# Chapter 5
# Development of Gastronomic Strategies for the Application and Valorization of New Inverse Emulsions of Vegetable Origin

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## 5.1 Introduction

According to the 2018 EU Food and Drink Industry Annual Report, the agri-food and beverage industry is the main sector of activity in Europe, with an annual turnover of 1.109 billion euros of exports, 4.57 million workers, more than 294,000 companies and 500 million consumers worldwide. Still in the report referred to, it is pointed out that 13.8% of the European family budget is used in food and beverages, as Portugal represents 18% (FooddrinkEurope 2018).

In the last few decades, there have been large changes in the agri-food industry that have led to growing innovation in food production and supply. The new consumers demand is mirrored in the design and availability of tailor-made food production and idealization, whether from an adequate nutritional, health and wellbeing point of view or from the perspective of convenience, reliability and quality, including sustainable management and ethics of the resources used in its production (PlantFoods 2018).

These challenges are an opportunity for the development of new products and the creation of new niche markets. Therefore, there is R&D investment and particularly in the food technology, biotechnology, and nutrition fields (EMF 2018).

Currently, the use of surplus production and agri-food by-products is very desirable and necessary concerning production and consumption sustainability. Nevertheless, to satisfy the consumer, food innovation strategies must incorporate

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in their structure process not only consumer trends but also direct interaction with the consumer, anticipating their acceptance and commercial potential.

The key to the product-market experience success lies in the balance between responsiveness and proactivity and the short-term success of incremental innovation and the long-term success of more radical innovations. In the globalization phenomenon of the food market, innovation is an essential strategic tool to obtain a competitive advantage, stand out from the competition and meet consumer expectations. However, the more a food product is distinct, the more choices product development teams must make, and these choices must be according to consumer desires. Thus, the successful development of innovative food products requires an excellent understanding of consumers' perceptions, expectations and attitudes towards food products. For this reason, the integration of the consumer in the innovation and development of food product activities can increase the amount of diversified and customer-based knowledge, which helps to reduce the rate of innovation failures. Besides, consumer integration also helps to create innovative ideas and feedback on new product concepts or prototypes (Traynor 2013).

Spreadable creams are essentially water-in-oil emulsions. The lipid phase is usually a mixture of vegetable oils and/or oils and fats of animal origin containing natural dyes (β-carotene), stabilizers, emulsifiers, flavorings, antioxidants, lecithin, and fat-soluble vitamins. The aqueous phase contains proteins, skim milk, where small amounts of other ingredients, such as salt, preservatives, thickeners, and water-soluble vitamins (Nylander et al. 2008).

The emulsions used in this study are of two kinds (Lima 2014):

- oil in water emulsion: for this kind of emulsion the emulsifier must be soluble in the aqueous phase. If anionic or cationic emulsifiers are used, the lipophilic end of the molecule will be adsorbed on the surface of the lipid phase and the hydrophilic end will be at the interface. The charge developed on the surface of the oil droplets will cause the charged particles to repel similarly, and this will prevent coalescence, giving stability to the system. When nonionic emulsifiers are used, stabilization is due to hydration and hydrogen bonding of the hydrophilic end of the emulsifier molecule. A surfactant forms a protective film around the oil droplet, not being very soluble in water, otherwise, it migrates to the aqueous phase and forms a new micelle and, if that happens, oil droplets without protective charges coalesce and the MS breaks down.
- water in oil emulsion: in these emulsions, the hydrophilic part of the emulsifier molecule is dissolved in the dispersed water droplets and the hydrophobic end is oriented towards the lipid phase. In the absence of fillers, the viscosity developed by the orientation of the carbon chains in the continuous lipid phase is probably a stabilizing factor. To form this kind of emulsion, the emulsifier must preferably be soluble in the lipid phase, reduce the interfacial tension between the two phases, form a rigid and non-deformable interfacial film to prevent coalescence, and be quickly adsorbed at the oil interface.

Like traditional butter, spreads have several applications: bread, toast, crackers and other bases, can be used as an appetizer or side dish and/or to prepare other

types of food, including cold meat, roast beef and grilled meat or fish. It is not recommended for people who are allergic to any of its ingredients (Lima 2017).

Mustards are emulsified, oil-in-water (o/w) type vinegar products, in which the continuous phase is water and the dispersed phase, oil. The lipid phase is an oil of vegetable origin. The milled mustard seeds release surfactant phospholipids which help to stabilize the emulsion formed. Mustard creams are used as a seasoning and/or side dish of salads, fried and grilled meats, sandwiches or in the confection of sauces. Mustards are used to add flavor to several dishes and to enhance the piquancy and texture of several types of sauces. They also are important ingredients of the English mustard, the Dijon mustard, vinaigrettes and the Chinese hot mustard (Hrideek 2004).

In the case of these categories of products, the success in the development of new food products by total or partial substitution of certain lipids by plant species and their by-products (e.g. polymers) is based on ensuring the maintenance or improving the sensory characteristics of traditional products; as well as achieving the stability of the product over a period considered enough. New possibilities may rely on providing new sensorial experiences and new applications for these products (Ribeiro et al. 2015).

Many factors contribute to the acceptability of newly launched products both in the market and in the foodservice industry, like the organoleptic attractiveness of the product and its convenience of use. Sensory evaluation is therefore an important step in the food development process as it is its potential gastronomic use (Yang and Lee 2019).

Sensory characteristics, such as appearance, odor, flavor, and texture are included within the important attributes that contribute for the perceived quality of food products (IFT 1981). The food specialist's sensory acceptance assessment may contribute to the understanding of the potential of the food developed and, in the context of consumers' test, to the prediction of the overall success of the product.

The affective test, was the test used in this investigation, using acceptance tests by the hedonic scale and attitude or intention scale tests. With the affective test hedonic scale, the individual expresses the degree of liking or disliking a given product, globally, or concerning a specific attribute. The most used threshold are those of 7 and 9 points, which contain the defined terms located, for example, between "I liked it a lot" and "I disliked it a lot" containing an intermediate point with the term "I didn't like it; I didn't even dislike". The threshold must have a balanced number of categories for taste and disgust. Samples encoded with three-digit and random numbers are presented to the taster to assess how much he likes or dislikes each one, using the previously defined threshold. In the attitude or intention threshold of the affective test, the individual expresses his desire to consume, acquire or buy, a product that is offered him through the attitude or intention threshold. The most used threshold is the verbal threshold of 5–7 points. Coded and random samples can be presented sequentially to the tester to be evaluated using the pre-defined threshold. Defined terms can be, for example, between "probably would buy" to "probably would not buy" and, in the middle "maybe buy, maybe not buy".

The threshold must have a balanced number of categories between the intermediate point and the extremes (Instituto Adolfo Lutz 2008).

Bearing in mind the quite different and innovative flavors that the consumer is used to, concerning simple margarine, it will be imperative, to the product's success, to find flavor combinations that fit its purpose. There is the possibility of looking differently at the combinations of flavors within a dish when using food pairing tools. Food pairing is a scientific method for identifying which foods and drinks are well suited to each other. To understand why the ingredients, combine, it is important to know how humans perceive flavor (Page 2008).

It has long been known that our food experience is extraordinarily complex and involves all our five senses. Although vision—the impact of food color or the presentation—and hearing—the expectation of crunchiness—affects our perception, there is no doubt that our taste experience is composed, for the most part, of the essential taste, touch and smell sensations. The taste sensation is easily correlated with our taste experience. When tasting food, we detect the five basic flavors in our mouth and on our tongue: sweet, salty, bitter, sour and umami. The feeling we experience while biting and chewing food, makes us experience texture, freshness, and pungency. However, on average, only 20% of our taste experience is due to taste and touch. Much more relevant is our smell sense. Through this sense, we can differentiate up to 10,000 different odors. Odors are also known as smells, aromas or fragrances and consist of one or more aroma molecules. The aromas are volatile and reach our smell sense through the air we inhale. We perceive aromas through both the nose (nasal) and the mouth (retronasal) (Kort et al. 2010).

Combining this tool and available knowledge, comes the work of the chef or bartender or another food specialist who shows his experience and ability to generate recipes, techniques, and confections, knowing in advance that the chosen ingredients combine well with each other. To be able to use this application, it is necessary to access the website https://www.foodpairing.com/en/home and the tools available are more than 1500 ingredients, more than 250 drinks, the best combinations, the seasonality filter, unique ingredients, mixology ingredients, aroma filter and aroma wheel. Whenever an ingredient is selected, the algorithm calculates and presents possible aromatic combinations. The greater the aromatic combination, the greater the chance that these ingredients will combine well in a recipe. The tool finds complementary pairs, while the researcher, as a chef, has the task of creating the perfect balance between flavor and texture and to add depth and dimension to the delicacy (Foodpairing 2017).

Finding the right balance seems simple in theory, but it can be the most difficult part of the job when you're in a culinary workshop. It is not possible to build a recipe based only on complementary aromas, which can become uninteresting. As mentioned, only about 20% of our food and drink experience is due to taste and texture, while 80% is due to aroma. However, these factors contribute together to the overall experience and satisfaction and must be taken into account, together and not separately, when building a recipe. Therefore, it is not enough to pair ingredients only with similar aromatic profiles, but also ingredients that have contrasting tastes and textures (This 2006). For example, using bitter to contrast with salty: adding a

pinch of salt when baking a chocolate cake, contrasts with the bitterness of dark chocolate. You can reduce the intensity of a dessert by counterbalancing it with something acidic. Most of the delicacies that arouse our interest are those that exhibit a variety of textures, instead of those that lack texture, such as baby food that becomes boring after a few spoons. Some textures are part of two distinct groups: the soft textures and the crunchy textures. When building a recipe, at least one contrasting texture must be included for each of these groups to give dimension to the dish. This ability is usually innate, because naturally we already have an affinity to create these combinations (soft and crunchy foods), as are the example of french fries with mayonnaise or ketchup or chocolate mousse served with a biscuit or crumble. A mousse (soft texture) becomes more interesting when you add something crunchy like a cookie (Foodpairing 2017).

The aroma profile of culinary ingredients is the starting point of the Foodpairing® computer application and this work. First, Foodpairing® determines the aroma profile of a specific ingredient—with simple gas chromatography coupled with mass spectrometry (GC-MS). From these results, the scientists responsible for the Foodpairing® application extract the aroma data relevant to the human smell sense. For example, a strawberry contains a few dozen different aromas. However, only a few aromas stand out clearly and determine that precise strawberry smell. An aroma has to reach a certain threshold in a specific ingredient to be sensitive to humans. Through potential interactions, some scents that are below this threshold generate a detectable smell. Second, the Foodpairing® application uses scientific techniques, such as data analysis and computational machine learning, to create algorithms that calculate how food and drinks combine. This way, when different foods share certain key aromas, they are more likely to combine well in a recipe. The tool allows the discovery of pairings with considerable ingredients. From dairy to meat, from vegetables to spices, from spirits to coffees, from plants to insects, the Foodpairing® application has traveled the world in search of local products and unknown ingredients (Traynor 2013).

The ingredients combine when they have key aromatic compounds in common. Flavors are important, as our smell is responsible for 80% of our taste experience. These are the sum of the characteristics of any material placed in the mouth, perceived mainly by taste, smell and by the nociceptors and tactile receptors of the mouth (Burdock 1994).

There is a lot of literature regarding the listing of aromatic compounds present in foods. There are databases with ingredients that were analyzed in the laboratory to trace their aromatic profile (Burdock 1994; This 2006; Page 2008; Segnit 2010). Each result when compared to thousands of other profiles determines the best combinations.

According to Heston Blumenthal, in his book The Fat Duck Cookbook (2009), the consumption of food and drinks is part of the most satisfying and multisensory life experiences. Pleasure comes, not only from the oral sensations of taste and smell but also from the sight, feeling and sound that is perceived when eating.

For most chefs, innovation is not seen as a competitive tool from an economic point of view but as a differentiating marketing strategy in which, in most cases, it

is financed by them and where the barriers mentioned are the difficulty in obtaining capital, customer responsiveness, lack of innovative culture in general and lack of qualified human resources. The study supports Gomez et al. (2003) when he mentions the importance of the chef's leadership in the process, adding that his search for innovation is a differentiating factor regarding the competition. Innovative activities improve not only the dish but also the culinary process, efficiency, flexibility, productivity and compliance with hygiene and food safety standards by formalizing the routines resulting from the process. Innovative chefs develop and manage their brand as a fundamental part of the marketing activity as described by Gomez and Bouty (2009). The customer's opinion hardly influences these processes described above, the chef's source of inspiration being his team, his competition and gastronomic fairs and congresses, an idea corroborated by literature (Harrington 2004; Svejenova et al. 2007).

Globally, it can be considered that innovation, in the context of food production, including catering, should be considered a strategy, as there is the possibility of being a differentiating tool for the layout of a brand and in the focus of a market segment; it must be managed in such a way as to produce successful results in which the process's formal organization can lead to accurate reproduction and ensure quality. Cooperation with scientists and external researchers to the production context enhances innovation and the formal management of the process. Innovation requires time and space as creativity seems to emerge more easily outside the pressure of the work context; in the particular case of catering (culinary arts), training and the study of culinary techniques must be encouraged because innovation depends on this factor and not on intuition.

The objectives of this study were to assess the gastronomic potential and possible uses of water-in-oil (60–65% lipid phase) innovative inverse emulsion prototypes previously developed (Lima et al. 2017; Laranjeira et al. 2018), using both sensory evaluation and the Foodpairing® tool and also to develop new gastronomic applications, determining consumer's acceptance.

## 5.2 Materials and Methods

### *5.2.1 Samples*

Five samples were analyzed—three emulsions of strawberry and bell pepper (one red and one yellow) processed differently, with aqueous vegetable phase and two mustards with red fruits or beet. These products were recently prototyped and are characterized for the additions of vegetables and/or fruit syrups, with no tradition of manufacture or consumption in Portugal, preserving expensive/seasonal raw materials and value surplus/regional by-products and for having nutritional quality. These emulsions have a vegan or lactovegetarian profile, which can be used as substitutes for butter (fat phases using cocoa butter or coconut oil). Traditional

mustards (in vinegar) are distinguished by ingredients, flavors and unusual colors (Lima et al. 2017; Laranjeira et al. 2018).

## *5.2.2 Gastronomic Potential Evaluation*

### 5.2.2.1 Sensory Evaluation

To carry out a first sensorial characterization of each of the samples and to determine the perception of the respective potential of gastronomic use, a hedonic test was performed using a taste panel (experts—six Chefs and three food professionals), previously established. The general attributes were considered from the descriptors previously generated by the researchers. The individual parameters selected were as follows:- visual appearance and color (on appearance); smell/odor, flavor/aroma, taste persistence (gustatory smell): used a 9-point scale with defined terms situated between "poor" and "excellent";- texture, ointment and acidity (for mustard fruity creams): used a 9-point scale with defined terms situated between "extremely unpleasant"and "extremely pleasant". An overall assessment item (using a 9-point scale with terms defined between "poor" and "excellent") was also presented. In the scope of the test were also measured:- consumption potential and purchase intention: a 5-point scale was used with definite terms between "definitely no" and "certainly yes");- the culinary potential of the samples per se and as a basis for other preparations: a 5-point scale with definite terms placed between "definitely without application" and "certainly with application"); It was also asked to identify the emulsion fat in the case of the first three samples and comments on the potential culinary applications of all creams.

The samples were coded using a three-digit code and analyzed in the laboratory at a temperature of about 20 °C, similar to the one that is customary to use with natural fluorescent lighting.

### 5.2.2.2 Foodpairing Assessment and Recipe Development

The online Foodpairing® tool was used. Through the data obtained in the sensorial analysis performed on the samples, the main aroma of each sample was identified. This identified ingredient was selected in the online application. Then the other ingredient (s) that composed the emulsions were selected. In view of future developments, it was previously established the context of use of a possible delicacy: for Food Service or domestic consumption, since the level of difficulty of producing the recipe, and the type of ingredients used would have to be different. Then it was considered the order to appear in a possible menu—sauce, canapé, a cold starter, hot starter, main course of fish, meat main course, garnish and dessert.

Following, one or more ingredients were selected from the presented results, calculated by the application algorithm, as being the "best aromatic combination".

A recipe set was developed based on previous results with the online Foodpairing® tool and also based on the culinary know-how creative/aesthetic talent of the researcher. The following aspects were taken into consideration: presentation of the delicacy on the plate; Development of cooking methods in a cooking laboratory environment; presentation suggestion developments. There was a non-systematic evaluation by four members of the research team.

#### 5.2.2.3 Consumer Testing

A script of the tasting menu was established, selecting ten recipes according to their logical sequence in the menu, respecting the place of delicacies: cover, starters, vegetarian dish, a fish dish, meat dish and dessert. Additionally, a sensorial questionnaire in the form of a test book was developed, including the parameters of acceptance; purchase intention; marketing and use potential for each emulsion sample and each delicacy, in agreement with the scales identified in Sect. 5.2.2.1.

Finally, an acceptance test was carried out in a tasting lunch in a pedagogical restaurant for 40 consumers (domestic/food professionals).

### *5.2.3 Statistical Analysis*

Data were treated using the Statistical Package for Social Sciences (SPSS), IMB software version 24.0 and Excel spreadsheet software, Microsoft Office 365, version 16.0.The results were presented in mean ± standard deviation (SD) and frequency. Emulsions were accepted when they obtained an average ≥ 5.0 (equivalent to the hedonic term "neither good nor bad").

## 5.3 Results and Discussions

### *5.3.1 Gastronomic Potential Revealed*

The panel positively evaluated all emulsions (global appreciation mean values between 5.6 and 7) but none was pointed out as having potential gastronomic use by itself, but always as an ingredient of some composition. These tasters preferred the yellow pepper spread on all aspects except for the smell/odor; in this parameter the preferred one was the red pepper cream (Table 5.1).

The least appealing in terms of the visual appearance, color and greasiness was the strawberry cream because everyone noticed a lack of red color, characteristic of the strawberry and a weak greasiness, due to its high viscosity at room temperature.

**Table 5.1** Mean values of the parameters analyzed in the study by the expert's panel, using a 9-point scale with defined terms situated between "poor" and "excellent"

| | Strawberry | Yellow pepper | Red pepper | Beet and raspberry mustard | Raspberry and blueberry mustard |
|---|---|---|---|---|---|
| Appearance | 4,78 ± 2,11 | 7,67 ± 1,12 | 6,44 ± 1,51 | 5,67 ± 1,50 | 6,78 ± 1,30 |
| Color | 4,33 ± 2,00 | 7,78 ± 0,83 | 7,00 ± 1,41 | 5,33 ± 1,58 | 6,67 ± 1,50 |
| Aroma | 6,11 ± 1,96 | 6,22 ± 0,97 | 6,67 ± 1,22 | 6,22 ± 1,39 | 6,22 ± 1,99 |
| Flavor | 6,22 ± 1,79 | 6,78 ± 1,20 | 6,44 ± 1,01 | 5,33 ± 1,73 | 6,33 ± 1,41 |
| Overall quality | 5,67 ± 1,5 | 7,00 ± 1,00 | 6,22 ± 0,97 | 5,78 ± 1,64 | 6,44 ± 0,88 |

The second less appreciated was the beetroot and raspberry mustard cream, again by the visual aspect and the color little appealing and also because it is not homogeneous, being the presence of the seeds a depreciative factor, not only in this sample, but like in the others which also had this aspect (strawberry emulsion and raspberry and blueberry mustard) (Table 5.1).

Fats used in the emulsions were always identified (data not shown) (cocoa butter or coconut oil) and led to satisfactory aroma and flavor acceptance levels (>6). Studies related to cocoa butter have shown that it can be used to alter the introduction of fats into margarine and chocolates, making them healthier, to reduce the epidemic problem of global obesity by manipulating the percentages in their emulsions (Norton and Fryer 2012).

The sensory results obtained in this phase of the study may be seen as an important contribution to the future commercialization of the products, since it gives us a perspective of the potential consumer acceptance (Mohamed and Shalaby 2016). A number of studies have been carried out during the development of the products in order to achieve an optimum formulation from the consumer's point of view. Several researches on similar products of the studied ones, confirm the importance of conducting acceptance tests during the development process, even leading to recommendations to reformulations or improvements of the sensorial characteristics of products to be better accepted by the consumer (Nwosu et al. 2014). Other studies reveal that appearance and color are aspects that influence the appreciation of products, which is in accordance to our findings. In comparison with products of similar aromatic profile, the consumer prefers what he is already used to as the reliable product (Racolta et al. 2014).

In our opinion, the study also benefits from using individuals experienced in tasting food, as they more easily were able to identify and name the flavors in the new products.

In relation to the possible gastronomic use of the emulsions (data not shown), none was pointed out as having great potential on its own, to be used alone, but always as an ingredient of some composition. Strawberry sour cream has been suggested only for desserts or sweet compositions; the yellow pepper spread was singled out as a flavoring potential for a white rice or a cooked dough, to finish off risotto or curry such as roasted meat seasoning or sauces ingredient; the red pepper cream was the least appreciated in terms of culinary potential because it was

compared to the mass of pepper and its consequent use; beetroot and raspberry and raspberry and blueberry mustard creams were used as ingredients for vinaigrettes or for spreading on roasted meats, the latter being the second most appreciated in this sensory evaluation.

Addressing the consumption potential (Fig. 5.1), on average the yellow pepper was the sample that showed the best results. The red pepper emulsion and the Raspberry-blueberry mustard showed intermediate results, followed by the strawberry emulsion and with the worst result, the beetroot mustard cream, however, all the samples revealed, on average, a positive consumption potential.

In what regards to the relation to the intention to buy, on average (Fig. 5.2) the yellow bell pepper was the sample that showed the best results. The red bell pepper emulsion and beetroot and raspberry mustard cream showed intermediate results, the strawberry emulsion and the beetroot mustard cream having the worst results, however, all the samples revealed, on average, a positive purchase intention.

### *5.3.2 Foodpairing Possibilities*

There were 33 combinations of ingredients with the Foodpairing® tool for the five prototypes considering possible meal courses which, cross-checked with the tasters' panel, led to 34 gastronomic compositions further developed in a culinary workshop (data not showed).

The chefs' opinion was not always coincident with the ingredients proposed by the application of Foodpairing®. We are aware that the suitability of the ingredients

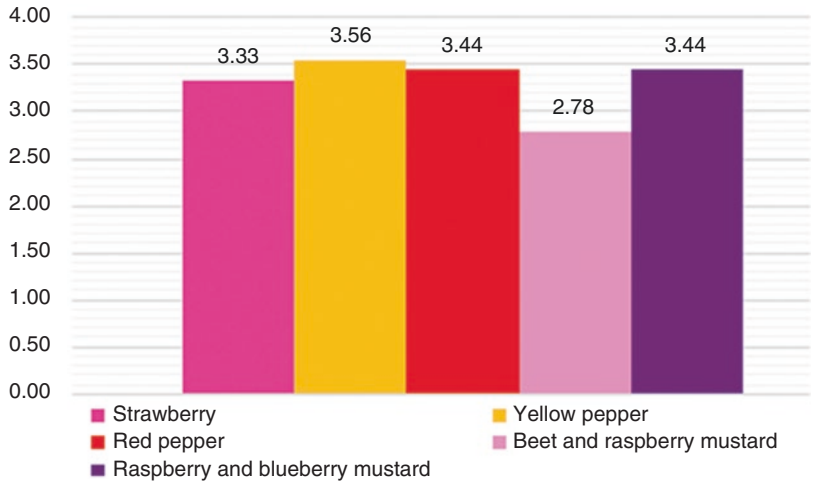


**Fig. 5.1** Consumption potential of the samples analyzed by the experts' panel, using a 5-point scale with definite terms placed between "definitely without application" and "certainly with application"

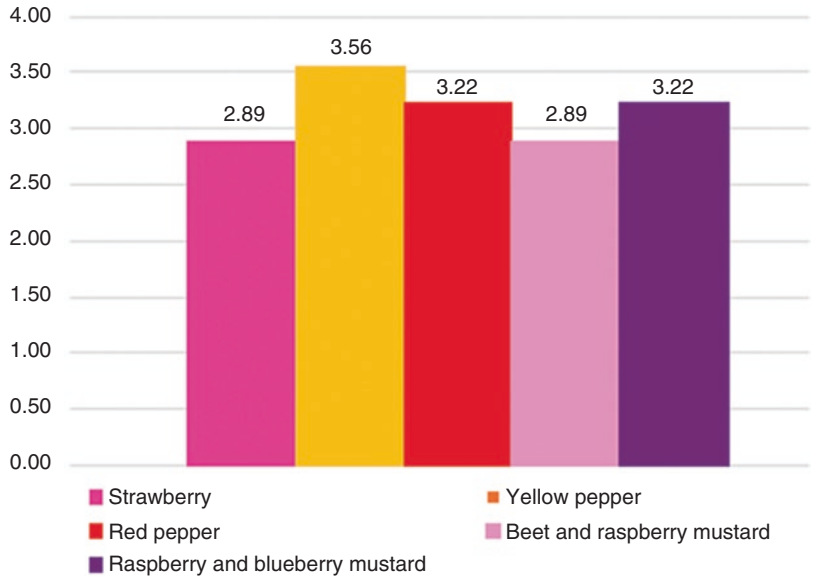


**Fig. 5.2** Purchase intention of the samples analyzed by the experts' panel, using a 5-point scale with definite terms between "definitely no" and "certainly yes"

for inclusion in recipes or food pairings depends on a myriad of ingredient characteristics in addition to their flavor profile. Flavor is not necessarily the main role of ingredients, recipes also rely on ingredients to provide the final textures and the overall structure of a given dish (Ahn et al. 2011). Actually, according to the above-mentioned authors, shared flavor compounds represent one of several contributions to the fitness value, while shared compounds clearly play a significant role in some cuisines, other contributions may play a more dominant role in other cuisines. Western cuisines, for example, show a tendency to use pairs of ingredients that share many flavor compounds, supporting the so-called food pairing hypothesis.

### *5.3.3 Consumer Testing*

According to Table 5.2 and overall, the samples were positively appreciated (average > 5), with values ranging from 6.19 ± 1.27 (Red bell pepper smell/odor) to 7.86 ± 1.07 (Raspberry and blueberry mustard color). Regarding appearance, the most prominent was the Raspberry-blueberry mustard cream (7.76 ± 1.15) and the least appreciated was the strawberry emulsion (6.41 ± 1.72). Regarding color, it was again the same Raspberry-blueberry mustard that stood out (7.86 ± 1.07) and the Beet-raspberry mustard was the least appreciated. In the same way, and for the smell/odor parameter, it was the latter that obtained the best results (7.22 ± 1.25) and the red bell pepper emulsion had the lowest result (6.19 ± 1.25). For the most

**Table 5.2** Mean values of the parameters analyzed in the study by consumers panel ($N$ = 37), using a a 9-point scale with defined terms situated between "poor" and "excellent

| | Strawberry | Yellow pepper | Red pepper | Beet and raspberry mustard | Raspberry and blueberry mustard |
|---|---|---|---|---|---|
| Appearance | 6.41 ± 1.72 | 7.49 ± 1.20 | 7.24 ± 1.40 | 7.03 ± 1.48 | 7.76 ± 1.15 |
| Color | 6.84 ± 1.50 | 7.78 ± 1.30 | 7.08 ± 1.48 | 6.81 ± 1.39 | 7.86 ± 1.07 |
| Aroma | 6.92 ± 1.68 | 6.78 ± 1.51 | 6.19 ± 1.27 | 7.22 ± 1.25 | 7.05 ± 1.21 |
| Flavor | 6.54 ± 1.43 | 7.35 ± 1.36 | 6.73 ± 1.50 | 7.30 ± 1.31 | 6.78 ± 1.66 |
| Overall quality | 6.65 ± 1.26 | 7.51 ± 1.06 | 6.84 ± 1.24 | 7.22 ± 1.19 | 7.16 ± 1.39 |

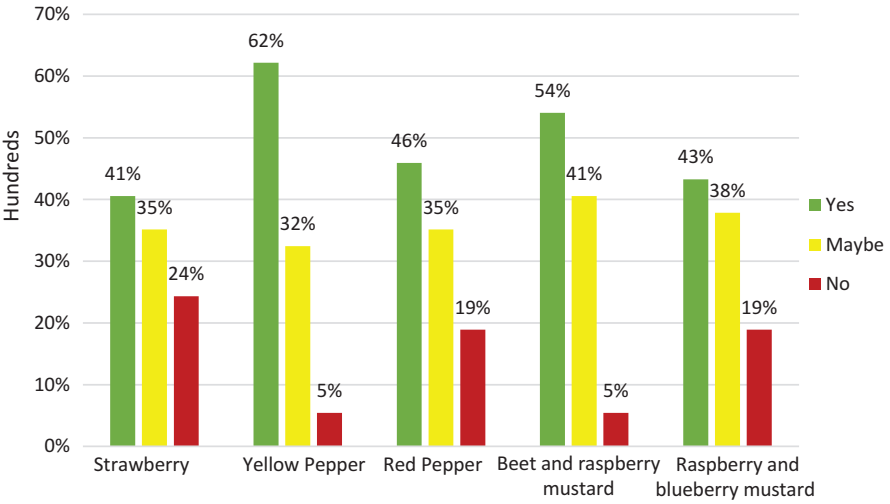


**Fig. 5.3** Purchase intention of the samples analyzed by consumers panel, using a 5-point scale with definite terms between "definitely no" and "certainly yes"

flavored flavor/aroma was emulsion yellow bell pepper (7.35 ± 1.36) and the strawberry one was the least appreciated (6.54 ± 1.43).

Regarding the overall appreciation the yellow bell pepper spread stood out (7.51 ± 1.06), and the strawberry spread obtained the lowest result (6.65 ± 1.26) compared to the others.

All samples obtained on average a positive purchase intention (Fig. 5.3). The yellow bell pepper and the beet and raspberry mustard obtained the best marketing potential, 62.2 and 54.10% respectively. The one with the lowest results was strawberry spread, with more divided opinions among the tasters.

The selected and served recipes to the consumers in the tasting menu are indicated in Table 5.3 and correspondent images are showed in Fig. 5.4.

All delicacies developed and presented had positive appreciation (average values of global appreciation between 6.87 and 8.65) (Fig. 5.5).

**Table 5.3** Selected ten recipes for the tasting menu

| | Name | Emulsion |
|---|---|---|
| Couvert | | |
| 1. | Yellow pepper dip with potato chips | Yellow pepper |
| 2. | Red pepper dip with king crab meat in ciabatta bread | Red pepper |
| Entrées | | |
| 3. | Pear carpaccio with raspberry, blueberry, honey and lemon vinaigrette, arugula and peanuts | Raspberry and blueberry mustard |
| 4. | Buffalo mozzarella, bacon and dehydrated strawberries, sidra, strawberry and cilantro reduction | Strawberry |
| Vegetarian | | |
| 5. | Red pepper fetuccine, walnuts and basil | Red pepper |
| Fish | | |
| 6. | Cod fillet, fava bean purée and dill | Yellow pepper |
| 7. | Grilled turbot and green asparagus with Sichuan pepper | Beet and raspberry mustard |
| Meat | | |
| 8. | Portuguese beef sandwich with king crab meat | Raspberry and blueberry mustard |
| 9. | Pork tenderloin wrapped in bacon and apricot crust with sweet Potato purée, dehydrated fennel, port reduction and cava mint gel | Beet and raspberry mustard |
| Dessert | | |
| 10. | Black and white in strawberry sauce | Strawberry |

The intention to purchase varied for each emulsion and the type of delicacy in which it was used: in some it increased by 57%, but in others it decreased, for


**Fig. 5.4** Images of the ten recipes for the tasting menu; numbers correspond to recipes of Table 5.2

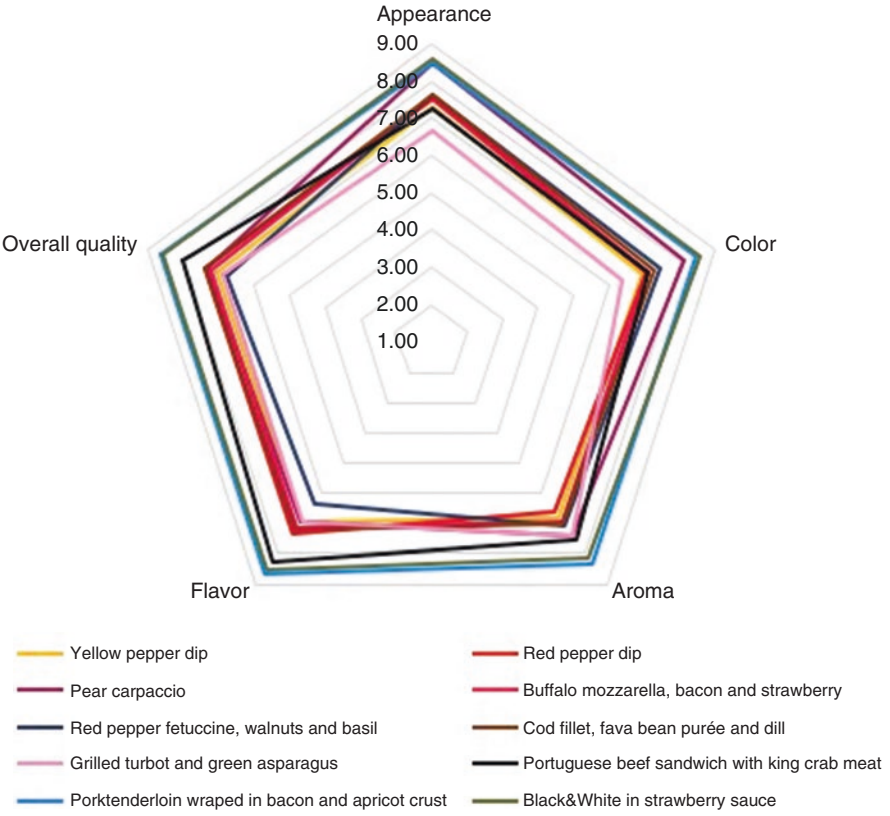


**Fig. 5.5** Hedonic sensory evaluation parameters, on average, by dish, analyzed by the consumer tasters, at the technical lunch

example by 14%; globally, most tasters would buy the creams analyzed and see potential commercialization in all emulsions (Fig. 5.6).

Data resulting from this study, demonstrate the importance of revealing recipes or gastronomic applications for new developed products before they are launched on the market so that the potential consumer can find added value, and even accept a premium price, which is distinguished in terms of one or more of the following unique characteristics: quality of ingredients, origin (eg, regional or ethnic), presentation (eg, brand and packaging), composition, raw material, manufacturing process, know-how, availability and a differentiated perception of consumption. (Straete 2008). In this sense, innovation and differentiation based on quality attributes, among which the sensory ones stand out, is extremely important for success.

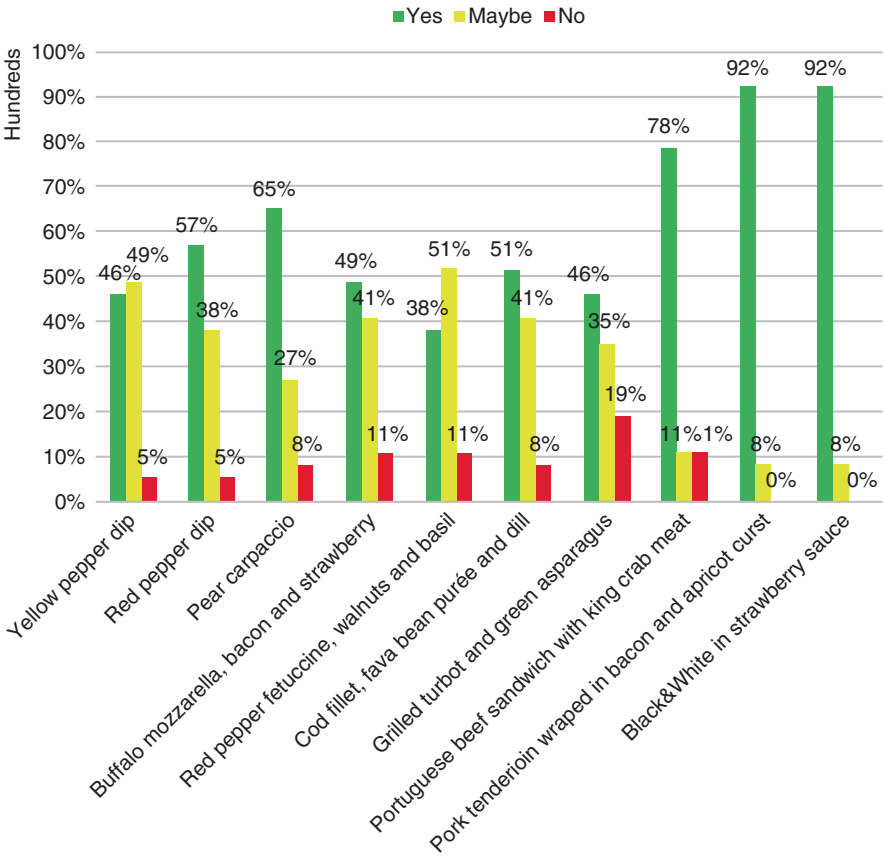


**Fig. 5.6** Intention to purchase the emulsions when applied to each delicacy, by the consumer tasters at the technical lunch

## 5.4 Conclusions

The tested prototypes have potential multiple food applications: pairings; recipes; gastronomic uses. Substantial increase in purchase intention for most samples after tasting the delicacies made with them: most tasters would buy the creams analyzed and see commercialization potential in all emulsions.

The opinion of the chefs was quite important and useful, but not always coincident with the ingredients proposed by the application of Foodpairing®. This tool together with the sensory results and with the available knowledge can be associated with the work of a chef (or other food producer) who demonstrates his experience and ability to generate recipes, techniques and confections, knowing in advance which ingredients will have a higher potential of combination.

Having the possibility of using a panel experienced in culinary arts and food production permitted a broader view on gastronomic possible uses of the tested

products, as these professionals can easily anticipate technical proprieties (both in catering and household environment) and also anticipates the final consumer reactions/acceptance.

Sensory evaluation and consumer testing have shown that the development of culinary applications following product innovation is very important as it may result in the acceptance or not of the product by the end consumer, whether food service or domestic consumer.

Further testing with other types of culinary applications may be made which may provide new evidence for this investigation Nevertheless, given the increasing availability of information on food preparation, this data-driven research has opened new avenues for a systematic understanding of culinary practice, that can be oriented towards a specific food product, like the emulsions and spreads tested.

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