. (2017) highlights
673 the importance of this aspect when investigating the nutritional profile of fish burgers via
674 sensorial analysis. In their study, they found that that the species used to make fish burgers
675 such as carp, goldfish, perch, and tench influence the overall liking and taste of these products
676 and as a consequence consumers acceptance and their purchasing intention. However, the idea
677 of developing these new functional fish products should be supported by research which
678 simultaneously evaluates both intrinsic (sensory) and extrinsic factors (brand, price, health
679 claims etc.) of new functional food. This type of approach has been growing fast during the
680 last ten years and several researchers have been employing so called alternative descriptive
681 methods or rapid methods to obtain more complete and realistic information about consumer
682 behaviour in real life buying and eating situations (Asioli et al., 2017). New methodologies like
683 projective mapping, check-all-that-apply and flash profiling are less time-consuming than
684 classic descriptive methods (conjoint hedonic methods and classic hedonic testing), more
685 flexible, and can be performed by both trained and non-trained assessors (Varela & Ares,
686 2012). By properly incorporating consumers` voices in research and development activities can
687 reduce the high rate of failure of new functional food products, but more effort is required on
688 behalf of researchers and the food industry in terms of investment and a more open minded
689 approach to tackle the interdisciplinary challenge of putting together a large number of
690 disciplines such as biology, consumer science, economics, food science, linguistics, marketing,
691 physiology, psychology, sociology, sensory, and typography.

692

693

694

695

696

References

697 Asioli, D., Varela, P, Hersleth, M., Lengard Almli, V., Veflen Olsen, N. and Næs. T.(2017).

698 A discussion of recent methodologies for combining sensory and extrinsic product
699 properties in consumer studies. *Food Qual and Prefe*, 56: 266-73

700 Altintzoglou, T., Einarsdottir, G., Valsdottir, T., Schelvis, R., Skå ra, T., & Luten, J. 2010. A

701 voice-of-consumer approach in development of new seafood product concepts. *J.*

702 *Aquat. Food Prod. T.* 19(2): 130-145.

703 Altintzoglou, T., Sveinsdottir, K., Einarsdottir, G., Schelvis, R., & Luten, J. B. 2012.

704 Evaluation of Seafood Product Concepts by Young Adults and Families with Young

705 Children from Denmark, Norway, and Iceland. *J. Aquat. Food Prod. T.* 21(5): 418-432.

706 Altintzoglou, T., & Heide, M. 2016. Fish Quality and Consumers: How Do Consumers’

707 Knowledge About and Involvement in Fish Quality Define Factors That Influence Fish

708 Buying Behavior *J. Aquat. Food Prod. T.* 25(6): 885-894.

709 Annunziata, A., & Vecchio, R. 2011. Functional foods development in the European market:

710 A consumer perspective. *J. Funct. Foods.* 3(3): 223-228.

711 Ares, G., Giménez, A., & Gámbaro, A. 2008. Influence of nutritional knowledge on perceived

712 healthiness and willingness to try functional foods. *Appetite*, 51:663–668.

713 Bech-Larsen, T., & Grunert, K. G. 2003. The perceived healthiness of functional foods: A

714 conjoint study of Danish, Finnish and American consumers’ perception of functional

715 foods. *Appetite.* 40: 9–14.

716 Berhaupt-Glickstein, A., Nucci, M. N., Hooker, N. H., Hallman, W. K. 2014. The evolution of

717 language complexity in qualified health claims. *Food Policy.* 47: 62-70.

718 Birch, D., & Lawley, M. 2012. Buying seafood: understanding barriers to purchase across

719 consumption segments. *Food Qual. Prefer.* 26(1): 12-21.

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

- 720 Birch, D., & Lawley, M. 2014. The role of habit, childhood consumption, familiarity and
721 attitudes across seafood consumption segments in Australia. *J. Food Prod. Market.*
722 20(1): 98–113.
- 723 Bleiel, J. 2010. Functional foods from the perspective of the consumer: How to make it a
724 success? *Int. Dairy J.* 20(4): 303-306.
- 725 Bochi, V. C., Weber, J., Ribeiro, C. P., Victório, A. D. M., & Emanuelli, T. 2008. Fishburgers
726 with silver catfish (*Rhamdia quelen*) filleting residue. *Bioresource Technol.* 99(18):
727 8844-8849.
- 728 Branciarri, R., Ranucci, D., Urbani, E., Valiani, A., Trabalza-Marinucci, M., Bosco, A. D., &
729 Franceschini, R. 2016. Freshwater fish burgers made from four different fish species as
730 a valuable strategy appreciated by consumers for introducing EPA and DHA into a
731 human diet. *J. Aquat. Food Prod. T.* (In Press).
- 732 Braun, V., & Clarke, V. 2006. Using thematic analysis in psychology. *Qual. Res. Psychol.* 3:
733 77 – 101.
- 734 Brunsø, K., Verbeke, W., Olsen, S. O., & Jeppesen, L. F. 2009. Motives, barriers and quality
735 evaluation in fish consumption situations. Exploring and comparing heavy and light
736 users in Spain and Belgium. *Brit. Food J.* 111(7): 699–716.
- 737 Burger, J., & Gochfeld, M. 2009. Perceptions of the risks and benefits of fish consumption:
738 Individual choices to reduce risk and increase health benefits. *Environmental research,*
739 109(3), 343-349.
- 740 Carlucci, D., Nocella, G., De Devitiis, B., Viscecchia, R., Bimbo, F., & Nardone, G. 2015.
741 Consumer purchasing behaviour towards fish and seafood products. Patterns and
742 insights from a sample of international studies. *Appetite.* 84: 212-227.
- 743 Claret, A., Guerrero, L., Aguirre, E., Rincón, L., Hernández, M. D., Martínez, I., ... &
744 Rodríguez-Rodríguez, C. (2012). Consumer preferences for sea fish using conjoint

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

- 745 analysis: Exploratory study of the importance of country of origin, obtaining method,
746 storage conditions and purchasing price. *Food Quality and Preference*, 26(2), 259-266.
- 747 Cox, D. N., Evans, G., & Lease, H. J. 2011. The influence of product attributes, consumer
748 attitudes and characteristics on the acceptance of: (1) Novel bread and milk, and dietary
749 supplements and (2) fish and novel meats as dietary vehicles of long chain omega 3
750 fatty acids. *Food Qual. Prefer.* 22: 205–212.
- 751 Cox, D. N., Koster, A., & Russell, C. G. 2004. Predicting intentions to consume functional
752 foods and supplements to offset memory loss using an adaptation of protection
753 motivation theory. *Appetite*. 33: 55–64.
- 754 Debucquet, J. C., Cornet, J., Adam, I., & Cardinal, M. 2012. Perception of oyster-based
755 products by French consumers. The effect of processing and role of social
756 representations. *Appetite*. 59(3): 844–852.
- 757 de Quadros, D. A., de Oliveira Rocha, I. F., Ferreira, S. M. R., & Bolini, H. M. A. 2015. Low-
758 sodium fish burgers: Sensory profile and drivers of liking. *LWT- Food Sci. Technol.*
759 63(1): 236-242.
- 760 .Di Monaco, R., Cavella, S., Masi, P., Sevi, A., Caroprese, M., Marzano, A., ... & Del Nobile,
761 M. A. 2009. Blue fish burgers: nutritional characterisation and sensory optimisation.
762 *Int. J. Food Sci. Tech.* 44(8): 1634-1641.
- 763 FAO/WHO 2011. *Report of the joint FAO/WHO expert consultation on the risks and benefits*
764 *of fish consumption*. Rome, Geneva: Food and Agriculture Organization of the United
765 Nations, World Health Organization.
- 766 FAO (2016). Fisheries and Aquaculture topics. Utilization and trade. Topics Fact Sheets. In:
767 FAO Fisheries and Aquaculture Department. Available online at:
768 http://www.fao.org/fishery/utilization_trade/en

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

- 769 Gilbert, L. 2000. The functional food trend: What is next and what Americans think about eggs.
770 J. Am. Coll. Nutr. 19: 507S–512S.
- 771 Granato, D., Branco, G. F., Cruz, G., Faria, J. F., Shah, N. P. 2010. Probiotic Dairy Products
772 as Functional Foods. Compr. Rev. Food Sci. F. 9: 455–470.
- 773 Griffiths J.C., Abernethy D.R., Schuber S. and Williams R.L. 2009. Functional food ingredient
774 quality: Opportunities to improve public health by compendial standardization. J.
775 Funct. Foods. 1: 128–130.
- 776 Grunert, K. G. 2010. European consumers' acceptance of functional foods. Ann. Ny. Acad. Sci.
777 1190:166-73.
- 778 Haq, M., Dutta, P. L., Sultana, N., & Rahman, M. A. 2013. Production and quality assessment
779 of fish burger from the grass carp, *Ctenopharyngodon idella* (Cuvier and Valenciennes,
780 1844). J.F. 1(1), 42-47.
- 781 Hailu, G., Boecker, A., Henson, S., & Cranfield, J. 2009. Consumer valuation of functional
782 foods and nutraceuticals in Canada. A conjoint study using probiotics. Appetite, 52:
783 257–265.
- 784 Hooker, N. H., & Teratanavat, R. 2008. Dissecting qualified health claims: evidence from
785 experimental studies. Crit. Rev. Food Sci. Nutr. 48: 160–176.
- 786 Jones, R. (2014a). Unwriting food labels: Discursive challenges in the regulation of package
787 claims. Journal of Business and Technical Communication, 28 (4): 1-32.
- 788 Jones, R. (2014b) The multimodal dimension of claims in food packaging. Multimodal
789 Communication, 3 (1): 1-10.
- 790 Kapsak, W. R., Schmidt, D., Childs, N. M., Meunier, J., & White, C. 2008. Consumer
791 perceptions of graded, graphic and text label presentations for qualified health claims.
792 Crit. Rev. Food Sci. Nutr.. 48: 248–256.

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

- 793 Kaushik, A. K., & Rahman, Z. 2014. Perspectives and dimensions of consumer innovativeness:
794 A literature review and future agenda. *Journal of International Consumer Marketing*,
795 26(3), 239-263.
- 796 Kearney, J. 2010. Food consumption trends and drivers *Philos. Trans. R. Soc. Lond., B, Biol.*
797 *Sci.* 365, 2793–2807.
- 798 Kotilainen, L., Rajalahti, R., Ragasa, C., & Pehu, E. 200). Health enhancing foods:
799 Opportunities for strengthening the sector in developing countries. Discussion Paper
800 30. Washington, DC: World Bank.
- 801 Krueger, R. A., & Casey M. A. 2014. Focus groups. A practical guide for applied research.
802 Sage, London.
- 803 Krutulyte, R., Grunert, K. G., Scholderer, J., Lähteenmäki, L., Hagemann, K. S., Elgaard, P.,
804 Nielsen, B., & Graverholt, J. P. 2011. Perceived fit of different combinations of carriers
805 and functional ingredients and its effect on purchase intention. *Food Qual. Prefer.* 22:
806 11–16.
- 807 Krutulyte, R., Scholderer, J., Hagemann, K., Grunert, G. K., Elgaard, P., Nielsen, B., &
808 Graverholt, J.P. 2008. Motivational factors for consuming omega-3 PUFAs: An
809 exploratory study with Danish consumers. *Appetite.* 51: 137–147.
- 810 Lalor, F., Madden, C., McKenzie, K., & Wall, P. G. 2011. Health claims on foodstuffs: a focus
811 group study of consumer attitudes. *J. Funct. Foods.* 3: 56–59.
- 812 Lampila, P., Van Lieshout, M., Gremmen, B., & Lahteenmaki, L. 2009. Consumer attitudes
813 towards enhanced flavonoid content in fruit. *Food Res. Int.* 42: 122–129.
- 814 Leathwood, P. D., Richardson, D. P., Sträter, P., Todd, P. M., & van Trijp, C. M. 2007.
815 Consumer understanding of nutrition and health claims: source of evidence. *Br. J. Nutr.*
816 98: 474-484.

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

- 817 Loose, S. M., Peschel, A., & Grebitus, C. 2012. Quantifying effects of convenience and product
818 packaging on consumer preferences and market share of seafood products. The case of
819 oysters. *Food Qual. Prefer.* 28(2): 492–504.
- 820 Lyly, M., Roininen, K., Honkapaa, K., Poutanen, K., & Lahteenmaki, L. 2007. Factors
821 influencing consumers' willingness to use beverages and ready-to-eat frozen soups
822 containing oat β -glucan in Finland, France and Sweden. *Food Qual. Prefer.* 18: 242–
823 255.
- 824 Mahmoudzadeh, M. A. R. Y. A. M., Motallebi, A. A., Hosseini, H. E. D. A. Y. A. T., Haratian,
825 P., Ahmadi, H. A. M. E. D., Mohammadi, M. E. H. R. D. A. D., & Khaksar, R. 2010.
826 Quality assessment of fish burgers from deep flounder (*Pseudorhombus elevatus*) and
827 brushtooth lizardfish (*Saurida undosquamis*) during storage at-18°C. *Iran. J. Fish.*
828 *Sci.*9(1): 111-126.
- 829 Mariotti, F., Kalonji, E., Huneau, J. F., & Margaritis, I. 2010. Potential pitfalls of health claims
830 from a public health nutrition perspective. *Nutr. Rev.* 68: 624– 638.
- 831 Martínez-González, M. A., Holgado, B., Gibney, M., Kearney, J., & Martinez, J. A. 2000.
832 Definitions of healthy eating in Spain as compared to other European Member States.
833 *Eur. J. Epidemiol.* 16(6): 557-564.
- 834 Matak, K. E., Tahergorabi, R. & Jaczynski, J. 2015. A review: Protein isolates recovered by
835 isoelectric solubilization/precipitation processing from muscle food by-products as a
836 component of nutraceutical foods. *Food Res. Int.* 77: 697-703.
- 837 Menrad, K. 2003. Market and marketing of functional food in Europe. *J. Food Eng.* 56: 181-
838 188.
- 839 Milner J.A., 2000 Functional foods: The US perspective, *Am. J. Clin. Nutr.* 71: 1654S–1659S
- 840 Morgan, D. L. 1998. Focus groups as qualitative research. Beverly Hills: Sage Publications.

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

- 841 Neale, E. P., Nolan-Clark, D., Probst, Y. C., Batterham, M. J., & Tapsell, L. C. 2012.
842 Comparing attitudes to fish consumption between clinical trial participants and non-
843 trial individuals. *Nutr. Diet.* 69(2): 124-129.
- 844 Nocella, G., & Kennedy, O. 2012. Food health claims: What consumers understand? *Food*
845 *Policy.* 37: 571–580.
- 846 O'Brien, G. M., Stewart-Knox, B. J., McKinley, A., de Almeida, M. D. V., & Gibney, M. J.
847 2012. Perceived risk of metabolic syndrome and attitudes towards fat-modified food
848 concepts among European consumers. *Food Qual. Prefer.* 23: 79–85.
- 849 Olsen, S. O. 2004. Antecedents of seafood consumption behavior: An overview. *J. Aq. Food*
850 *Prod. Technol.* 13(3): 79-91.
- 851 Olsen, S. O., Scholderer, J., Brunsø, K., & Verbeke, W. 2007. Exploring the relationship
852 between convenience and fish consumption. A cross-cultural study. *Appetite.* 49(1):
853 84–91.
- 854 Olsen, S. O., Tudoran, A. A., Honkanen, P., & Verplanken, B. (2016). Differences and
855 Similarities between Impulse Buying and Variety Seeking: A Personality- based
856 Perspective. *Psychology & Marketing*, 33(1), 36-47.
- 857 Pieniak, Z., Verbeke, W., & Scholderer, J. 2010. Health-related beliefs and consumer
858 knowledge as determinants of fish consumption. *J. Hum. Nutr. Diet.* 23(5): 480-488.
- 859 Pieniak, Z., Verbeke, W., Scholderer, J., Brunsø, K., & Olsen, S. O. 2007. European
860 consumers' use of and trust in information sources about fish. *Food Qual. Prefer.* 18(8):
861 1050-1063.
- 862 Pothoulaki, M., & Chryssochoidis, G. 2009. Health claims: Consumers' matters. *J. Funct.*
863 *Foods.* 1(2): 222-228.
- 864 Powell, R. A., & Single, H. M. 1996. Focus groups. *Int. J. Qual. Health Care.* 8 (5): 499-504.

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

- 865 Research and Markets 2014. Global Functional Food and Nutraceuticals Market (2014 - 2020)
866 - By Type (Foods, Beverages, Supplements); Benefits (Health and Wellness, Disease
867 Prevention, Fitness, Beauty); Origin & Ingredient.
- 868 Richardson, D. P. (2012). Preparing dossiers: Strength of the evidence and problems of proof,
869 Proceedings of the Nutrition Society. 71, 127–140.
- 870 Roe, B., Levy, A. S., & Deby, B. M. 1999. The impact of health claims on consumer search
871 and product evaluation outcomes: Results from FDA experimental data. J.P.P.&M.
872 18(1): 89–105.
- 873 Rortveit, A. W., & Olsen, S. O. 2007. The role of consideration set size in explaining fish
874 consumption. *Appetite*, 49(1), 214-222.
- 875 Rortveit, A. W., & Olsen, S. O. 2009. Combining the role of convenience and consideration
876 set size in explaining fish consumption in Norway. *Appetite*. 52(2): 313-317.
- 877 Siegrist, M., Stampfli, N., Kastenholz, H. 2008. Consumers' willingness to buy functional
878 foods. The influence of carrier, benefit and trust. *Appetite*. 51: 526–529.
- 879 Siegrist, M., Hartmann, C., & Keller, C. (2013). Antecedents of food neophobia and its
880 association with eating behavior and food choices. *Food Quality and Preference*, 30(2),
881 293-298.
- 882 Sirò, I., Kápolna, E., Kápolna, B., Lugasi, A. 2008. Functional food. Product development,
883 marketing and consumer acceptance. A review. *Appetite*. 51: 456–467.
- 884 Tahergorabi, R., Matak, K. E., & Jaczynski, J. 2015. Fish protein isolate: Development of
885 functional foods with nutraceutical ingredients. *J Funct Foods*. 18: 746-756.
- 886 Taşkaya, L., Cakli, S., Kişla, D., & Kilinc, B. 2003. Quality changes of fish burger from
887 rainbow trout during refrigerated storage. *J Fish Aquat Sci*. 20, 147-154.
- 888 Tudoran, A., Olsen, S. O., & Dopico, D. 2009. The effect of health benefit information on
889 consumers health value, attitudes and intentions. *Appetite*. 52(3), 568-579.

INSIGHTS FOR NEW FUNCTIONAL FISH PRODUCTS

- 890 Tuorila, H., & Cardello, A. V. 2002. Consumer response to an off-flavor in juice in the presence
891 of specific health claims. *Food Qual. Prefer.* 13, 561–569.
- 892 Urala, N., & Lähteenmäki, L. 2003. Reasons behind consumers' functional food choices. *Nutr.*
893 *Food Sci.* 33, 148–158.
- 894 Varela, P., & Ares, G. (2012). Sensory profiling, the blurred line between sensory and
895 consumer science. A review of novel methods for product characterization. *Food*
896 *Research International.* 48, 2: 893–908.
- 897 Verbeke, W., Sioen, I., Pieniak, Z., Van Camp, J., & De Henauw, S. 2005. Consumer
898 perception versus scientific evidence about health benefits and safety risks from fish
899 consumption. *Public health nutrition*, 8(4), 422-429.
- 900 Verbeke, W. 2006. Functional foods: Consumer willingness to compromise on taste for health?
901 *Food Qual. Prefer.* 17, 126–131.
- 902 Verbeke, W., & Vackier, I. 2005. Individual determinants of fish consumption: application of
903 the theory of planned behaviour. *Appetite.* 44(1), 67-82.
- 904 Verbeke, W., Frewer, L. J., Scholderer, J., & De Brabander, H. F. 2007. Why consumers
905 behave as they do with respect to food safety and risk information. *Analytica Chimica*
906 *Acta*, 586(1), 2-7. Verbeke, W., Vermeir, I., & Brunsø, K. 2007. Consumer evaluation
907 of fish quality as basis for fish market segmentation. *Food quality and preference*, 18(4),
908 651-661.
- 909 Wansink, B., Westgren, R. E., & Cheney, M. M. 2005. Hierarchy of nutritional knowledge that
910 relates to the consumption of a functional food. *Nutrition.* 21, 264–268.
- 911 Williams, P. G. 2005. Consumer understanding and use of health claims for foods. *Nutr. Rev.*
912 63, 256–264.

913

Footnotes

- 914 1. The selection of these functional ingredients was previously discussed with academic experts in food
915 technology and dietetics.