What do consumers think about aquaculture fish and the products made from it?

What we know...

Aquaculture supply approximately 50% of global food fish production compared with just 9% in 1980s
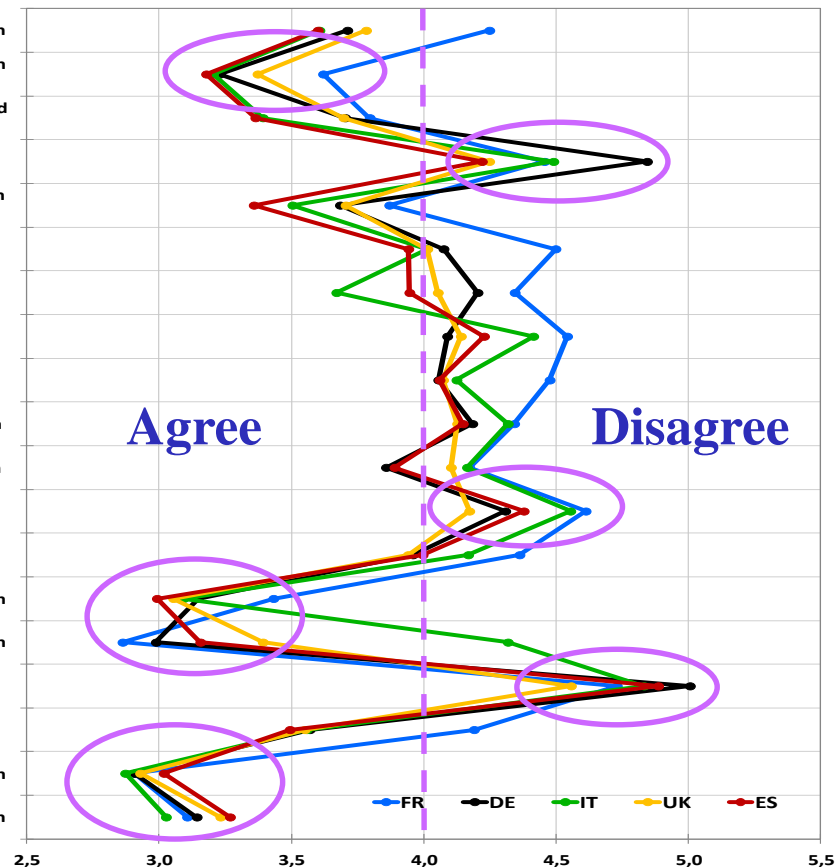
Aquaculture is still far from its full potential development since European aquaculture production represent about 20% of the total fish production

European consumers perceive farmed fish as being of lower general quality than wild fish
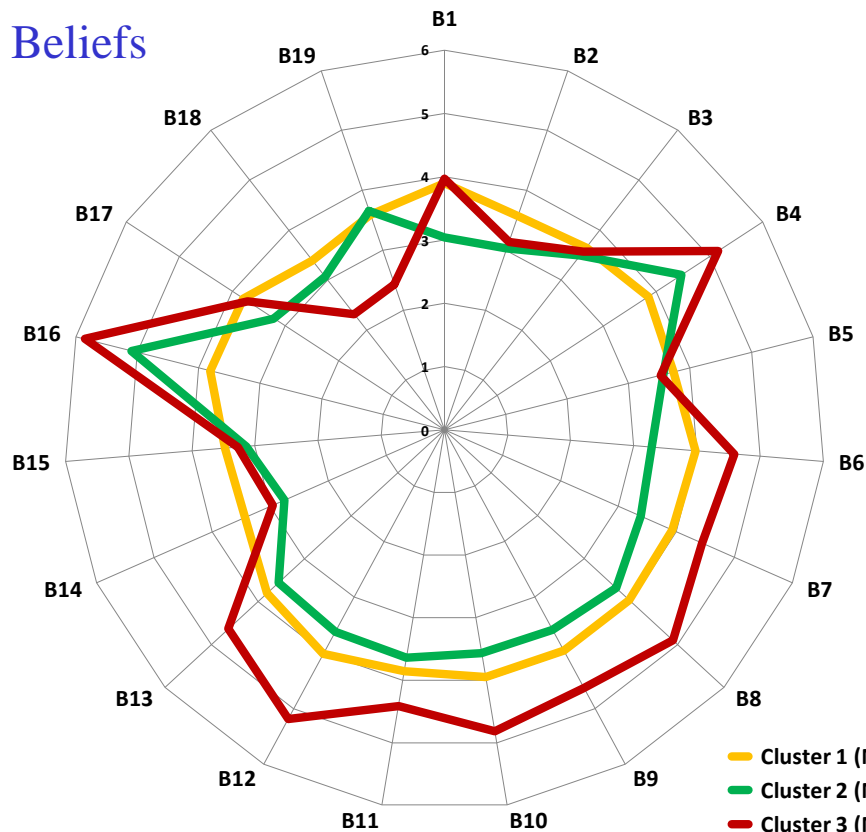
What we know...

What we know...

Beliefs

Cluster 1 "Neutral":

< 40 years

Cluster 2 "Pro-farmed fish"

Cluster 3 "Pro-wild fish"

> 50 years

Cluster 1 (N=1151)
Cluster 2 (N=391)
Cluster 3 (N=969)

Should we worry?

The Spanish case:

- 2008 vs. 2014 vs. 2016

- Low effectiveness

Aquaculture

Does information affect consumer liking of farmed and wild fish?

Anna Claret [a], Luis Guerrero [a,*], Irene Gartzia [b], Maruxa Garcia-Quiroga [b], Rafael Ginés [c]

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Overall liking of wild and farmed fish in the blind and informed conditions.

	Overall liking		RMSE	p Value
	Wild fish	Farmed fish		
Informed condition	7.4	6.7	1.803	<0.0001
Blind condition	6.3	6.7	2.095	<0.0001
RMSE	2.003	1.950		
p Value	<0.0001	0.957		

Does information affect consumer liking of farmed and wild fish?

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Efforts should be more oriented towards an improvement of the image of farmed fish than towards an enhancement of the sensory properties

What we know...

The relative low market share of aquaculture can also be a direct consequence of the <u>poor variety</u> of aquaculture products in the market, and in particular because of the <u>lack of processed aquaculture foodstuffs</u>

Variety has been identified as a relevant factor in order to stimulate consumers' purchase, thus avoiding boredom and satisfying individual curiosity

Diversification: new species and new products, DIVERSIFY (high risk!!)

Objective:

To assess consumer perception of new products from new farmed species in the five countries investigated (i.e., Germany, France, United Kingdom, Italy and Spain)

New product development

Selected descriptors used for the final descriptive profile along with their description.

Attributes	Description
Appearance	
Color intensity	Color intensity from white to light brown inside the flesh of the fish
Color uniformity	Color homogeneity inside the flesh of the fish without black veins or spots
Exudate quantity	Quantity of liquid released after cooking the sample
Fat droplets	Fat released in fish exudate in the form of oil droplets
Laminar structure	Visual distinction of muscular structures when removing the skin of the fish
Turbidity of exudate	Suspended particles in exudate that block transparency
Odor	
Butter	Intensity of odor like butanedione
Earthy	Intensity of odor like humid earth
Sardine	Intensity of odor like fish oil
Sea food	Intensity of characteristic odor
Flavor	
Sour	Flavor like citric acid
Boiled vegetable	Flavor like cooked vegetable
Butter	Flavor intensity like butanedione
Bitter	Flavor like quinine
Earthy	Flavor like humid earth
Sea food	Flavor like seafood
Texture	
Chewiness	Number of chews before swallowing
Crumbliness	Degree of fish disintegration in the first bite
Firmness	Force required to deform the fillet between the tongue and palate
Juiciness	Liquid released when chewing the fish sample
Pastiness	Degree in which fish turns in to a paste after chewing
Teeth adherence	Degree in which fish sticks between molars
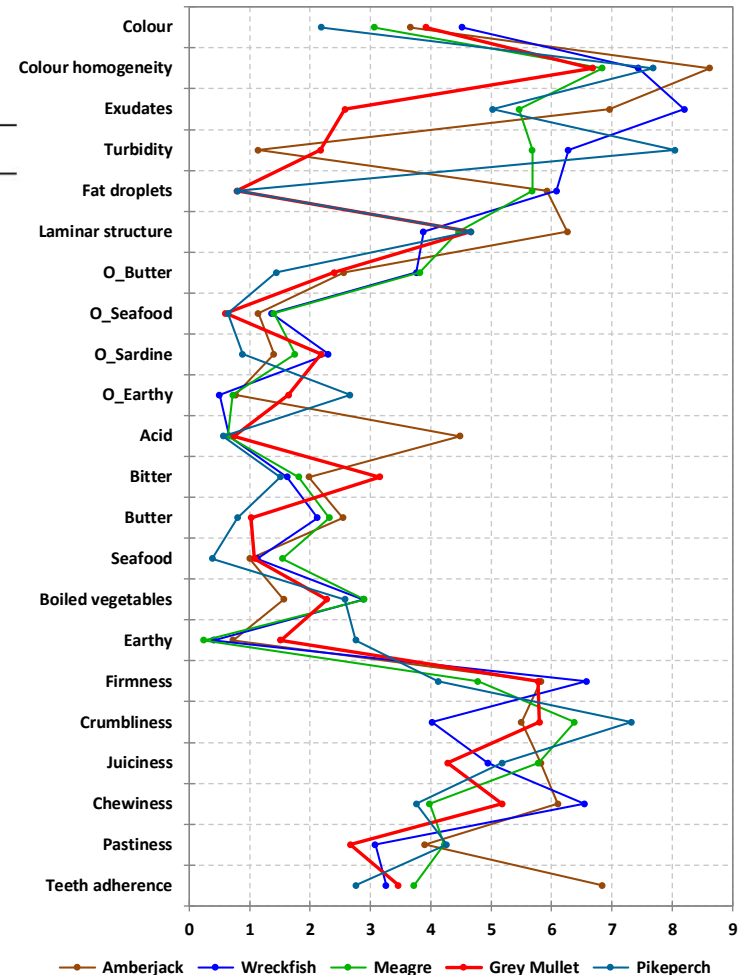
New product development
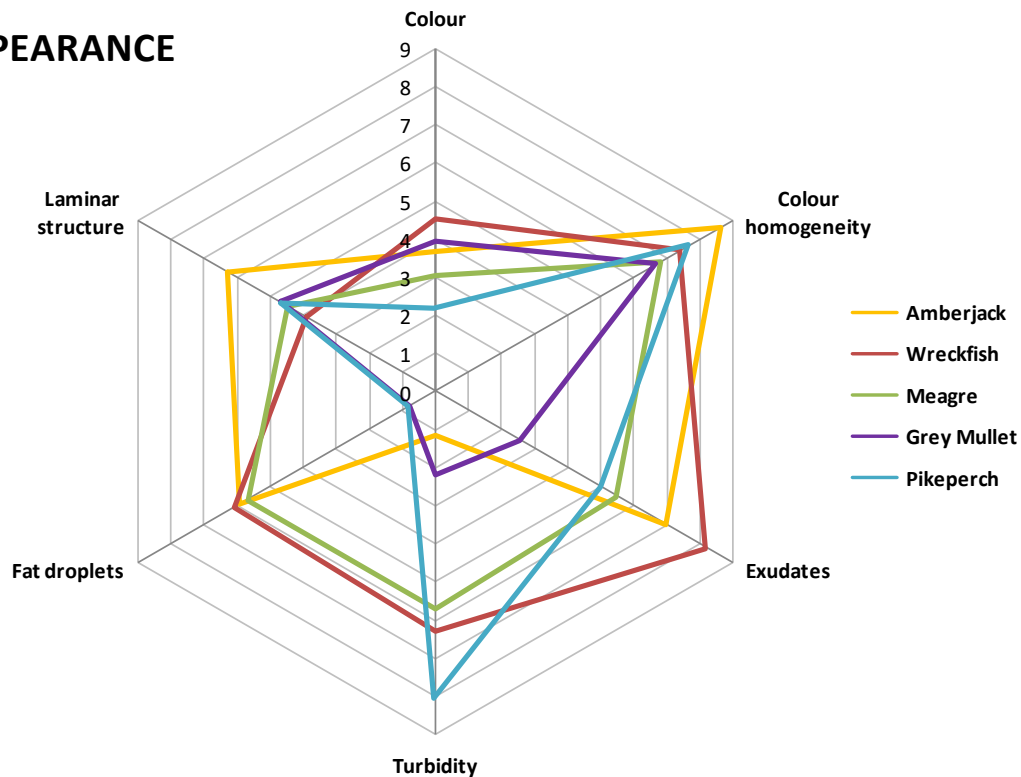
Sensory properties

New product development

Sensory properties

ODOUR radar chart with axes: Butter (top), Seafood (right), Sardine (bottom), Earthy (left), scale 0 to 4. Series: Amberjack, Wreckfish, Meagre, Grey Mullet, Pikeperch.
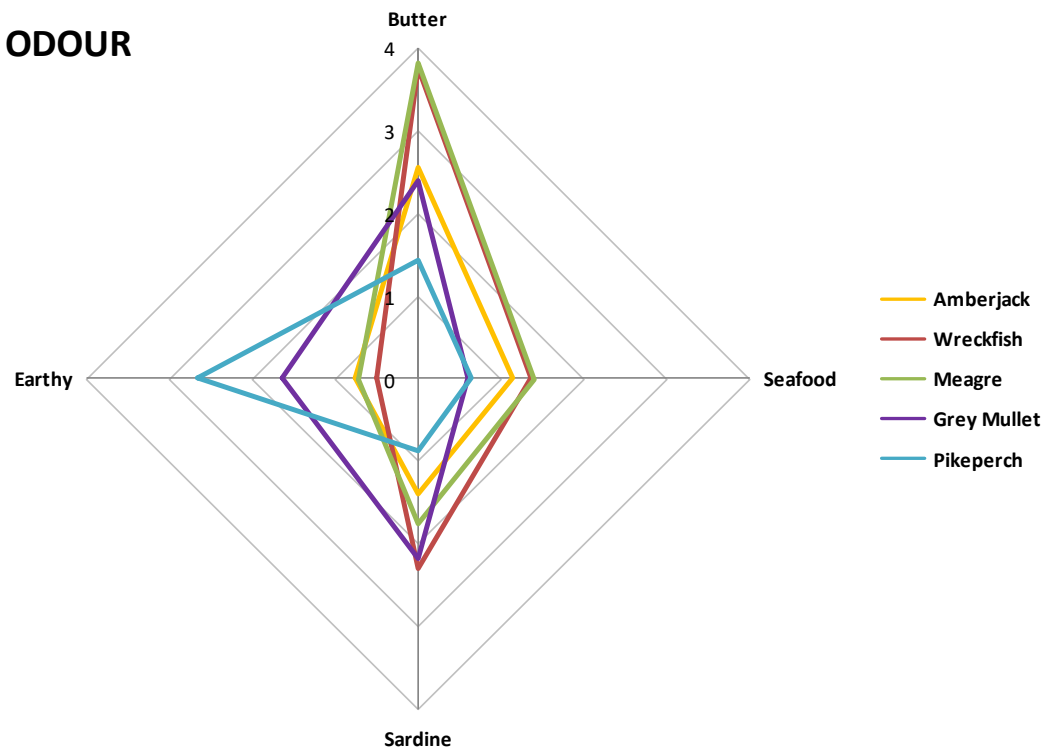
New product development

Sensory properties

FLAVOUR

Radar chart axes: Acid, Bitter, Butter, Seafood, Boiled vegetables, Earthy (scale 0–5)

Legend:
- Amberjack
- Wreckfish
- Meagre
- Grey Mullet
- Pikeperch

New product development

Sensory properties

TEXTURE

Firmness · Crumbliness · Juiciness · Chewiness · Pastiness · Teeth adherence

Legend:
- Amberjack
- Wreckfish
- Meagre
- Grey Mullet
- Pikeperch
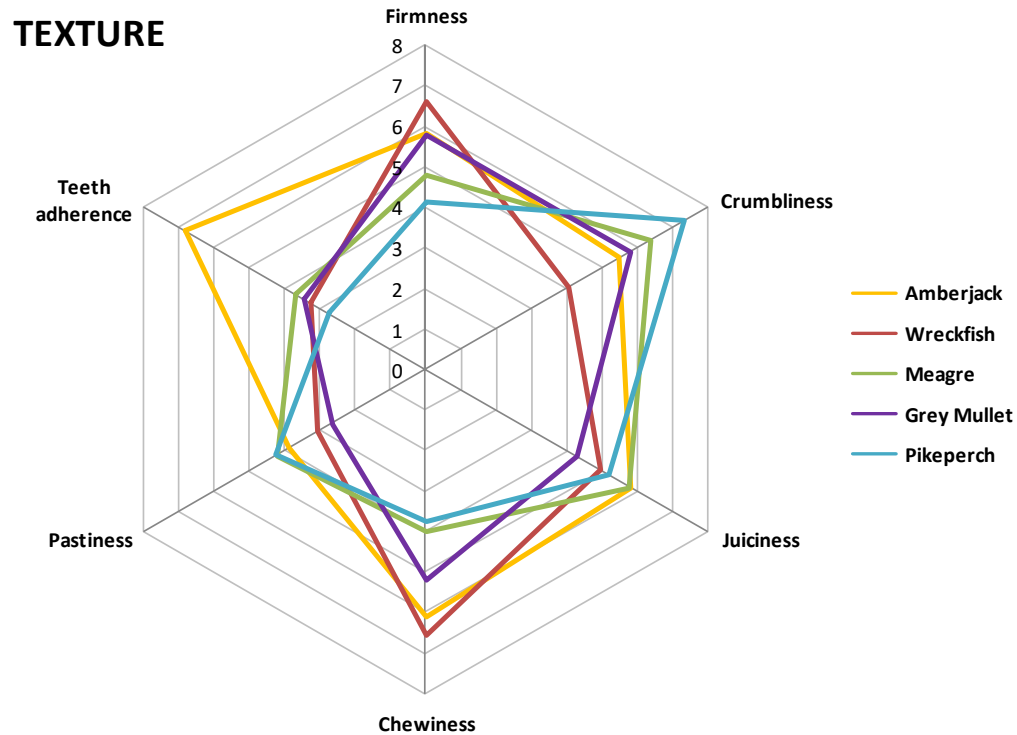
New product development

Selected ideas for NPD

Based on <u>technical feasibility</u> and the <u>opinion of experts</u> (19 factors: Nutritional benefit, Healthiness, Convenience in preparation (easy-to-cook), Convenience in consumption (ready-to-eat), Cost for consumer (price), Technical feasibility (equipment & raw material), Technical feasibility (know-how), Specific consumer targeting, Familiarity, Newness/ innovativeness, Existence of similar/competitive products, Shares characteristics of successful products, Perceived consumer freshness, Safety, Shelf life, Packaging, Added value, Attractiveness (Appearance/ presentation), Recipes)

Species	Growth rate	Fillet Size	Yield	Firmness	Fat content	Flavor
Grey Mullet	Slow	300-500g	Low	High	Medium/high	Bitter
Meagre	Fast	1-2kg	Medium	Medium	Low	Mild
Greater Amberjack	Fast	3-5kg	High	Medium	High	Sour
Wreckfish	Fast	>8kg	High	High	Low	Neutral
Pikeperch	Medium	1-2kg	Medium	Low	Low	Earthy

New product development

Selected ideas for NPD
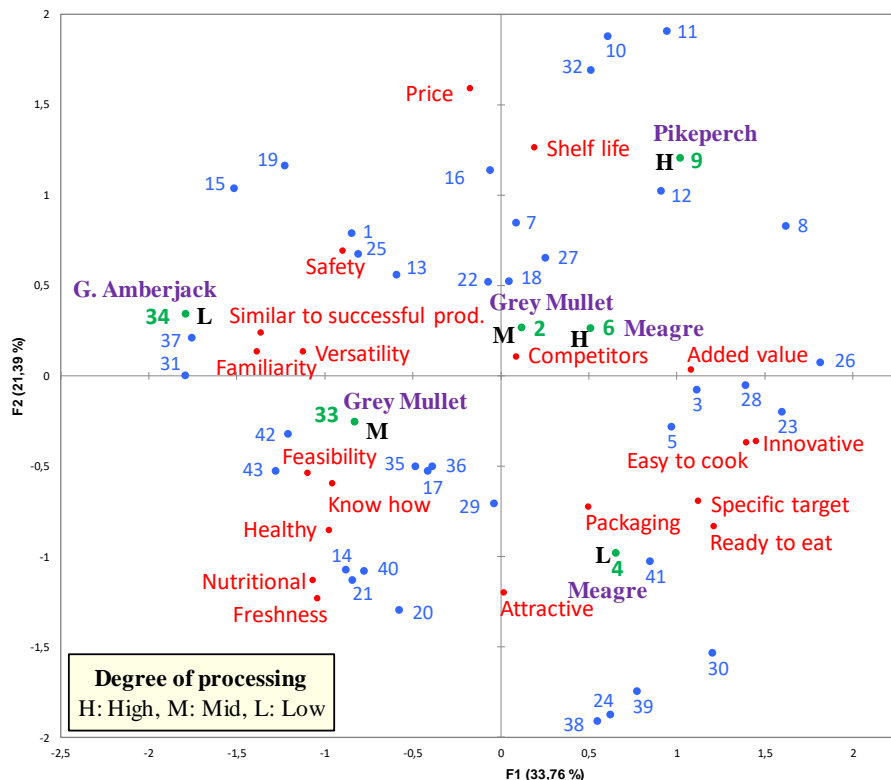
Selected Ideas

1. Frozen fish fillets with different recipes
2. Thin smoked fillets
3. Ready to eat meal: fish soup
4. Ready to eat meal: salad with fish
5. Ready to eat meal: fish risotto
6. Fish burgers shaped as fish
7. Fish balls
8. Dried fish sticks with accompanying dip
9. Fish pate/spreads
10. Fish broth in cubes
11. Fish powder/ seasoning
12. Fish sauces
13. Frozen fish filet that is seasoned or marinated
14. Fresh fish fillet with herbs and spices
15. Whole deep frozen fish
16. Frozen whole fish filled with spices and with organic vegetables
17. Fresh whole fish filled with spices and with organic vegetables
18. Frozen fish fillet with potatoes and vegetables
19. Deep frozen white fish fillet in the transparent packaging with additional information
20. Fresh back fish fillet
21. Fresh fish fillet with different 'healthy' seasoning and marinades
22. Frozen fish and seafood salad
23. Varied meal with fish fillet, burgers sausages
24. Fresh fish Carpaccio
25. Frozen back fish fillet in transparent packaging and accompanying marinades
26. Fresh ready to eat meal with fish fillet with different cheese and fine herbs
27. Fish sausages and fish hamburgers
28. Liquid fish to make soups or drink.
29. Fresh fish fillet medallions with garnish and sauce, separately packed.
30. Ready-made fish tartar with additional soy sauce
31. Whole fresh fish with information how to be prepared
32. Bread crusted crispy frozen fish product with a topping
33. Ready-made fish fillets in olive oil
34. Fresh fish steak for grilling in the pan
35. Steamed fish fillets
36. Ready-made larger pieces of fish without bones
37. Fresh fish fillet in a simple package
38. Fresh fish Carpaccio 2
39. Bottarga sliced as medallions
40. Fresh fish fillet sliced presented in the shape imitating of fish scales
41. Ready-made fish fillet / fish dices accompanied with cereals and vegetables
42. Fresh fish roast
43. Fresh fish fillet that comes with 3-day plan

New product development

• Selection of the new products to test

MEAGRE	Idea 1*: Frozen fish fillets with different recipes
	Idea 6: Fish burgers shaped as fish (H)
	Idea 4: Ready to eat meal: salad with fish (L)
PIKEPERCH	Idea 21: Fresh fish fillet with different "healthy" seasoning and marinades
	Idea 30: Ready-made fish tartar with additional soy sauce
	Idea 9: Fish spreads/pate (H)
GREY MULLET	**Idea 2: Thin smoked fillets (M)**
	Idea 33: Ready-made fish fillets in olive oil (M)
	Idea 21: Fresh fish fillet with different "healthy" seasoning and marinades
GREATER AMBERJACK	Idea 13: Frozen fish fillet that is seasoned or marinated
	Idea 30: Ready-made fish tartar with additional soy sauce
	Idea 34: Fresh fish steak for grilling in the pan (L)

L: low processing; M: mid processing; H: high processing.

Consumer test

Recruitment of participants

100 consumers

- 50% of the individuals per country "Involved innovators" and "Involved traditional"

- Balanced fish consumption (farmed and wild), age, gender, income and marital status, trying to fit the average frequencies in their respective segments per country

Consumer test

Preparation of the samples

Consumer test

Test design and execution

• Ten tasting sessions (1-1.5h) in each location in two consecutive days (10-12 participants)

• Each tasting session was divided in four main parts:
1) Participants were informed about the aim of the test and how to use the computers for inserting their answers
2) Overall liking expectation and image for each of the 10 different ideas
3) Blind tasting: liking of the six selected products
4) Overall expectation in informed condition: overall acceptability and personal perception of each product by means of a semantic differential scale (made up of 11 adjectives)

Results

Liking expectations

Average expected degree of liking of selected product ideas.

Idea	Mean value	Standard deviation
Grilled fillet (Idea 34)	7.5[a]	1.672
Fresh fillet (Idea 21)	7.1[b]	1.843
Smoked fillet (Idea 2)	6.8[bc]	1.862
Frozen fillet (Idea 1)	6.7[c]	1.716
Salad (Idea 4)	6.7[c]	1.867
Fish olive oil (Idea 33)	6.6[c]	1.879
Frozen marinated fillet (Idea 13)	6.6[c]	1.858
Hamburger (Idea 6)	6.2[d]	1.929
Tartar (Idea 30)	5.8[e]	2.273
Pate (Idea 9)	5.8[e]	2.184

a-e: Mean values with different superscripts differ significantly ($p<0.05$).

• Higher preference for those products having the genuine sensory properties of fish, without any interference (recruitment criteria)

Results

Liking expectations
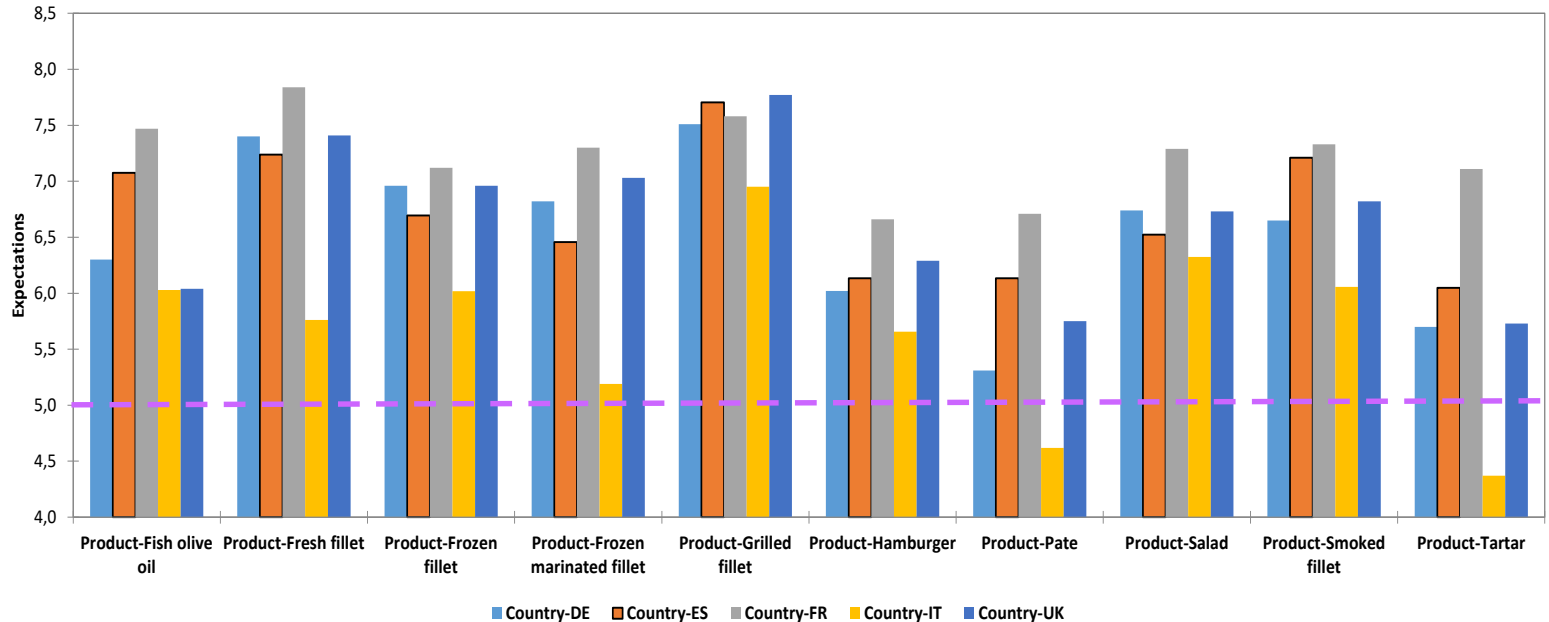
• Higher preference for those products having the genuine sensory properties of fish, without any interference (recruitment criteria)

Results

Image/perception of the different products or ideas

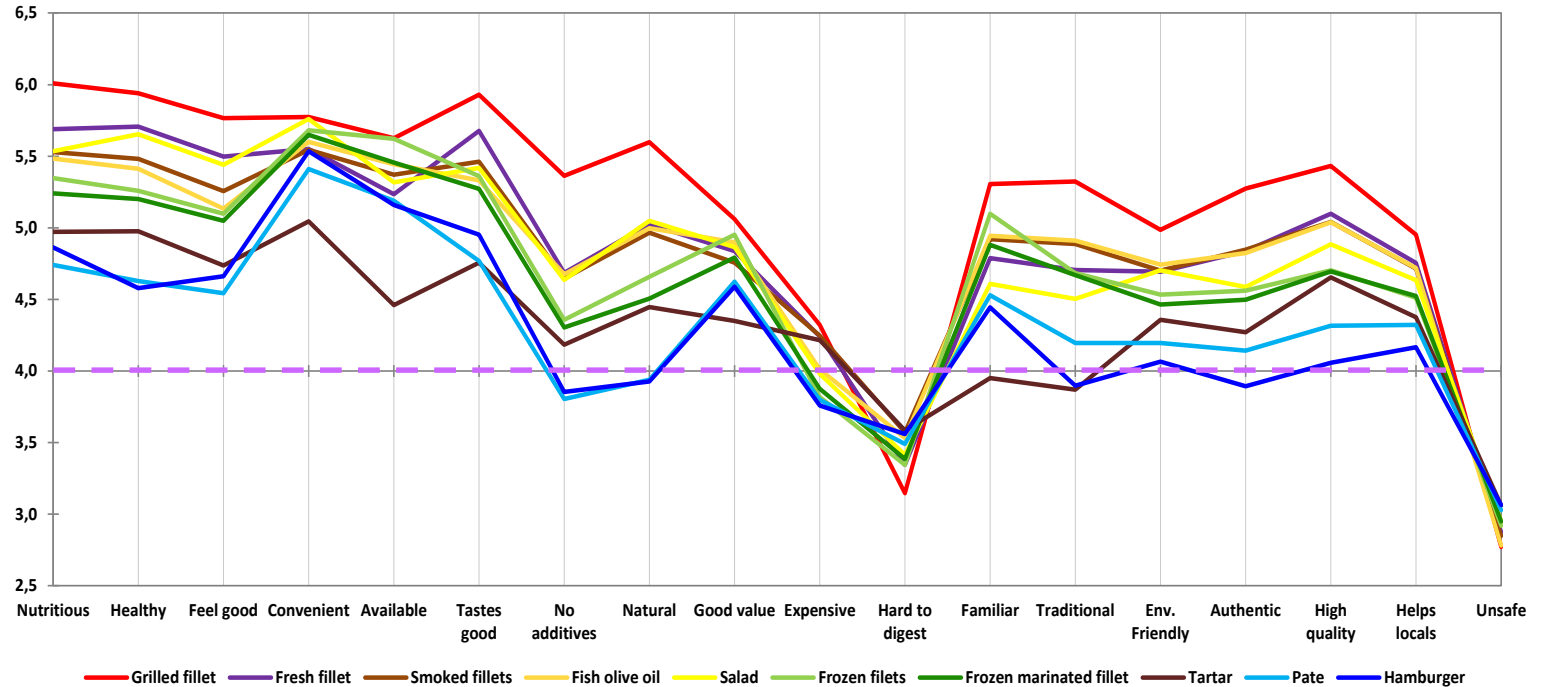- All the products were perceived quite positively

Results

Effect of image/perception on expectations

Parameter	Effect on expectations					
	Overall	DE	ES	FR	IT	UK
Nutritious	+			+	+	
Healthy	+				+	
Feels good	+	+		+		
Convenient			+			-
Available	-					
Tastes good	+	+	+	+	+	+
No additives						
Natural						
Good value	-					-
Expensive	-			+		-
Hard to digest	-				-	
Familiar	+	+	+			
Traditional						
Env. friendly	-			-		
Authentic						
High quality				+		
Helps locals		+				
Unsafe	-			-		-
*R²	0.418	0.585	0.350	0.465	0.342	0.391

+: significant positive effect on expectations (p<0.05); -: significant negative effect on expectations (p<0.05); *: All the R² values are significant (p<0.0001). Signs marked in green are those with the highest standardised regression coefficient, in orange the second highest and in red the third highest ones (in absolute value).

Results

Blind tasting (6 products)

Mean acceptability values for the different products per country.

Product	Overall	DE	ES	FR	IT	UK
Fish olive oil	6.3[b]	6.0[b]	6.7[ab]	7.2[abc]	6.0[bc]	5.7[bc]
Grilled fillet	7.1[a]	6.9[a]	7.0[a]	7.5[a]	6.8[a]	7.3[a]
Hamburger	6.5[b]	6.2[ab]	6.9[ab]	7.1[abc]	6.4[ab]	6.0[bc]
Pate	5.8[c]	5.2[c]	6.4[ab]	6.6[c]	5.3[c]	5.3[c]
Salad	6.3[b]	6.0[b]	6.2[b]	7.4[ab]	5.5[c]	6.4[b]
Smoked fillet	6.2[b]	6.3[ab]	6.7[ab]	6.7b[c]	5.6[c]	5.9[bc]
Std. Error	0.088	0.200	0.192	0.166	0.186	0.228

a-c: Mean values with different superscripts differ significantly ($p < 0.05$).

• Agreement with the previously reported expected liking

Results

Overall liking in the full informed condition

Mean acceptability values for the different products per country.

| Product	Overall	DE	ES	FR	IT	UK
Fish olive oil	6.4[bc]	6.0[bc]	7.0[ab]	6.9[ab]	6.0[b]	5.8[b]
Grilled fillet	7.1[a]	7.0[a]	7.3[a]	7.5[a]	6.8[a]	7.1[a]
Hamburger	6.2[c]	5.7[bc]	6.5[b]	6.8[ab]	6.0[b]	5.7[bc]
Pate	5.6[d]	5.2[c]	6.5[b]	6.5[b]	4.9[c]	4.8[c]
Salad	6.3[bc]	5.9[bc]	6.4[b]	7.5[a]	5.5[bc]	6.2[ab]
Smoked fillet	6.5[b]	6.5[ab]	7.1[ab]	6.9[ab]	6.2[ab]	6.1[b]

a-d: Mean values in the same column with different superscripts differ significantly ($p < 0.05$).

- Similar to what was observed in the blind tasting

Results

Confirmation/disconfirmation of expectations
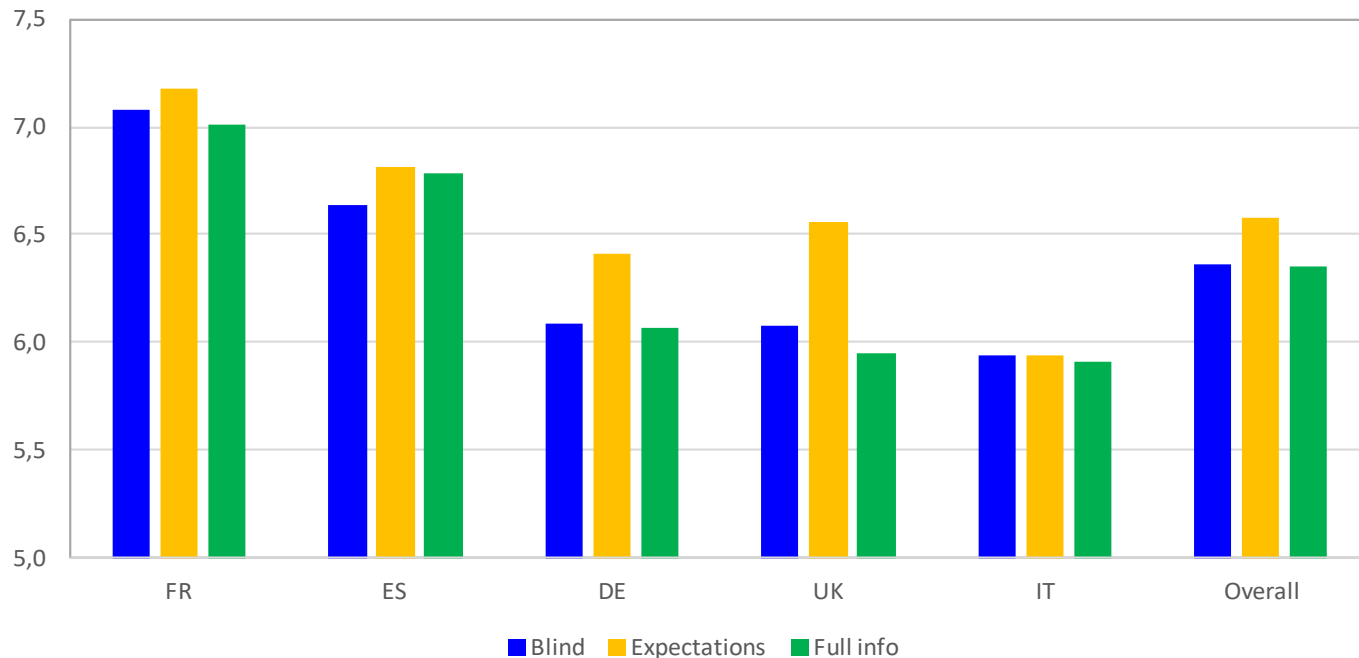
• In most cases the difference between the blind and the fully informed tasting was not significant

Results

Product image with full information

- Positive perception

- High discrepancies between countries, perception clearly different when dealing with the main intangible dimensions that might define the different products
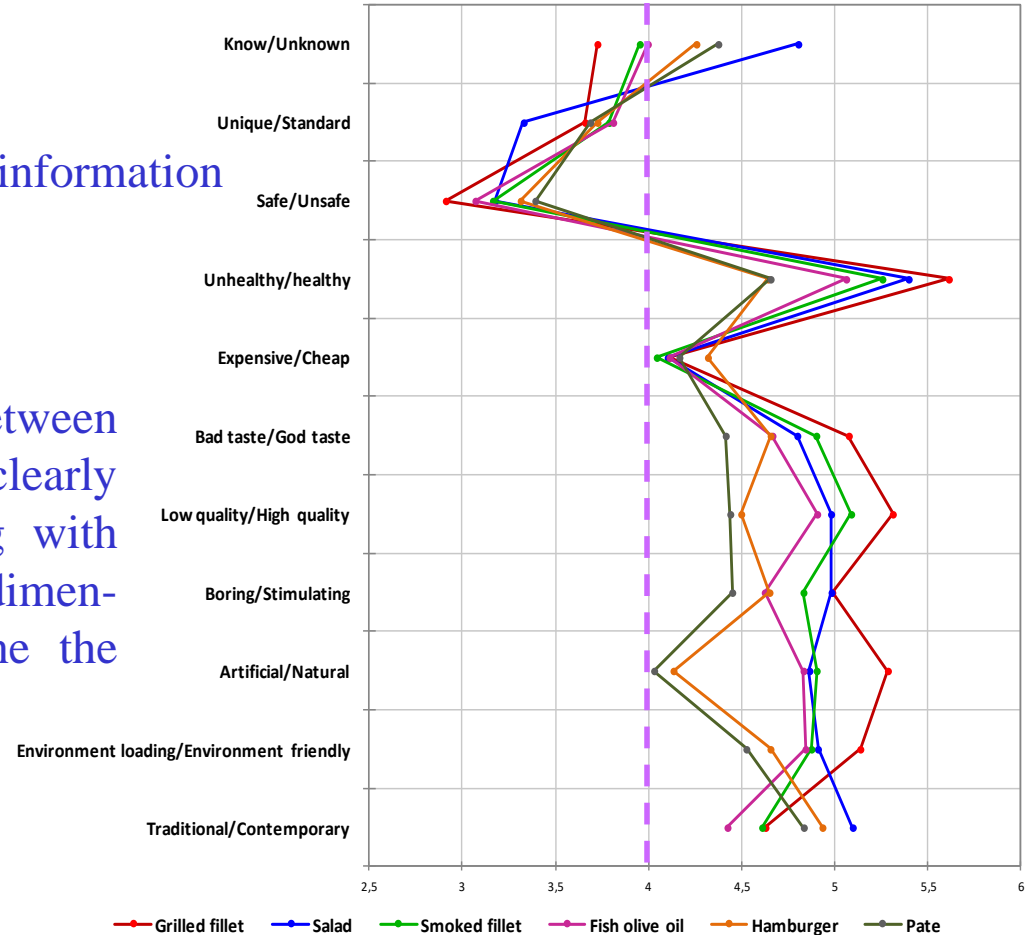
Results

Effect of product perception on acceptability in informed condition

Parameter	Overall	DE	ES	FR	IT	UK
Known/Unknown	-		-	-	-	
Unique/Standard	-	-				
Safe/Unsafe	-	-				-
Unhealthy/healthy	+				+	
Expensive/Cheap	-					-
Bad taste/Good taste	+	+	+	+	+	+
Low quality/High quality	+			+	+	
Boring/Stimulating	+		+		+	+
Artificial/Natural	+			+		
Environment loading/Environment friendly						
Traditional/Contemporary						
*R^2	0.49	0.67	0.51	0.62	0.34	0.60

+: significant positive effect on expectations ($p<0.05$); -: significant negative effect on expectations ($p<0.05$);
*: All the R^2 values are significant ($p<0.0001$). Signs marked in green are those with the highest standardised regression coefficient, in orange the second one and in red the third one (in absolute value).

Take-home messages

- Sensory dimension seems to have an important contribution to the overall acceptance of the product and to its purchase probability

- The products already developed were not able to reach the initial expectations that they produced in the participants

- Products with a lower degree of processing were those who generated higher expected scores and higher acceptability in the blind test (recruitment criteria)

- The environmental friendly character of the products did not affect the preference (it was included in the description of the different products)