

Modification of Consumer Perception when *Sous-vide* Technology is Applied to a Fish-based Product

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Abstract Two studies were conducted using projective techniques due to the need to increase fish consumption in some populations and consumer demand for convenience foods. The first study explored the perception of 156 consumers of fish, meat, chicken, and lentil burgers using the Word Association projective technique. The second study used the Dialogue Completion technique to explore the perception of 162 consumers of fish burgers with vacuum cooking (*sous-vide*). In both studies, the fish burger received a low number of *like* mentions (18 and 24%), but 14% of consumers were interested in tasting the burger with vacuum cooking due probably to the perception of practicality. The price did not show to be a barrier to purchasing the product. The smell that at first could appear as a motive for the dislike of fish burgers (31%) in the study of the Word Association, disappeared when the product is prepared with vacuum cooking and therefore there was no reason for rejection. In the Word Association study, there is 25% of mentions regarding the benefits to health linked to the fish burger, but then in the second study, it disappeared due probably to the lack of confidence regarding fish freshness and the perception of some consumers that this product has preservatives and other additives. At the time to introduce a novel product in the market such as fish burgers with vacuum cooking, it is necessary to take into account the negative associations that consumers have regarding the product. Therefore, it is necessary to find an effective information strategy that remarks the practicality, nutritional benefits, and absence of additives as well.

Keywords: *sous-vide*, burger, fish, Word Association, Dialogue Completion, projective acceptability

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1. Introduction

Globalization and lifestyle changes have promoted great modifications in food patterns, causing a significant increase in non-transmitted diseases [1]. When talking about healthy food we think of a balance in which all groups of food and their components are integrated. Food in which fish is included helped disease prevention; the omega-3 fatty acids provided cardiovascular protection, increase good cholesterol levels (high density lipoprotein), reduced arterial pressure as well as developed an essential role during pregnancy, breastfeeding, and childhood [2,3]. Worldwide, 12 kg of fish consumption per year per person is recommended [4]. According to [5], in Latin American and Caribbean countries seafood consumption (except algae) is 9.9 kg per year per person. In Uruguay, as reported in the region, studies are confirming this low consumption [6,7,8].

The low consumption of fish has been a reason for concern in several studies worldwide. [9] in Russia, [10] in Australia, [11] in Croatia, [12] in Norway, [13] in Africa, [14] in Argentina and [15] in Mexico, report that the intake of this

important source of proteins is little by little being abandoned. Several workers have reported that the low frequency of fish consumption might be due to different barriers such as the difficulty perceived to purchasing, preparing, and/or cooking it, the belief that is an expensive food, sensory unpleasant properties associated with fish (spines or smell) as well as the risk perceived [8,16,17].

Generally, consumers demand comfortable and fresh foods with a minimal content of additives and low thermal processing, hence, there has been an increase in sales of “convenience food”, such as ready-to-eat, ready-to-heat, ready-to-end-cook and ready-to-cook worldwide [18]. Vacuum cooking or *sous-vide* cooking is one of the technologies to prepare convenience foods [19]. Those are raw or pre-cooked foods vacuum packed in heat-resistant vacuum seal bags, cooked by using moderate combinations of temperature (65-90°C) and for a long time (2-24 h), quickly cooled and stored allowed for reducing the water loss of the product during cooking but also preserved the sensory and nutritional quality of foods and spread out a product’s shelf-life regarding other methods of cooking-freezing [19,20].

For the consumer, a product is more than the sum of its attributes, it also implied an emotional component and a

symbolic meaning [21]. Good access to consumers' opinions and thoughts is through applying qualitative techniques such as projective techniques. The projective techniques allowed a condition of free interpretation and stimulus-response searching for an understanding of motivations, feelings, beliefs, attitudes, and deep reasons to choose alternative responses within a specific topic [22]. In the literature, the projective techniques are classified or subdivided into five categories: construction, completion, choice ordering, expressive, and association [23].

In the association task, the participants are asked to indicate the first words, images, or thoughts induced by a stimulus [24,25]. In this category, the Word Association (WA) technique has been the most used where the stimulus presented is a word or phrase [26,27]. For feeding products, the first associations that came to the consumers' minds are the most relevant in the process of selection and decision-making for purchasing [28]. The WA technique is one of the most used projective techniques due to its easy application and effectiveness to explore consumers' perceptions [29,30,31,32,33].

There are antecedents of the WA technique application on fish and products prepared with fish. Mitterer-Daltoé *et al.* [34] evaluated an image of a fish burger with 100 consumers. Latorres *et al.* [35] evaluated that a fish meatball with 132 students from a public school after tasting them. Mitterer-Daltoé *et al.* [16] evaluated that the following stimulus: "Today you will have fish for dinner at home" with 149 children from public schools. Godoy *et al.* [36] evaluated that images with 112 untrained assessors of the flathead gray mullet's general appearance, eyes, gills, and abdominal cavity obtained after 3, 6, 10, 15, and 19 days of ice storage.

In the Dialogue Completion (DC) task, the participant received a sentence, story, argument, or incomplete conversation and is asked to complete it. This technique can be divided into three types: (a) sentence completion, (b) story completion, and (c) dialogue completion. To complete dialogues, the stimuli are generally presented in bubble drawings which the participant is required to fill out with the characters' thoughts [24,25]. To date, several studies are reported to have applied this technique: ready-to-eat salads [23], cheese packages [37], frozen burgers [38], Petit-Suisse cheese [39] and snacks [40].

Although, there are numerous published studies regarding the benefits of vacuum cooking, there are very few studies regarding the consumer's perception of a dish prepared with this cooking technique, mainly in countries in which the dishes with vacuum cooking, out of the restoration area, are unknown and are not offered to the consumer. Through the Focus Group technique, [41] explored the perception Uruguayan consumers have regarding a product with vacuum cooking. The information reported was useful for the introduction of this non-habitual type of product in the market. To study the influence of vacuum cooking on the consumer's perception of a product made with fish, the burger presentation was selected. On one hand, because it is a popular fast food, currently and widely used in food due to its practicality, and on the other hand, because it can be an alternative to healthy food for the whole family [42].

The objective of this study was to use two projective techniques (Word Association and Dialogue Completion)

to do a preliminary study about consumer perception of fish burgers with or without vacuum cooking in a population with low fish consumption.

2. Materials and Methods

2.1. Participants

Two studies were held between September and November 2021. Since the present study was not intended to represent a specific segment of the market population but to explore the general consumer perception of a fish-based product, convenience sampling was used. Convenience sampling is a non-probabilistic method that is used in qualitative study, in which the participants are recruited according to the availability or convenience of the researcher [43].

For this work, online surveys were used to recollect data to obtain a large number of responses from geographically dispersed respondents, in a short-time and at a low-cost [38]. The online survey was held using RedJade software (RedJade, Redwood Shores, CA, USA). 340 participants were recruited through social networks. The only inclusion criterion was that participants were older than 18 years old. At the time of recruiting, the participants had to complete a survey regarding their social-demographic data (age, gender, marital status, number of children at home, level of education) and frequency of consumption of different types of meat. The participants were divided into 2 clusters so that there were no significant differences ($p > 0.05$) in their socio-demographic data nor the frequency of fish consumption, according to the chi-square test. The WA task was sent to 170 recruited and the DC task was sent to the other 170 recruited.

2.2. Study 1: Word Association

Four names of different products were presented to participants for the WA method: red meat burger, chicken burger, fish burger, and lentil burger. No description or photograph of the burgers was given. The participants were asked to provide the first four words (images, associations, thoughts, or feelings) that came to their minds when each of the four stimuli was presented. For instance: *What are the first four words that come to mind when you think of a fish burger?* Each stimulus was presented randomly for each participant. Under the name of the stimulus, a white space was left to write what the participants considered necessary. At the beginning of the questionnaire, there was a brief explanation about the study, the confidentiality of the data, voluntary participation, and email contact for any questions.

2.2.1. Data Analysis

The words associated with each type of burger were qualitatively analyzed. A first analysis of the recurrent terms was held by grouping the terms with similar meanings in categories. The procedure was based on the personal interpretation of the researchers regarding the meaning of the words. The researchers held the analysis individually, and the results obtained were thoroughly

discussed later. The final categories and their name were finally agreed upon by consensus. The frequency of mention for each category was determined by counting the number of participants who used similar words to describe the concepts included within each category. Only, one mention was considered if the participant used more than one word within the same category. Once the frequencies of mention were calculated, only the categories mentioned by more than 5% of the respondents were considered. This cut-off point was selected to avoid the loss of a significant amount of information [26,44].

A Cochran's Q test was performed to determine statistical differences in the frequency of mention of each category for each stimulus [45], and the information was visually presented through a Correspondence Analysis [26]. The Correspondence Analysis allowed us to graphically observe the relationship between the types of burgers and the word categories.

A chi-square test was performed to explore the influence of age, gender, marital status, number of children in the family, level of studies, and frequency of fish consumption according to the frequency of mentions of the responses. The statistical analyses were performed using the XL-Stat 2021 software (Addinsoft, NY).

2.3. Study 2: Dialogue Completion

A stimulus was designed to orient the responses of the respondents to the product [23]. The stimulus consisted of the image of a couple in a place for purchasing food. The man told the woman: "Look at these vacuum-packed fish burgers. They are already cooked and you just have to heat and serve, what do you think?" Participants were instructed to write the woman's response as they thought pertinent. At the beginning of the questionnaire, there was a brief explanation about the study, data confidentiality, voluntary participation, and email contact for any questions.

According to [38], it is essential to catch the attention of the respondents and rely on their interest in completing the test online. To achieve that, an image with good resolution, good colors, and which represented relatively ordinary consumers among the Uruguayan population was used. Common words used by the population were used for the sentence. In the beginning, the correct interpretation of the stimulus was confirmed through a pilot test with 10 assessors.

2.3.1. Data Analysis

First, a search for recurring terms was performed on the responses obtained. In the second place, the researchers, independently and based on their interpretation, grouped the terms with similar meanings into categories. Lastly, final categories were obtained by consensus. Those categories mentioned by more than 5% of the respondents were considered. This cut-off point was chosen to avoid losing significant information [26,44]. In each category, the frequencies were determined by counting the number of participants who used similar terms to assess the stimuli presented.

Chi-squared test was used to explore the influence of age, gender, marital status, number of children in the family, level of studies, and frequency of fish consumption according to the frequency of mentions of the responses. The analyses were held with the XL-Stat 2021 software (Addinsoft, NY).

3. Results

156 participants completed the WA task, and 162 participants completed the DC task. Table 1 showed that the socio-demographic characteristics and frequency of fish consumption by the participants who completed the survey.

Table 1. Socio-demographic characteristics and frequency of fish consumption of participants

	Study 1 (WA task) n = 156	Study 2 (DC task) n = 162	P- value Chi-square test
Gender			
Male	39.1 %	35.2 %	0.470
Female	60.9 %	64.8 %	
Age			
18 to 30	48.7 %	37.7 %	0.138
31 to 50	34.6 %	42.0 %	
51 to 70	16.7 %	20.4 %	
Marital Status			
With a couple	39.1 %	44.4 %	0.334
Without a couple	60.9 %	55.6 %	
Children at home			
0	85.2 %	77.1 %	0.147
1-3	14.7 %	20.5 %	
Educational level			
High school graduates and undergraduates	21.2 %	18.7 %	0.098
College graduates and undergraduates	28.8 %	19.3 %	
University graduates	50.0 %	59.6 %	
Fish consumption			
Never	17.9 %	12.0 %	0.353
Occasional (1 to 3 times a month)	53.2 %	53.6 %	
Regular (1 to 7 times per week)	28.8 %	31.9 %	

Table 2. Results of the WA task. The number of mentions within each category and Cochran's Q test for significant differences in frequency of mention of categories between stimuli (n=156)

Categories	Red meat burger	Chicken burger	Fish burger	Lentil burger	p-value
Benefits for health	7	23	39	79	<0.0001
Color	11	23	13	24	0.005
Consumer	5	4	5	66	<0.0001
Dislike	22	48	58	46	<0.0001
Flavor	16	18	21	34	0.008
Garnish	41	25	8	12	<0.0001
Ingredients	41	44	36	11	<0.0001
Like	74	45	28	44	<0.0001
Method of consumption	44	15	11	14	<0.0001
Method of cooking	32	23	18	1	<0.0001
Ocassion of consumption	35	3	10	5	<0.0001
Place of consumption	27	9	1	2	<0.0001
Practicality	12	4	4	5	0.012
Prejudices for health	15	6	0	0	<0.0001
Preparation	21	16	12	12	0.215
Seasoning	14	16	16	15	0.970
Smell	6	3	48	1	<0.0001
Texture	31	58	26	48	<0.0001
Unknown	5	28	40	28	<0.0001

Table 3. Results of the WA task. Examples of individual associations

Categories	Red meat burger	Chicken burger	Fish burger	Lentil burger
Benefits for health	*	Protein, healthy, good	Healthy, good, omega-3, nutritive	Healthy, iron, proteins, fiber, nutritive, good
Color	Brown, red	White	White	Brown
Consumer	*	*	*	Vegetarian, vegan
Dislike	Junk food, do not like, reject	Disgust, dislike, awful, do not like	Disgust, dislike, awful, do not like	Awful, do not like, boring
Flavor	Tasty, salad	Little flavor, tasteless, insipid	No flavor, salad, soft flavor	Little flavor, insipid
Garnish	Lettuce, tomato, cheese, French fries	Lettuce, tomato, salad	Rice, puree, salad	Salad, vegetables
Ingredients	Fat	Cartilages, waste	Hake, salmon	Lentils
Like	Delicious, tasty, want to eat	Delicious, tasty	Tasty, want it	Delicious, love it, tasty
Method of consumption	In a bun	In a bun	In a bun	In a bun
Method of cooking	Barbecue grill	Fried, grilled	Fried	*
Ocassion of consumption	Meeting with friends, birthday parties	*	Beach, summer	*
Perjudices for health	Oily, unhealthy	*	*	*
Place of consumption	Fast food restaurants	Fast food restaurant	*	*
Practicality	Quick preparation	*	*	*
Preparation	Homemade, processed	Homemade, processed, ultra-processed	Processed industrialized	Homemade
Seasoning	Mayonnaise, ketchup	Mayonnaise, ketchup	Lemon	Mayonnaise, soy sauce
Smell	*	*	Fish smell, awful smell, strong smell, smelly	*
Texture	Juicy	Dry, juicy, crispy	Light, dry, soft, loose	Rough, dry, pasty
Unknown	*	Strange, no idea, never tried one	Strange, never tried one, curiosity	Not very common, never eaten, curiosity

* Examples of categories with less than 5% of mentions are not included.

3.1. Study 1: Word Association

1575 valid words were obtained from the respondents, equivalent to an average of 2.5 associations per participant. All the participants could be provided a minimum of two different associations for each burger. The words were grouped into 19 categories. Table 2 and Table 3 showed that both the categories from resulting words and the examples of personal associations.

According to the type of burger, significant differences ($p < 0.05$) were found in the frequency in 17 of the 19

categories. This result showed the different associations used by the assessors in response to the different burgers used as stimuli. The *like* category presented the highest number of mentions (191), in which the most relevant terms were: delicious and tasty. The red meat burger received the highest number of mentions within this category (47.4%) whereas the fish burger received the lowest number of mentions (17.9%).

The second category with the highest number of mentions was *dislike* (174), in which the following were included: disgust, dislike, and do not like. To

approximately a third part of the assessors, the chicken, fish, and lentil burgers caused *dislike* whereas the red meat burger received the lowest number of mentions in this category.

The *texture* was another of the categories with a high number of mentions (163), the chicken and lentil burgers were mainly described as dry. In the category of *benefits for health*, chicken, fish, and lentil burgers received a high number of mentions (148) opposite to the red meat burger. The latter was the only one that received negative mentions regarding health by the 10% of the respondents (not healthy, oily). 50% of participants considered lentil burgers healthy due to their iron, protein, and fiber contribution. 25% of participants considered the fish burgers healthy and nutritious due to their omega-3 contribution.

42% of the participants linked lentil burgers with vegetarian and vegan consumers. The fish burger presented the highest number of mentions as an *unknown* product (strange, never eaten). The highest number of mentions of *dislike* (37.2%) for fish burgers can be linked to the highest number of mentions regarding *smell*. 30% of participants considered the fish burger was going to have a strong and awful smell.

The relationships between the types of burgers and their associations are reflected in the results of the correspondence analysis (Figure 1). The analysis explained 89.6% of the variance. Factor 1, explained that 56.9% of the variance, was positively correlated with the *garnishes*, *the method of cooking*, *the method of*

consumption, *the place of consumption*, *the occasion of consumption*, and *the prejudices for health*, and negatively with the *consumer* and *the benefits for health*. Factor 2, which represented 32.6% of the variance, was positively correlated with the *consumer* and negatively with the *smell*.

The red meat burger received the highest number of mentions of *like*, and as a popular food, was the most linked to the *method of cooking* (barbecue grill), *the method of consumption* (in a bun), *the place of consumption* (fast food restaurants), *garnish* (vegetables, cheese, French fries), *the occasion of consumption* (meetings with friends, birthday parties) and the *practicality*, though considered by some of the participants less healthy, mainly due to its fatty content.

The chicken burger received similar percentages of mentions of *like* (28.8%) and *dislike* (30.8%). The dislike could be explained by the ingredients which the consumer thinks are made of (cartilage, waste).

The lentil burger was considered the healthiest, due to its content of nutrients, although 29.5% of the respondents expressed their *dislike* in presence of this stimulus, which could be explained by the flavor perception (little flavor, insipid) and the texture (rough, dry, pasty). It was mainly associated with vegan and vegetarian consumers.

The fish burger received more mentions of *dislike* (37.2%) than *like* (17.9%) and was the most unknown (25.6% of evaluators never tasted it and seemed strange to them). The main associations were with the *smell* (awful, strong) and the *benefits for health* (nutritive, healthy).

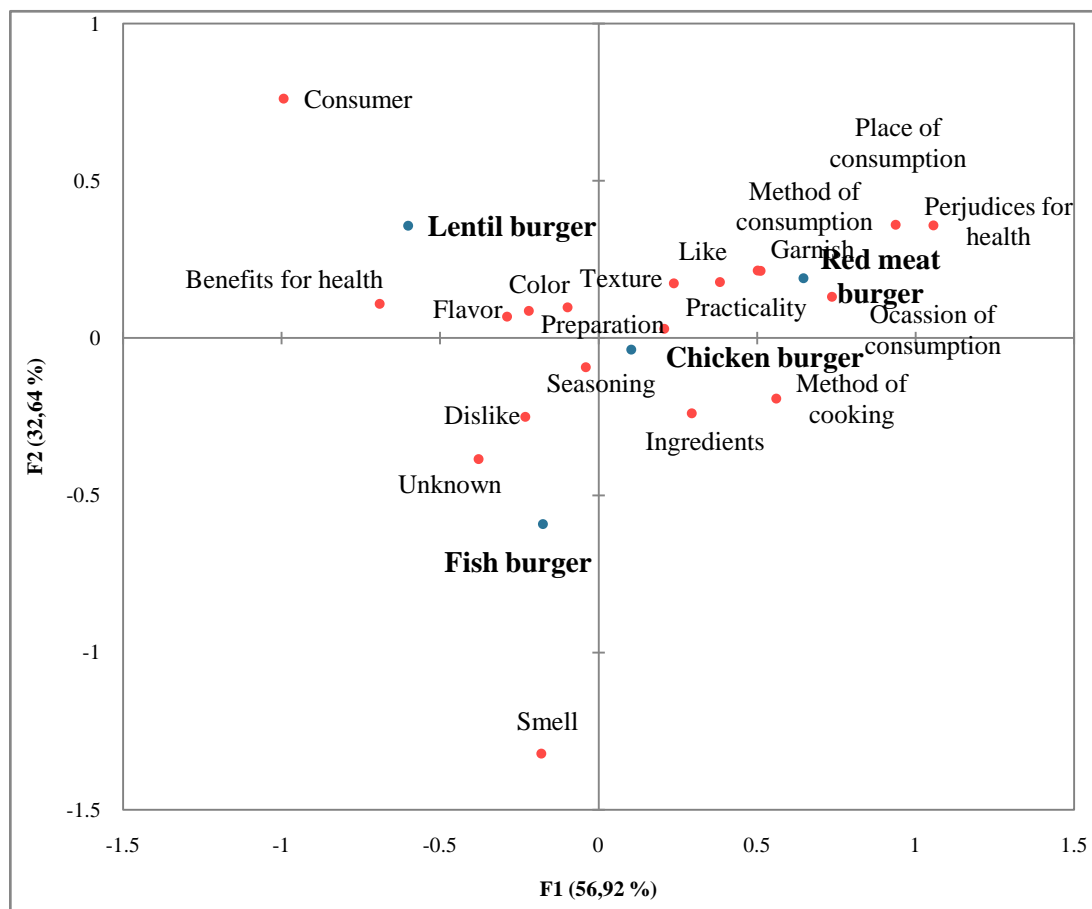


Figure 1. Correspondence analysis plot for the categories associated with the different burgers during the WA task

According to the chi-square test, no influence of marital status or educational level was found in the frequency of mentions of the responses ($p>0.05$) about fish burgers. The influence of gender, age, the number of children in the family, and the frequency of fish consumption were found in the frequency of mentions of some categories.

Women presented the highest number of mentions of *dislike* to fish burgers than men did (45.3% vs 24.6%, $p=0.009$). Young participants (18 to 30 years old) had a higher number of mentions to *smell* than the other age clusters (39.5% vs 24.1/19.2%, $p=0.045$), whereas the participants between 31 and 50 years old presented a higher number of mentions regarding health benefits (37.0% vs 18.4/19.2%, $p=0.041$). The participants with children had a higher number of mentions regarding the preparation (homemade) than the ones without children (17.4% vs 6.0%, $p=0.049$).

The more fish consumption the fewer mentions regarding the *smell* of fish burgers. 50% of no consumers mention the *smell*, whereas those values decrease to 30.1% among the occasional fish consumers and 20.0% among the regular ($p=0.026$). Also, no fish consumers gave a significantly higher number of mentions about the texture (35.7% vs 13.3/11.1%, $p=0.011$).

3.2. Study 2: Dialoge Completion

The identified categories in the DC task are shown in Table 4.

Table 4. The identified categories in the DC task (n=162)

Categories	Example of mentions	Number of mentions
Dislike	...horrible, do not purchase, do not like	47
Like	...take them, excellent, great, good option	38
Mistrust	...do not trust, how are made of? What else do they have? Will they be tasty? Synthetic	44
Perjudices for health	...not very healthy, full of sodium, something to eat but not to feed	8
Practicality	... save time, practical, pull through, easy and quick	33
Preference	...prefer to make them, prefer no-processed, prefer to purchase fresh fish	37
Purchase potential	...we should try, let us buy to try	22

Due mainly to their practicality, more than a third part of consumers liked the idea of the product and showed purchasing potential (37.1%). On the other hand, 27.1% of the respondents rejected the product, mainly for the mistrust of their ingredients, as they think these products have preservatives and/or because they are not healthy or have too much sodium. Near 23% of the respondents declared their preference to purchase fresh fish and/or make them at home, rejecting industrialized food.

According to the chi-squared test, no influence was found either in the age or the level of studies in the frequency of mention of the responses ($p>0.05$) regarding the stimulus presented. The influence was found regarding gender, marital status, number of children in the family, and frequency of fish consumption, in the frequency of mentions of some of the categories.

Men presented a higher percentage of mentions regarding the *purchasing potential* than women did (21.8 vs 9.3%, $p=0.028$), whereas women mentioned the health prejudices linked to the product (8.0 vs 0.0%, $p=0.038$).

The participants with couples gave a 33.3% of mentions of *like* versus 15.6% of mentions of *like* of the participants without couples ($p=0.008$). The participants with children gave a higher number of mentions regarding *dislike* (47.1 vs 24.2%, $p=0.009$) and *mistrust* of the product (32.4 vs 15.6%, $p=0.028$).

50% of no consumers expressed *dislike* to the product, versus 22.5% of mentions of occasional consumers and 32.1% of mentions of regular consumers ($p=0.041$). The cluster of regular consumers gave the highest number of mentions regarding their preference for fresh fish (20.8% vs 5.0/5.6%, $p=0.012$), whereas the cluster of occasional consumers gave a higher number of mentions of the *practicality* of the product (27.0% vs 5.0/15.1%, $p=0.045$).

4. Discussion

As it is reported in other studies, the participants of this study were mainly women without children and with high education levels, presumably as a result of a higher availability to participate in a survey [46]. In addition, only 30% of respondents regularly consumed fish. This low consumption is in accordance with what the FAO established concerning the intake of seafood products in Latin America and the Caribbean, a region that has not accomplished the recommendations of consumption yet. Their consumption is 9.9 kg of fish a year per person. In Uruguay, the studies showed 8 g of consumption per person a day [5,6,7].

The red meat burger received the highest number of *like* mentions (47%), versus the fish burger which received the lowest number of mentions in this category (18%). Lentil and chicken burgers presented lower mentions of *like* than red meat ones. This can be regarded as either the red meat burger being a popular food or the food habits of the Uruguayan population which consumed 91.2 kg of red meat a year per inhabitant [47].

On the contrary to the high *like* mentions, the red meat burger received a lower percentage of mentions regarding health benefits due to the link with high amounts of fat. The other burgers were named as healthy, with positive attributes which highlighted the contribution of nutrients such as proteins, fatty acids, fiber, etc. In this way, the contrast caused by certain foods is evident as it has not been possible to connect the *like* and health benefits they can be contributed, something that is a challenge for food innovation. In addition, the study showed that the surveyed population has some nutritional knowledge, which can be explained by the high percentage of participation of university participants (50-60%) which matched with what [48] reported that there is a direct relationship between health knowledge and healthy habits in the university population.

Many studies have shown that the necessities of the consumer's convenience are correlated with food choice [49]. According to contemporary lifestyles, food products that save time and are practical to prepare are more

present in homes daily [50]. Although, Scholderer and Trondsen [51] considered that the negative evaluations associated with fresh fish will make people tend to consume more and more processed fish products, the fish burger did not have more than 18-20% of *like* mentions in each of our study respectively and several mentions of high *dislike* (37 and 29%, respectively). These results matched what [34] reported. They suggested that the reason for this rejection is probably because a fish burger is a very unknown concept.

In the WA study, no mentions were linked to the fish burger's practicality. As it is an unknown product and does not exist in the Uruguayan market, perhaps the surveyed population thought of a homemade preparation of the fish burger and therefore they did not consider it practical (Table 1). However, when in the second study, the fish burger was presented vacuum packed and cooked, and ready to serve, 20.4% mentioned its practicality. At the same time, 22.8% said that they preferred to do it homemade, and with fresh fish. 8.6% of respondents considered that the product has preservatives and other additives (Table 2).

Although, the fish burger could overcome the limitations of purchasing, preparing the product, and avoiding the presence of fish spines, the "fish burger" stimulus had a 37% of *dislike* mentions which decreased to 29% when the product was prepared with *sous-vide* technique. The *dislike* expressed in our study could be implied difficulties to introduce the product in the Uruguayan market.

The price is a factor that influenced the choice of food and played an important role in determining food patterns [52]. Although in several studies [10,53,54], the cost appeared to be a barrier to fish consumption, in our study the price received a very low number of mentions, maybe because of "burger" presentation is commonly associated with an economic preparation [55]. The countries with high and middle-high incomes are the greatest consumers per capita [5], and in Uruguay, this can be seen as a limitation when fish is purchased [56].

In our study, the smell appeared as a motive for *disliking* fish burgers (31% of the respondents mention awful and strong smell), which highlights the concern that fish smells generally cause [54]. However, in the second study that perception disappeared and there are no mentions linked to smell. These outcomes match with what [8] informed in their study of the Brazilian population, where the smell did not appear as a consumption barrier. The authors suggested that when the members of that population think of fish, they are thinking of processed fish, almost ready to eat (as in a restaurant, or fish nuggets, pre-fried). In our study, the fish burger product caused associations of *smell* similar to the associations with fresh fish, which strengthens the idea that in the WA study, the participants thought about having to prepare the fish burgers themselves. This association disappeared when the product was processed, as the second study proposed.

In the WA study, there are 25% of mentions of health benefits linked to the fish burger, which matches with the image reported in other studies of the fish burger as a healthy product [34]. Some mentions of omega 3 within this category showed that the participants did know this

fatty acid and related it to fish. Older consumers especially gave more mentions regarding the benefits of the fish burger to health. This matched what [57] found, that older consumers thought of health as the most important characteristic at the moment of choosing food. The associations with the health benefits disappeared in the second study in which there is no mention. Besides, 5% of consumers think the fish burger vacuum packed and cooked is not that healthy (Table 1). This might be due to a mistrust regarding fish freshness and the perception of some consumers that this product has preservatives and other additives. These findings supported the idea that for introducing this product in the Uruguayan market, the absence of additives needs to be indicated on the package.

What was reported by other authors matched the idea that young people have given more mentions of the *smell* of a fish burger. Myrland *et al.* [58] reported that when there are adolescents (from 12 years up) at home, there is a negative relationship with fish consumption due to the smell and flavor of this food.

Regular fish consumers made fewer mentions of *smell* in the first study and fewer mentions of *dislike* in the second study, although in that study they had a higher number of mentions of preference for unprocessed fish and fresh (Table 2). This matched what [34] reported where the consumers considered the fish steak as much healthier than a fish burger which was related to a processed product with a lower nutritional value, and maybe also linked with fast food compared with a fish steak prepared in the barbecue (linked to homemade food). Other studies also have reported that the products of processed fish generally are not perceived as very healthy as fresh products [59].

Either in the WA study or the DC task, women gave more mentions to *dislike* of the products. In homes with children, there were a higher number of mentions of *dislike*, about the mistrust regarding the ingredients as well as preference for homemade cooking (possibly motivated by the concern regarding the food their children consume). These results match what [60] reported in which it is shown that in families, women are the ones who took care of giving food more nutritionally adequate and adapted to their children's likes. Opposite to men who prioritize practicality.

Abalos *et al.* [61], have shown the mistrust and insecurity that vacuum-cooked food (*sous-vide*) caused consumers. Although, the results have reflected the importance of practicality for consumers, there is also a great ignorance regarding this technique. The same was reported by [41] in another study with Uruguayan consumers who gave a negative opinion about the *sous-vide* technique based on their mistrust and the possible use of additives. This matched what consumers expressed in this study regarding that this type of product can have added preservatives and other ingredients which generate doubts (27%), and therefore they can be harmful to health (5%).

5. Conclusions

The WA and DC techniques allowed us to know the consumers' perception of a novel product for a

market where convenience products prepared with a cooked/preservation method have not been introduced yet. In our study, the ignorance about fish burgers goes together with the ignorance about vacuum cooking. This is reflected in the number of mentions of *dislike* and *mistrust* towards the *ingredients* and *benefits to health*.

When developing a novel product with vacuum cooking to be introduced in a non-traditional market of similar products, it is necessary to take into account the negative associations consumers have concerning the product, and therefore it is necessary to find an effective information strategy that remarked the practicality, nutritional benefits, and the absence of additives of a product obtained through this cooking technique.

The findings of this study contributed to the present literature regarding how consumers perceive *sous-vide* products. Further research must be required to evaluate the acceptability of these products, preferably with the fish-based burger presentation prepared with this technology of vacuum/preservation.

Competing Interests

The authors have no competing interests.

List of Abbreviations

WA: word association.

DC: dialogue completion.

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