



Old, new, or borrowed – the role of familiarity and cross-cultural recipe integration in the liking and choices of fish products

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ABSTRACT

Food cultures evolve as they absorb new influences while retaining aspects of their origins. Blending cultural influences with traditional foods gives rise to new cuisines with familiar and exotic elements. In this study, we aimed to seek influence from other fish-centric cultures to develop dishes that blended local fish with international flavors.

In Sub-study I, the pleasantness and familiarity of commercial fish products were compared with developed prototypes in a consumer sensory evaluation ($n = 100$). In Sub-study II, one of the prototypes was used as an ingredient in developing new dishes with elements from Basque, Spanish, Catalan, Italian, and Mexican food cultures, with a traditional Finnish ingredient. A twice repeated consumer sensory evaluation ($n = 93$) of the new dishes was conducted in a multisensory dining context.

The Sub-study I showed that pleasantness of some of the fish products increased with increasing familiarity. This was seen especially in the case of commercial and prototype pickled Baltic herring; their pleasantness was higher among the frequent users of traditional pickled fish. In Sub-study II of the new dishes Nachos had the highest overall liking in the first and second sensory evaluation (mean scores 6.38 and 6.42 out of 7, respectively). It was also found that in the case of new products, consumers relied on appearance and impression, whereas with familiar products, choice was based rather on sensory perception. Moreover, we were able to develop liked products by combining a traditional but nowadays less popular ingredient with elements from global food cultures.

1. Introduction

Local food production as well as the utilization of local and native raw materials play an important role in a sustainable food system. For example, as part of the 17 sustainable development goals (United Nations, 2015) United Nations recognized that local food production is important especially in the context of sustainable agriculture and food security (United Nations, 2019). The benefits of using local foods include reduced food miles thus decreasing the carbon footprint of food (Pretty, Ball, Lang, & Morison, 2005; Weber & Matthews, 2008). The role of local food systems is also of high importance in preserving biodiversity, local economies, and cultural food traditions (Feagan, 2007).

Consumers value traditional foods, which are also associated with preserving culture (Guiné, Florença, Barroca, & Anjos, 2021).

Traditional food is associated with habit and frequency of consumption, traditional ingredients and processing, local production (Roininen, Arvola, & Lähteenmäki, 2006), as well as characteristic sensory properties (Guiné et al., 2021). Laureati, Pagliarini, Calcinoni, and Bidoglio (2006) showed that traditional foods are liked more than non-traditional foods by elderly people. The same has also been seen in younger adults: Fibri and Frøst (2019) showed that products viewed as traditional received a higher hedonic rating than products viewed as modern. However, also traditional foods need product development to become for example healthier, more nutritious, or more convenient. Food cultures evolve continuously as they absorb new influences while retaining aspects of their origins. Moreover, imported products often replace traditional foods due to price, availability, and marketing (Chambers, Lobb, Butler, Harvey, & Bruce Traill, 2007). While it can be challenging for consumers to accept the development of traditional products (Guiné

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et al., 2021) it is essential for the livelihood of the culture as adopting elements from other cultures create new culinary landscapes and practices that the new consumer generations find attractive. The blending of cultural influences with traditional foods can give rise to interesting fusion cuisines that have both familiar and exotic elements.

Herring and Baltic herring are traditional ingredients and have a long history in the European fishing industry and food culture. Herring still has the largest percentage of the total fish landings in the European Union (European Commission, 2025). Herring and Baltic herring were already important fish foods during the Hanseatic League in the late Middle Ages; smoked herring was consumed all over Europe (Laine, 2016, p. 36) and salted Baltic herring was exported from Finland to Russia, Estonia, and Livonia (Laine, 2016, p. 61). Baltic herring has been important, especially for the Finnish food culture: Laine has collected approximately 2700 Baltic herring recipes (Laine, 2016, p. 10). However, since the 2000s, the consumption of Baltic herring has decreased considerably in Finland (Natural Resources Institute Finland (Luke), 2023) and its popularity and significance in consumers' diets has decreased. The users consist mainly of elderly people, who are used to consuming Baltic herring throughout their lives (Pihlajamäki, Asikainen, Ignatius, Haapasaari, & Tuomisto, 2019).

Traditional products made of herring and Baltic herring no longer appeal to the younger population today. For example, the strong sensory properties of traditional products, such as the preservative treatment in vinegar of Baltic herring (Logrén et al., 2022), might cause aversion towards the products. Thus, there is a need for development of the traditional products. By developing the products, for example towards milder sensory properties, it might be possible to make them more attractive to consumers, that otherwise would not use them. An earlier study showed that by using other food-grade weak acids, such as lactic or citric acids, it is possible to achieve milder sensory properties in marinated Baltic herring products (Logrén et al., 2022).

However, in addition to the sensory properties of the product itself, i. e., the intrinsic or food-internal factors, a variety of other factors affect the eating and drinking behavior and food choices of consumers. Chen and Antonelli (2020) established a framework of factors influencing food choices: Food-internal and food-external factors, personal state factors (e.g., physiological needs, experience, habits), cognitive factors (e.g., knowledge, preference, values), and sociocultural factors (e.g., norms in culture, socioeconomic status, policy, and regulations). This paper focuses on the effects of food-internal and -external factors as well as personal state factors, such as earlier experiences in decision-making.

Intrinsic, or food-internal factors consist of the internal properties such as sensory quality and ingredients of the food product. While the properties of the product are important, the extrinsic or food-external factors, such as the product information and the serving dish, as well as the social and physical surroundings (Chen & Antonelli, 2020) are often overlooked. However, they are crucial parts of the dining experience and can affect the pleasantness or duration of the dining situation or even the perception of the product. E.g., Mathiesen, Hopia, Ojansivu, Byrne, and Wang (2022) showed that the presence and tempo of background sounds affect the duration of a meal. Spence, Velasco, and Knoeferle (2014) also found that the color and sound of the environment affect the flavor as well as the liking of wine. Surroundings are also closely related to a situational context that takes into account the "actual/external environment at the point of purchase" (Carrington, Neville, & Whitwell, 2010). In a dining situation, a single choice can be considered as a purchase decision.

Consumer's level of experience with a product is related to the concept of familiarity (Aldridge, Dovey, & Halford, 2009). Familiarity can be measured as the amount of knowledge consumers have or think they have of a product (Park & Lessig, 1981). On the other hand, familiarity has been defined as "the number of product related experiences that have been accumulated by the consumer" (Alba & Hutchinson, 1987). The familiarity scale of Tuorila, Lähteenmäki, Pohjalainen, and Lotti (2001) utilizes the latter approach by measuring the level of

previous encounters and uses of a product. In another approach, as a subjective familiarity was measured on an ordinal scale from 1 to 7 (Arvola, Lähteenmäki, & Tuorila, 1999). Familiarity also has an influence on food product liking. Pliner (1982) showed that multiple exposures significantly affected product liking.

This work aimed to investigate whether the interest of a traditionally used but underutilized domestic raw material among consumers can be increased by product development integrating intrinsic and extrinsic factors into the development process, and combining elements from global food cultures. Baltic herring was used as an example of raw material. It is a traditional Nordic food, whose consumption has collapsed during the last decades, especially among young urban consumers. Sub-study I was a consumer study where the liking of commercial products and newly developed prototypes was investigated. From this part of the study, a potential prototype was identified as an alternative to a traditional commercial version of the product. Thus, the aim of Sub-study II was to investigate whether the acceptability of the alternative to the traditional raw material can be improved. This was done by focusing on intrinsic and extrinsic factors and adding cultural elements from other fish-centric food cultures; Basque, Spanish, Catalan, Italian, and Mexican food cultures to local products and dishes.

2. Methods

2.1. Sub-study I

In Sub-study I, a total of 100 consumers participated in the evaluation. During recruitment, the aim was that the participants should be equally distributed into males and females, age groups of 18–29 years, 30–49 years, and 50–79 years, as well as single households, adult households, and families with children. Only consumers using fish at least monthly were accepted to participate in the study. The fish using frequency of the participants varied as follows: Once a month; 2–3 times a month; 1–2 times a week; More often.

The participants evaluated six Baltic herring products. Three of the samples were commercial products (bought from a grocery or shop) and three were prototypes of novel Baltic herring products. The commercial products were fish fingers, a Baltic herring steak, and a Baltic herring preservative. The steak and preservative are traditional foods utilizing Baltic herring in Finland. The fish fingers from Baltic herring were quite a new product at the time of the study, it had been launched approximately 7 months prior to the study. In general, however, fish fingers are a familiar concept in Finland but are often made of Alaska pollock. The prototypes were designed and prepared by the project partners and were extruded Baltic herring (Nisov et al., 2020), a fish ball from Baltic herring (Kakko, Damerou, Mejia Rios, Laaksonen, & Yang, 2023), and a Baltic herring preservative (Logrén et al., 2022). The preservative prototype was visually very similar to the commercial preservative but it was treated with lactic acid instead of vinegar to achieve milder sensory properties. The fish ball was a similar concept to meatballs. Meatballs are common in the Western food culture and fish balls can also be found in groceries. However, Baltic herring is rarely used in such products. The extruded Baltic herring was a new-to-the-world concept. The samples are described in more detail in Table 1.

The samples were presented to the participants one at a time in a randomized order on a white porcelain plate coded with three-digit numbers. The pleasantness of appearance, taste, texture, and overall pleasantness of the samples was determined with a 7-point pleasantness scale as well as familiarity on a 5-point familiarity scale (Table 2). After this, the participants were provided with more information about the samples: the sample name and the list of ingredients (Table 1). The overall pleasantness of the samples was requested again after providing additional information about the samples to the participants. To identify the users of pickled fish the participants were asked whether they use pickled fish, such as Atlantic or Baltic herring. The evaluation survey included demographic questions about the respondent's age, gender,

Table 1
The evaluated products, their descriptions, and their ingredients in Sub-study I.

Product	Description	Provided sample name and list of ingredients
Commercial fish finger from Baltic herring	Fish paste coated with breading.	Fish finger: Skinless Baltic herring fillet 56 % (<i>Clupea harengus membras</i> caught with trawl or fyke in the Baltic Sea), Finnish potato, gluten-free breading (rice flour, chickpea flour, corn starch, dextrose), turnip oil, Finnish potato flakes, egg white powder, chickpea flour, pea fiber, thickening agents (E461, E407a), lemon juice concentrate, iodized salt, black pepper
Commercial Baltic herring steak	A butterfly fillet of Baltic herring, coated with rye flour and fried on a pan.	Baltic herring steak: Baltic herring (<i>Clupea harengus membras</i>), rye flour, white pepper, salt, dill, butter, rapeseed oil
Commercial Baltic herring preservative	Baltic herring fillets pickled in an acidic solution with salt and after some time marinated with sugar and spices.	Baltic herring preservative: Baltic herring (<i>Clupea harengus membras</i> , caught by trawling in the Sea of Bothnia FAO area 27IIIId), water, sugar, juniper berry (3.5 %), onion, salt, dill, acidity regulator (E260), preservatives (E202, E211)
Prototype extruded Baltic herring	Extruded Baltic herring paste (based on Nisov et al. (2020)).	Pulled Baltic herring: Baltic herring (<i>Clupea harengus membras</i>), pea protein isolate, salt (1 %), spice mixture (ginger, coconut, onion, garlic, lemon powder, tomato, jalapeno, coriander, tarragon, thyme)
Prototype fish ball of Baltic herring	Fish ball with sea-buckthorn berry press cake to improve shelf life (based on Kakko et al. (2023))	Fish ball of Baltic herring: Baltic herring (<i>Clupea harengus membras</i>), egg, breadcrumb, turnip oil, sea-buckthorn berry, salt, dill, black pepper, cayenne pepper
Prototype Baltic herring preservative	pickled and marinated Baltic herring fillets where the traditional acetic acid had been replaced with lactic acid (based on Logrén et al. (2022))	Baltic herring preservative: Baltic herring (<i>Clupea harengus membras</i>), water, sugar, salt, lactic acid, preservative (sodium benzoate)

and household type. The evaluation survey is described in more detail in Table 2.

The data was collected with Compusense® software (Version 22.10, Compusense Inc., Guelph, ON, Canada) in May 2022. The evaluations were conducted in the sensory laboratory of the Nutrition and Food Research Centre, University of Turku, Finland (ISO-8589:1988).

2.2. Sub-study II

A total of 93 consumers participated in Sub-study II. Only consumers who were not allergic to oats, eggs, milk, fish, wheat and hazelnut, peanut, other nuts, soy, and sesame seeds were able to participate in the study. Six pintxo samples were evaluated. The samples represented fusion cuisine, “a style of cookery which blends ingredients and methods of preparation from different countries, regions, or ethnic groups” (Oxford English Dictionary, 2002), and they were of Basque, Catalan, Mexican, Italian, or Spanish origin but utilized Finnish ingredients; Two of the samples contained a citric acid treated Baltic herring based on the Baltic herring preservative prototype, which was identified as a potential raw material in Sub-study I, two samples contained oats, and two

Table 2
The evaluation survey with questions and response options in Sub-study I.

Survey item	Question	Scale/Response options
Pleasantness	How pleasant do you think this product is in... • appearance? • taste? • texture in mouth? • overall?	1 = Extremely unpleasant; 2 = Very unpleasant; 3 = Slightly unpleasant; 4 = Neither pleasant nor unpleasant; 5 = Slightly pleasant; 6 = Very pleasant; 7 = Extremely pleasant
Familiarity (Tuorila et al., 2001)	How familiar does the product seem?	1 = I do not recognize the product; 2 = I recognize the product but I have not tasted it; 3 = I have tasted the product but I do not use it; 4 = I occasionally eat the product; 5 = I regularly eat the product
Pleasantness	See above for more information about the product you have tasted (descriptions in Table 1). How pleasant do you think this product is?	1 = Extremely unpleasant; 2 = Very unpleasant; 3 = Slightly unpleasant; 4 = Neither pleasant nor unpleasant; 5 = Slightly pleasant; 6 = Very pleasant; 7 = Extremely pleasant
Use of different fish products	Do you use [fish product] at least every now and then? The fish product of interest was pickled fish such as Atlantic or Baltic herring	Yes; No
Age	My age is...	Numeric (years)
Gender	My gender is...	Female; Male; Other/I don't want to respond
Household type	What kind of household do you live in?	I live alone or independently in a shared household; Adult household, there are no children below 18 years in our household; Household with children, there are children below 18 years in our household

samples contained both the preservative and oats.

The samples were served on white porcelain plates or glass cups and were presented to the participants on the table with name tags and allergens (Fig. 1). The placement of the samples varied, however, so that the glass cups were always in the middle. The participants also evaluated the samples in a randomized order. Additionally, there were two forks, glasses of water, and iPads for answering the evaluation survey in each table.

To create a context where pintxos could typically be consumed the samples were introduced to the participants in English by a Basque chef student who had developed the products at the beginning of each evaluation. The sample names, introduction, and allergens are described in Table 3. The recipes can be found in more detail in Supplementary Table S1.

The evaluations were held in a multisensory space “Aistikattila®” at the University of Turku, Finland. Two Finnish cultural landscapes were created as dining environments: the Turku Archipelago and a field of grain. In the archipelago environment, there was a video on two walls of the evaluation room from the island Ruissalo in Turku Archipelago, the sound of the sea with seagulls and dimmed lighting (Fig. 2A). In the field environment, there was a video of a grain/cereal field with the sound of wind and bird singing and similar lighting as in the archipelago environment (Fig. 2B). The participants evaluated six samples twice on separate days: once in each environment. The order of the two environments was randomized for the participants.

The samples were also evaluated in two different multisensory environments to create a situational context for the evaluation situation. The Baltic herring preservative prototype from Sub-study I was identified as a potential new Baltic herring product and, thus, was used as a typical Finnish ingredient in part of the samples in Sub-study II. It was



Fig. 1. The presentation of the samples in the evaluations. There were samples for two participants on each table. The samples were presented with name tags and allergens. The data was collected with iPads.

combined with Basque, Spanish, Catalan, Italian, and Mexican recipes to study whether the acceptability of the traditional raw material can be improved from the level in sub-study I by adding cultural elements from Basque, Spanish, Catalan, Italian, and Mexican food cultures.

The participants were asked about the pleasantness of appearance, odor, taste, and texture, and the overall pleasantness of the samples on a 7-point scale. The food choice was studied by asking the participants to choose 3 out of 6 samples they would prefer at the beginning of both evaluations as well as their arguments for the choice. The background questions included age, gender, educational level, consumption of fish overall, and Baltic herring consumption at the end of the second evaluation. The evaluation survey questions are described in Table 4 in more detail. The data was collected with Compusense® software (Version 23.0, Compusense Inc., Guelph, ON, Canada) in May and June of 2023.

2.3. Data analysis

During the data analysis, the familiarity scale was analyzed in three categories: “Has not tasted the product” (ratings 1 and 2 combined), “has tasted the product but does not use it” (rating 3), and “uses the product” (ratings 4 and 5 combined). The categories were combined since separately the group sizes were not large enough for data analysis.

Fisher’s Exact Test was used to compare the difference between categorical variables with two response choices. The Chi² test with column proportions z-test and Bonferroni correction was used to compare more than two categorical response choices. To compare the statistically significant differences between two continuous dependent variables Wilcoxon signed-rank test was used. To compare the statistically significant differences between 2 and 3 or more continuous independent samples Mann-Whitney *U* test and the Kruskal-Wallis *H* test together with Sidák correction were used, respectively. The correlation coefficient values between two nonparametric variables were calculated with Spearman’s rank correlation coefficient. The statistical significance level was set at $p < 0.05$ and the statistical analysis was conducted with SPSS (version 28.0, IBM SPSS Statistics, IBM Corporation, Armonk, NY, The United States).

The answers to open-ended questions about the arguments for the choices were analyzed qualitatively with thematic analysis. Two

researchers independently familiarized themselves with the data. They generated the initial codes after which themes were agreed, reviewed, and defined together. After that, the answers were assorted in the defined themes and reviewed until agreement was achieved to find the frequencies of different themes in the comments.

3. Results

3.1. Sub-study I

A total of 100 consumers participated in the study. The recruited participants were equally distributed into males (49 %) and females (51 %), as well as in groups aged 18–29 (34 %), 30–49 (34 %), and 50–79 (32 %). A total of 43 % lived in a single household, 38 % in a household with only adults, and 19 % in a household with children.

The pleasantness of appearance, taste, and texture as well as the overall pleasantness of the six Baltic herring products before and after providing the product name and a list of ingredients to the participants were evaluated. The commercial products were evaluated often as more pleasant than the developed prototypes ($p < 0.05$). The pleasantness of the developed fish ball did not statistically differ from the Baltic herring preservative in appearance and overall pleasantness before and after providing the list of ingredients and from the fish finger and the Baltic herring preservative in texture ($p > 0.05$). The provided name and list of ingredients statistically increased the overall pleasantness of the fish ball and decreased the pleasantness of the fish finger ($p < 0.05$). The provided information did not affect the pleasantness of the other samples. The results can be further seen in Fig. 3.

According to the Chi²-test coupled with the column proportion z-test the familiarity of the samples varied between the participants ($p < 0.001$) (Table 5). The prototype extruded Baltic herring and fish balls from Baltic herring were not tasted by most of the participants. The commercial fish finger from Baltic herring and Baltic herring steak were used by more participants than the prototypes. The familiarity of the commercial and prototype Baltic herring preservatives did not significantly differ from each other.

A statistically significant correlation between the overall pleasantness and familiarity was found in all samples except the extruded Baltic

Table 3

The sample names and their allergens shown to the respondents, as well as their introductions in Sub-study II.

Sample	Description	Allergens
Coca ¹	The Catalan coca, a typical dish from Catalonia, consists of a base called “coca” topped with different roasted vegetables and anchovies. In this version, we have substituted the anchovies with Baltic herring.	Wheat, fish, egg, sulfites
Talo ¹	The talo, a typical bread from the Basque Country made from corn flour, similar to Mexican tortillas, can be filled with various ingredients. In this case, it has been filled with ajoarriero, a traditional Basque dish with tomato, onion, and peppers, substituting the cod for Baltic herring.	Fish, milk, hazelnut, almond. Can contain traces of other peanuts, soy, and sesame seed
Croqueta ^{1,2}	The croqueta, a typical dish throughout Spain, is made using a béchamel sauce based on wheat flour, cow’s milk, and butter, which is then coated in breadcrumbs. In this case, we have replaced the wheat flour, milk, and breadcrumbs with oat flour, oat milk, and oat bread.	Oat, milk, fish, egg
Nachos ^{1,2}	Nachos with salsa are very typical in Mexico, but today we bring you a different version. The nachos are made from oats and the salsa consists of a cream made from dairy, vegetables, and Baltic herring marinated in spices.	Oat, milk, fish
Risotto ²	Risotto is an authentic Italian dish made with rice, different sauces, and seasonings. In this case, it has been made with oat grains, mushrooms, and wild asparagus.	Oat, milk, celery, sulfites
Torrija ²	Finally, we have the torrija, a typical dessert from the Basque Country, which is made with old wheat bread soaked in milk and more seasonings. For this occasion, wheat bread has been replaced with oat bread and has been soaked in oat milk.	Oat

¹ Contains citric acid-treated Baltic herring. ²Contains oats.

herring and fish ball from Baltic herring which were very unfamiliar for consumers. The statistically significant correlations varied from 0.262 in commercial Baltic herring preservative to 0.467 in prototype Baltic herring preservative. Further results can be seen in Table 6.

The pleasantness of the samples was also compared between participants using and not using pickled fish, such as Atlantic or Baltic herring. Those using the products regarded the appearance of the fish fingers less pleasant (5.42 and 5.95, respectively, $p = 0.044$), the appearance of the steak of Baltic herring (5.73 and 5.34, respectively, $p = 0.046$) and the overall pleasantness with the list of ingredients of the steak of Baltic herring (6.06 and 5.76, respectively, $p = 0.013$) as more pleasant than those not using the products (data not shown). The commercial and prototype Baltic herring preservatives were regarded as more pleasant in all categories by those using fish such, as Atlantic or Baltic herring, preserved in pickle compared to those not. The results can be further seen in Fig. 4.

In addition, the familiarity of the commercial and prototype Baltic herring preservatives was compared between those using and not using pickled fish such as Atlantic or Baltic herring (Table 7). Among those using the commercial and/or the prototype Baltic herring preservative the proportion of those using (also other) pickled fish was larger than

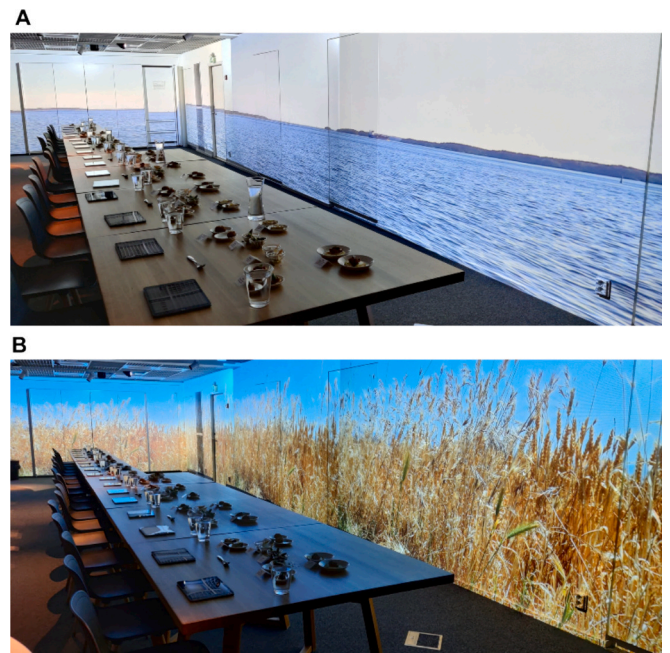


Fig. 2. The sea environment (A) and field environment (B) settings of the multisensory space “Aistikattila®”.

Table 4

The evaluation survey with questions and response options in Sub-study II.

Survey item	Question	Scale/Response options
Choice*	There are six different types of pintxos set on the table. If you could choose three of them, which would you prefer?	Coca; Talo; Nachos; Croqueta; Risotto; Torrija
Argument for the choice*	Why did you choose these three pintxos?	Open answer
Pleasantness*	How pleasant do you think this product is in... <ul style="list-style-type: none"> appearance? odor? taste? texture in mouth? overall? 	1 = Extremely unpleasant; 2 = Very unpleasant; 3 = Slightly unpleasant; 4 = Neither pleasant nor unpleasant; 5 = Slightly pleasant; 6 = Very pleasant; 7 = Extremely pleasant
Age	Age	Numeric (years)
Gender	Gender	Female; Male; Other/I don’t want to respond
Education	Education level	Comprehensive school; Upper secondary education; Lower academic degree; Higher academic degree; Doctoral degree
Fish consumption	How often do you eat fish?	Twice a week or more often; Approximately once a week; 1–3 times a month; Less frequently than monthly
Baltic herring consumption	How often do you eat Baltic herring?	Once a month or more often; Seasonally (e.g., in the summer/winter); A few times a year; I don’t eat Baltic herring at all

* Repeated in both first and second evaluation.

that of those not using pickled fish. On the other hand, among those having tasted but not using the commercial and/or the prototype Baltic herring preservative the proportion of those not using (also other) pickled fish was larger than that of those using pickled fish. Among those who had not tasted the commercial Baltic herring preservative the proportions of participants using and not using pickled fish did not

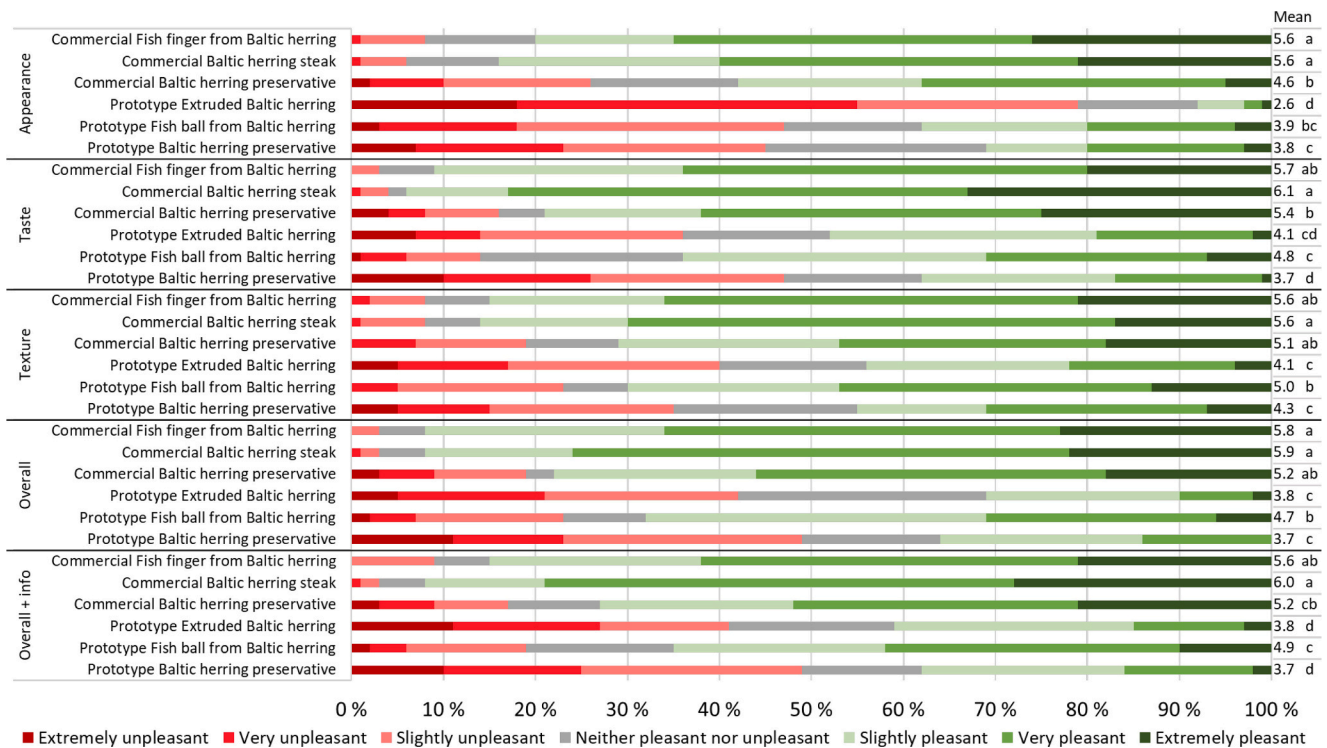


Fig. 3. The pleasantness of the samples (n = 100) evaluated on a 7-point scale. Mean pleasantness can be seen on the right-hand side of the figure. The pleasantness between the samples was compared using the Kruskal-Wallis H test together with Šidák correction and the different small letters indicate statistically significant differences between the samples (p < 0.05).

Table 5

The familiarity of the samples (n = 100) analyzed with the Chi²-test and the column proportions z-test with Bonferroni correction. The familiarity was evaluated on a 5-point scale but during data analysis, the scale was combined into three categories.

Familiarity (combined into three categories)	Sample (%)					
	Commercial Fish finger from Baltic herring	Commercial Baltic herring Steak	Commercial Baltic herring preservative	Prototype Extruded Baltic herring	Prototype Fish ball from Baltic herring	Prototype Baltic herring preservative
Has not tasted the product	46.0 ^a	20.0 ^b	48.0 ^a	98.0 ^c	85.0 ^d	61.0 ^a
Has tasted the product but does not use it	14.0 ^{ab}	26.0 ^a	24.0 ^{ab}	2.0 ^c	10.0 ^{bc}	21.0 ^{ab}
Uses the product	40.0 ^{ab}	54.0 ^a	28.0 ^{bc}		5.0 ^d	18.0 ^{cd}

abcd Different letters indicate statistically significant differences within each row.

Table 6

The correlation coefficient values calculated with Spearman's rank correlation coefficient. The familiarity scale was combined into three categories (Has not tasted the product; Has tasted the product but does not use it; Uses the product).

Spearman's rank correlation coefficient	Overall pleasantness – Familiarity
Commercial Fish finger from Baltic herring	0.292**
Commercial Baltic herring Steak	0.300**
Commercial Baltic herring preservative	0.262**
Prototype Extruded Baltic herring	0.018
Prototype Fish ball from Baltic herring	0.195
Prototype Baltic herring preservative	0.467***

p < 0.01; *p < 0.001.

differ.

3.2. Sub-study II

In Sub-study II, there were 93 participants in total. Women represented 66.7 % of the participants and men 32.3 %. Most of the participants (50.5 %) had a higher academic or a doctoral degree. One-fourth

(23.7 %) had a bachelor's degree and the remainder (25.8 %) had an upper-secondary education. One-third of the participants (33.3 %) used fish twice a week or more often, 41.9 % used fish weekly, and 24.7 % used fish less often than weekly. A total of 10.8 % reported not using Baltic herring at all, 36.6 % reported eating it a few times during a year, 39.8 % reported eating it seasonally, and 12.9 % reported eating Baltic herring at least once a month.

Whereas Sub-study I explored the pleasantness of intrinsic factors in fish products, Sub-study II took the situational context into account. The participants evaluated the six pintxo samples twice in two different environments. When comparing the first and second evaluations without differentiating the environments, there were increases in the pleasantness of the appearance of Nachos and Torrija as well as the texture and overall pleasantness of Coca from the first to the second evaluation. The results can further be seen in Fig. 5.

In the different environments, the overall pleasantness ranged from 4.74 (Torrija) to 6.53 (Nachos) in the sea environment and from 4.76 (Torrija) to 6.27 (Nachos) in the field environment. There was a statistically significant difference between the overall pleasantness only in the case of Nachos in the two environments, while no statistically significant

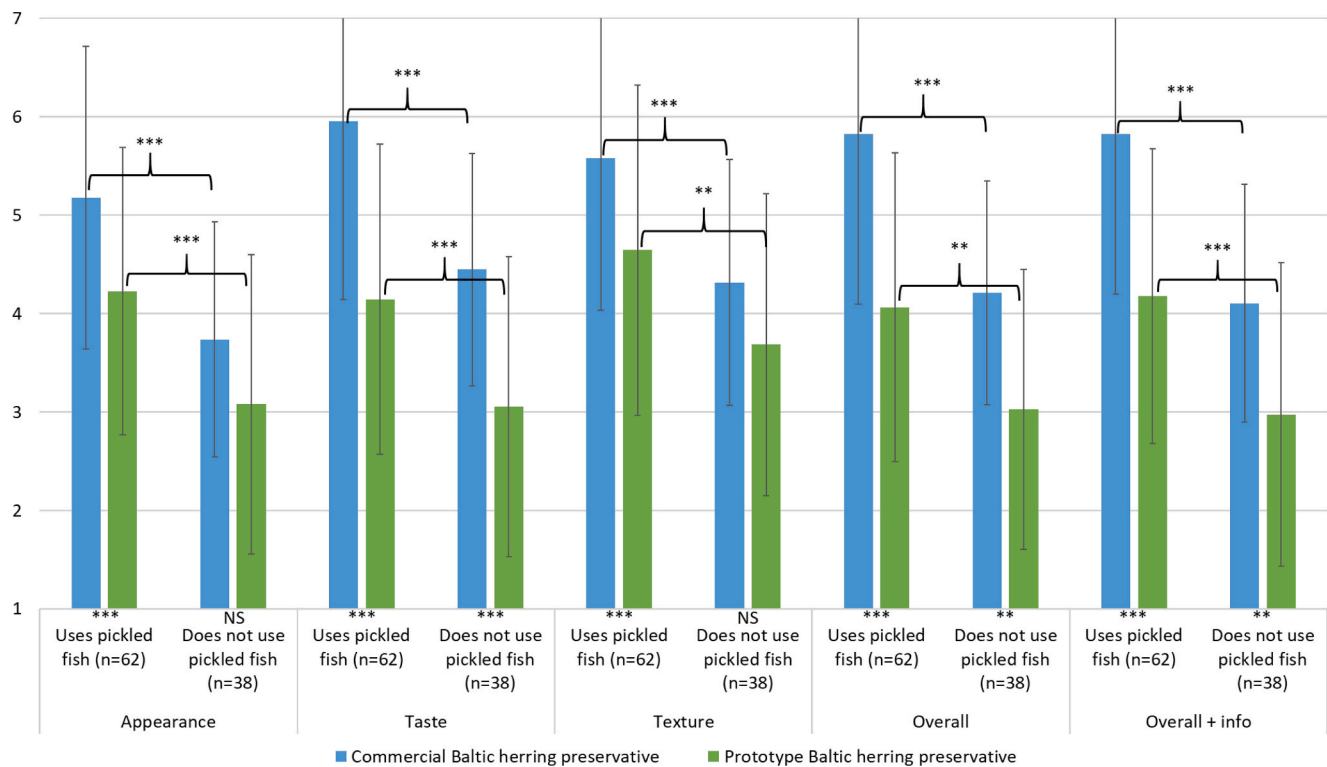


Fig. 4. The mean and standard deviation of pleasantness of the traditional and modified Baltic herring preservative between those using and not using pickled fish, such as Atlantic or Baltic herring. The pleasantness of the samples was evaluated on a 7-point scale. The statistical significance between the samples as well as those using and not using pickled fish, such as Atlantic or Baltic herring was analyzed with the Mann-Whitney *U* Test. NS: not significant; ***p* < 0.01; ****p* < 0.001.

Table 7

The proportions of those using pickled fish, such as Atlantic or Baltic herring among the different familiarity categories in the case of the commercial and prototype Baltic herring preservative analyzed with the Chi²-test and the column proportion z-test with Bonferroni correction. The familiarity scale was merged into three categories (Has not tasted the product; Has tasted the product but does not use it; Uses the product).

Sample	Familiarity (combined into three categories)	The use of pickled fish, such as Atlantic or Baltic herring	
		Yes, <i>n</i> = 62, (%)	No, <i>n</i> = 38, (%)
Commercial Baltic herring preservative	Has not tasted the product	48.4 ^a	47.4 ^a
	Has tasted the product but does not use it	11.3 ^a	44.7 ^b
	Uses the product	40.3 ^a	7.9 ^b
Prototype Baltic herring preservative	Has not tasted the product	62.9 ^a	57.9 ^a
	Has tasted the product but does not use it	9.7 ^a	39.5 ^b
	Uses the product	27.4 ^a	2.6 ^b

a,b Different letters indicate statistically significant differences within each row.

difference was seen in the liking of the five other test dishes. The pleasantness of the samples in different environments can be seen in Supplementary Fig. 1.

The participants also chose three of the samples at the beginning of both evaluations. Coca and Nachos were the samples chosen most often in the sea environment (64.5 % and 59.1 %, respectively). Nachos and Talo were the samples chosen most often in the field environment (63.4 % and 61.3 %, respectively). There were no statistically significant differences in the choices between the environments (data not shown). When comparing the first and second times choosing the samples it was found that Nachos were chosen more often in the second than in the first evaluation (80.6 % and 41.9 %, respectively, *p* < 0.001). Risotto was

chosen more often in the first than in the second evaluation (48.4 % and 32.3 %, respectively, *p* = 0.036). The data can be seen in Table 8 in further detail.

The most important reasons to choose three samples in the first evaluation were the appearance, the impression, and interest in the samples. In the second evaluation, appearance, preference, and familiarity were the most important reasons for the choice and the importance of impression decreased. The results are further described in Table 9.

4. Discussion

In the present study, commercial and prototype fish products differed in pleasantness and familiarity. Moreover, the pleasantness of the preservatives was higher among those using similar, pickled fish products. One of the preservatives was later served in a multicultural context and it was found that the interest of traditional ingredients can be increased by combining them with both familiar and exotic elements in food. It was also found that repeated exposure to products affects people’s food choice motives as the focus shifts from extrinsic factors to intrinsic properties.

In Sub-study I, a total of six Baltic herring products, three commercial and three prototypes, were evaluated. The three commercial products were fish fingers from Baltic herring, Baltic herring steak, and a Baltic herring preservative, and the prototypes were extruded Baltic herring (Nisov et al., 2020), fish balls from Baltic herring (Kakko et al., 2023), and modified Baltic herring preservative (Logrén et al., 2022). The samples were of a different level of novelty, e.g., a Baltic herring steak and preservatives are traditional products in Northern Europe, whereas the fish finger from Baltic herring had been launched approximately 7 months before the study and the extruded Baltic herring was a completely new-to-the-world product.

The commercial products were generally regarded as more pleasant than the prototypes. For example, the prototype Baltic herring

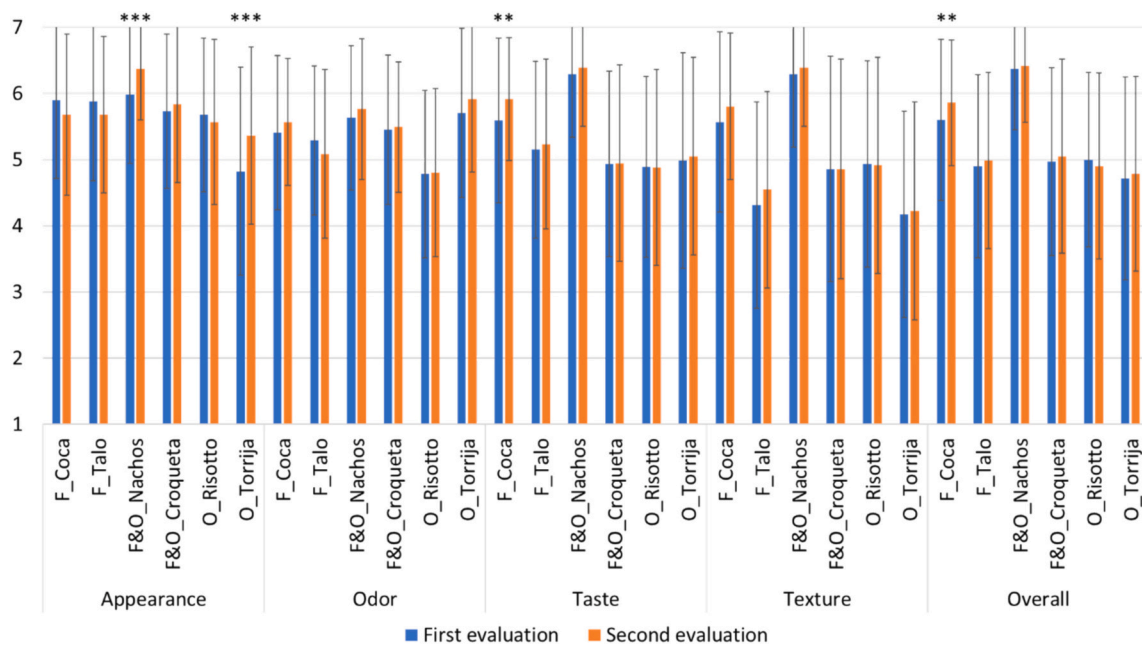


Fig. 5. The mean and standard deviation of pleasantness of the samples in the first (blue) and the second (orange) evaluation. The statistically significant differences in the pleasantness ratings between the first and second evaluation were analyzed with the Related-Samples Wilcoxon Signed Rank Test. $**p < 0.01$, $***p < 0.001$, F = fish, O = oat; (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Table 8

The proportions of participants choosing the sample in the first and the second evaluation analyzed with the Fisher's Exact Test.

Sample	Evaluation 1 (% of the participants)	Evaluation 2 (% of the participants)
Coca	57.0	65.6
Talo	62.4	49.5
Nacho***	41.9	80.6
Croqueta	57.0	43.0
Risotto*	48.4	32.3
Torrija	33.3	29.0

*p < 0.05, ***p < 0.001.

preservative, which was similar to the commercial one, was found less pleasant likely because it was marinated in a solution containing only sugar and lactic acid in contrast to the commercial preservative with vinegar and seasoning. Therefore, it was probably very dull compared to the commercial variation. On the other hand, the fish ball, which was seasoned, was regarded as pleasant as some of the commercial samples and more pleasant than the other prototypes. The list of ingredients provided during the evaluation had only a little effect on the pleasantness of the samples.

Familiarity, on the other hand, had a clear effect on the pleasantness of the samples; pleasantness increased with increasing familiarity, apart from two of the prototypes. The low familiarity of the extruded Baltic herring and fish ball of Baltic herring, however, explains the lack of correlation. Although the correlation coefficient was below 0.5 in the rest of the samples, a high statistical significance was still shown. Familiarity can also explain the higher pleasantness of the commercial products since there may have been encounters with the products before. For example, this was demonstrated with the pickled Baltic herring preservatives: their pleasantness was higher among the frequent users of traditional pickled fish.

Familiarity has also been shown to affect the pleasantness of food products in earlier studies. E.g., Arvola et al. (1999) found that familiar cheeses were perceived more positively than unfamiliar cheeses before tasting. Furthermore, (Tuorila & Hartmann, 2020) suggest that sensory

Table 9

The results of the thematic analysis of the open-ended questions about the reasons for choosing the samples.

Code	Definition	% of the participants mentioning in the first evaluation	% of the participants mentioning in the second evaluation
Appearance	Anything related to the appearance.	78 %	66 %
Impression	Impression or expectation gained by, e.g., the appearance or description.	60 %	31 %
Interest	Interest and curiosity	27 %	13 %
Preference	Preference is described with ingredients and other senses than sight.	17 %	52 %
Familiarity	Earlier experiences.	11 %	48 %
Size	Size, fillingness, appetite.	10 %	5 %
Gastronomy	Forms a meal, suitable for the moment, variety.	10 %	6 %
Novelty	Novelty, difference, variability.	5 %	1 %
Other	Values, name of the sample, choice by random.	2 %	1 %

quality is essential and the primary factor in the familiarization and acceptance of a new food product. However, familiarization requires repeated exposure. (Pliner & Stallberg-White, 2000) demonstrated the effect of repeated exposure to dips on the willingness to taste and expected liking of different kinds of chips, together with the exposed or unfamiliar dip in children. Higher familiarity with the dip increased the willingness to try even an unfamiliar chip (Pliner & Stallberg-White, 2000).

Olsen, van Belle, Meyermann, and Keller (2011) also showed that only small modifications of familiar foods have little to no effect on their

liking suggesting that while novel and unfamiliar products alone can be challenging for consumers to accept, combining them with familiar elements can enhance their acceptance. The results of our study suggest that the prototype Baltic herring preservative interests users of similar product types. With careful food product development and seasoning there is potential for the product to reach higher pleasantness among the users as well as the non-users of pickled fish. Thus, the Sub-study I focused mainly on the effects of familiarity on the pleasantness of the intrinsic, i.e., the sensory properties of the samples. It also demonstrated the importance of careful product development.

However, the eating experience also consists of other factors, such as the product information or eating environment. These are called extrinsic factors. Indeed, [Bolha, Blaznik, and Korošec \(2020\)](#) suggest that research samples should be studied in multiple different situations. Blind testing can give different results from, e.g., informed conditions since the name and expectations of the product have been shown to affect its pleasantness ([Yeomans, Chambers, Blumenthal, & Blake, 2008](#)). Therefore, in Sub-study II, the pleasantness of six pintxos based on Basque, Spanish, Catalan, Italian, and Mexican food cultures were evaluated in a specific context; The samples were presented visually and with spoken narratives ([Fig. 1](#) and [Table 3](#), respectively) with the actual sample names on the table. The Baltic herring preservative prototype was identified as a potential new raw material based on the results of Sub-study I due to the sample's familiarity and its effects on pleasantness, as well as the milder sensory properties identified in an earlier study ([Logrén et al., 2022](#)) compared to the traditional, vinegar-treated version. Therefore, it was used as a Finnish ingredient in Sub-study II. Oat was used as another example of a typical Finnish ingredient due to its increased consumption in recent years ([Official Statistics of Finland & Natural Resources Institute Luke, 2024](#)). Two of the samples contained only the Baltic herring preservative, two contained only oats, and two contained both.

Two of the highest-rated samples in overall pleasantness were Coca and Nachos, of which Coca contained only the prototype Baltic herring preservative and Nachos contained also oats. The preservative had added seasoning and the pintxo recipes were carefully developed and chosen for the study. This shows, that even though as a raw material the preservative did not appeal, in ready-made products with added elements of international food cultures it is a noteworthy ingredient and an alternative option for the traditional, vinegar-treated Baltic herring preservative.

A situational context was created for the evaluations in the Sub-study II by introducing the samples with spoken narratives and evaluating them in multisensory environments. The samples were also presented on the table with name tags and allergens. Hardly any difference in the hedonistic ratings between the two multisensory environments nor the first or second evaluation was found. However, the two repeated evaluation sessions showed clear differences in the choices of the products, indicating that the preferred samples were decided during the first evaluation but only after the first choices were made. A thematic analysis, showed that the participants were not able to form opinions of the intrinsic, i.e., sensory properties of the products in the first evaluation, but rather the extrinsic factors such as impression, or expectations, in addition to appearance were highlighted as the reasons behind the choices. [Arvola et al. \(1999\)](#) showed that the purchase attitude and behavior are stronger towards familiar compared to novel products.

However, a shift from extrinsic to intrinsic factors in the arguments for the choices was observed already during the second evaluation. The role of familiarity and sensory properties emerged as the justification for the choices, whereas the roles of impression and curiosity decreased. Earlier studies have identified a similar phenomenon where consumers unfamiliar with products rely on extrinsic properties, i.e., description, product name, and package information, and those familiar with the food product rely on the intrinsic properties, i.e., the sensory properties of the product ([Banović, Fontes, Barreira, & Grunert, 2012](#); [Nacef et al., 2019](#)).

Even though the samples were evaluated in a specific situational context instead of a typical sensory laboratory environment the results still indicate the importance of the intrinsic properties after the participants had had an opportunity to further familiarize themselves with the samples. However, it is likely that the created situational context also had an effect on the overall pleasantness of the samples and, thus, the effect of the atmosphere and other extrinsic factors should not be ignored. Furthermore, in Sub-study I the prototype Baltic herring preservative as raw material was not appealing to consumers, but when it was further developed and used as a key ingredient in products served in a specific context in Sub-study II the pleasantness as a whole was high. Indeed, the appealingness of and interest in new foods can also be affected in other ways than only by taste exposure. For example, [Birch, McPhee, Shoba, Pirok, and Steinberg \(1987\)](#) found that the more often foods were visually exposed to children the more preferred the food was. Similarly, [Houston-Price, Butler, and Shiba \(2009\)](#) found that showing children pictures of unfamiliar vegetables and fruits increased their willingness to taste them.

This study shows that by combining elements from global food cultures it is possible to increase the interest towards traditional ingredients. The findings confirm the results of [Messeni Petruzzelli and Savino \(2015\)](#). In the case of Baltic herring especially, by combining elements from Basque, Spanish, Catalan, Italian, and Mexican food cultures with a traditional Finnish ingredient it was possible to develop products with high pleasantness for Finnish consumers.

4.1. Limitations of the study

Some limitations in the study were identified. In Sub-study I, the used familiarity scale had some disadvantages, and thus the scale needed to be combined into three categories instead of the original five. Despite this, the familiarity results of the samples can be distorted and the familiarity of the samples could be even higher. What is more, the commercial products had an advantage in the study design, since they had already gone through a detailed product development and marketing process whereas, e.g., the seasoning of the developed products had not been tested beforehand. Additionally, the ingredient lists of the samples were not edited to a similar form; the fishing area of Baltic herring was stated in some samples and the use of *E*-numbers was inconsistent. This study did not consider the purchase intention of the developed products and, thus, even though the product is perceived as pleasant, there are also other factors affecting whether or not the product ends up in the consumer's shopping basket. In Sub-study II it was impossible to test one variable, such as the environment, repeated evaluation, and sample description, at a time, and therefore, multiple elements in the study design were varied. Therefore, we were not able to determine the exact cause of the changes between the settings, and the results were viewed as a whole.

5. Conclusions

In conclusion, the commercial fish products were found more pleasant than the prototype fish products. The overall pleasantness ratings of the prototype products varied between 3.7 and 4.7 out of 7, on average. However, the pleasantness of the prototype pickled fish product as well as that of the commercial products increased with increasing familiarity. The users of traditional pickled fish also found both commercial and prototype pickled fish products more pleasant than those not using the products.

The prototype pickled fish product was incorporated into dishes that combined elements from global food cultures with traditional ingredients. It was found that in the case of new products, consumers relied on appearance and impression, whereas intrinsic factors, i.e., sensory properties, weighed less. When the dishes became more familiar, the intrinsic factors were relied on more. In this case, it was possible to develop products liked by Finnish consumers by combining a

traditional but nowadays less popular Finnish ingredient with elements from global food cultures, in this case with Basque, Spanish, Catalan, Italian, and Mexican food cultures. This fusion cuisine-based approach may support the rediscovery and modern use of traditional ingredients whose interest among consumers has decreased.

CRedit authorship contribution statement

Nora Logrén: Writing – original draft, Visualization, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Terhi Pohjanheimo:** Writing – review & editing, Supervision. **Mari Sandell:** Writing – review & editing, Supervision. **Anu Hopia:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Funding acquisition, Formal analysis.

Ethical statement

The study was conducted in accordance with the Declaration of Helsinki and all participants consented on participation. The study was approved by the Ethics Committee of the Hospital District of Southwest Finland (Sandell 145/1801/2014) (Sub-study I) as well as by the Ethics Committee for Human Sciences at the University of Turku, Humanities and Social Sciences Division (Sandell 12.5.2021) (Sub-study II).

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Author contribution

Nora Logrén: Conceptualization, Methodology, Formal analysis, Investigation, Data Curation, Writing – Original Draft, Visualization, Funding acquisition. **Terhi Pohjanheimo:** Writing – Review & Editing, Supervision. **Mari Sandell:** Writing – Review & Editing, Supervision. **Anu Hopia:** Conceptualization, Methodology, Formal analysis, Resources, Writing – Review & Editing, Supervision, Project administration, Funding acquisition.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.foodqual.2025.105631>.

Data availability

Data will be made available on request.

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