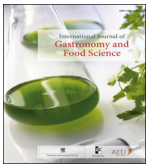

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International Journal of Gastronomy and Food Science 1 (2012) 116–122

International Journal of Gastronomy and Food Science

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Culinary Concept

New concept of desserts with no added sugar

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Received 13 September 2012; accepted 12 June 2013
Available online 21 June 2013

Abstract

Desserts are known in many cultures of the world as courses that typically come at the end of a meal. They usually consist of sweet and creamy food and, consequently, high in sugar and fat. The aim of this work was to take advantage of the natural sweetness of fruit and to enhance it with different techniques in order to break with the idea that finishing a pleasant meal involves sugary foods. The techniques used to enhance product sensory attributes were vacuum cooking, hot infusion, filtration, vacuum impregnation, smoking, gelling, aerating and freezing. As a result, a novel culinary concept for creating desserts without the addition of fat and sugar has been developed. Pear, grapefruit and figs are some examples of products from the vegetable kingdom that with the right combination of aromas and textures could be the key ingredients for the elaboration of natural and healthy desserts.

Keywords: Dessert; Vegetable; Fruit; Low-sugar; Vacuum cooking

Introduction to the culinary concept

Although the predilection for sweetness is evolutionary in origin, dessert is a purely cultural phenomenon. Throughout history cultures have found in fruits many uses for dessert: dried dates, figs, and other fruits were commonly used for this purpose in the Ancient Middle East; grape juice used to be boiled down to a thick, sweet syrup for sweetening pastries. In Egypt, apiculture goes back to at least forty-five hundred years and these days the most widespread ancient sweetener is honey. Sweets were fed to the gods in Ancient Mesopotamia and continue to be the preferred sacred offering among Hindus (Krondl, 2011).

In the past, dessert was only available to the wealthy people; the creation of sweetmeats was always reserved for special occasions where cost was not an issue. Imperial Rome had professional sweet makers at their pastry shops. In Renaissance Venice, confectioners were also expected to be skilled sculptors, sometimes collaborating with noted artists. This caused sugar to be one of the first food ingredients to promote international commerce, after all, the heart of dessert is sugar. In Europe, sugar was a rare and expensive spice before the slave plantations of the New World made available its confectionary.

Sugar was especially appealing because it was quickly metabolized and absorbed yet it provided "empty" calories lacking in minerals and vitamins. Sugar's crucial role in industrialization developed gradually as the plantation system expanded to make sugar more available and as sugar proved to be an ideal complement to the tropical foods such as tea, coffee and chocolate, which began to reach England in the seventeenth century. These are all bitter, calorie-free, stimulating drinks that are sweetened by the addition of sugar (Bodley, 2011).

Sugar consumption by the English working poor grew in stages. It was used first with tea and then in rich puddings, which by the nineteenth century became a dessert course to an end meal (Mintz, 1986). Sugar was combined with wheat and flour in sweetened baked goods; by the end of the 19th century sugar became a relatively cheap source of calories and tended to supplement and replace more expensive grains, fruits, vegetables, meat and dairy products.

As Krondl (2011) explains the French noun "dessert" originates with the verb desservir or un-serve, which means to remove

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Peer review under responsibility of AZTI-Tecnalia.

Production and hosting by Elsevier

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http://dx.doi.org/10.1016/j.ijgfs.2013.06.002

what has been served. In other words, "le dessert" was set out once the table had been cleared of the dishes that made up the main part of the meal.

By the 18th century the gradual replacement of *service à la française*, where numerous dishes were served simultaneously, by *service à la russe*, where one dish followed another, resulted in dessert as we know it.

Instinctively, humans show preference for sweet flavors because they are considered as a source of energy, avoiding those that are bitter and sour as they are related to toxicity and danger (Plotnik and Kouyoumdjian, 2011). From a simple point of view, physiologically the body is no more than a chemical processing unit that runs on water, oxygen and sugar. The food we eat is eventually reduced into glucose, a simple sugar. This chemical reaction takes less effort if we supply sugar itself to the body, whether in the form of lactose, fructose or sucrose, for instance.

Changing dietary habits and sedentary lifestyles have led to an increase in worldwide obesity with the World Health Organisation reporting 12% of the adult population being obese (WHO, 2012). Current estimates from the Food and Agriculture Organisation's (FAO, 2012) expect the daily intake of calories to rise from 2803 kcal/capita/day in the late 1990s to 3050 by 2030. Government, health professionals and retailers are continuously putting pressure on food manufacturers to reduce the calorific value of sugar rich, processed food products (Navarro et al., 2012). There are different strategies to transform traditional recipes into low fat or low sugar versions for the food industry: (a) by reducing its content and/or (b) by using ingredients that mimic their functional properties. Nevertheless, it is still a challenge for food technologists to preserve the original sensory attributes of a traditional dessert while still achieving reduced calorie contents.

On the opposite, avant-garde cuisine is searching for pleasure by exploiting the characteristics of products at their purest state on nature (i.e. natural), creating healthier desserts with alternative strategies than those applied by the food industry (Adrià, 2004).

Generally, a piece of fruit is enjoyed without the addition of sugar; likewise, many products have the ideal characteristics for elaborating sweet recipes with no added sugar. However, in order to obtain the feeling of sweetness exclusively from the product, its structure and functionality must be understood beforehand. Controlling variables such as the ripening period may allow the creation of naturally sweet desserts as sweetness of fruits and vegetables depends mainly on type and composition of sugars present. In most of the fruits, glucose and fructose form the major proportion of soluble sugars, while in few wild species of tomato and melons, sucrose is the major sugar. The amount of total soluble sugars changes with fruit maturity showing a maximum score at ripening. Therefore, sweetness can be obtained without the addition of extra ingredients that do not naturally occur on the raw material used for the elaboration of the dessert.

Our research and development process focuses its creativity on reducing the importance of added sugar and fat in desserts by creating a new concept of natural and healthy dessert where the main character is the fruit or vegetable. The challenge accepted in this work was to obtain the essence of fruits by linking creativity, taste memory, surprise and emotions. Therefore, the aim was to investigate how to enhance the natural sensory attributes of different fruits by adapting existing culinary techniques: vacuum cooking, hot infusion, filtration, vacuum impregnation, smoking, gelling, aerating and freezing.

Culinary concept: definition

The new culinary concept consists of using naturally sweet fruit on desserts, enhancing its attributes with different techniques in order to break with the idea that finishing a pleasant meal at any casual or fine dining consumer based contemporary restaurant involves eating fatty and sugary foods. The techniques used to enhance product sensory attributes were vacuum cooking, hot infusion, filtration, vacuum impregnation, smoking, gelling, aerating and freezing.

Description of the culinary process

The concept development process starts with the selection of the "*star*" product depending on seasonality. Farmers can be asked to provide the raw material at different growth stages so the same product is studied all along its shelf-life; occasionally new properties that do not occur in the product as we use to eat it are found. Furthermore, producers can be asked to harvest their crops in a particular way or also to provide by-products as sometimes they can have unknown culinary applications.

With all this information, a brainstorming process takes place and different ideas are brought up to the table, including potential cooking techniques that may be applied for studying their effect on product properties (i.e. direct fire, vacuum oven, water bath, vacuum cooking, raw cooking, etc.) resulting in a dish idea. At this point, quality standards of the prototype dish are defined and everything is organized with the producers/breeders in order to ensure product meets the quality standards.

Throughout the development process there is not a methodology clearly established because products are so variable that essence might be lost if always the same methodology is applied, therefore, the key relies on adapting to the product instead of adapting the product to the restaurant's needs. This philosophy accepts the risk of high variability among dishes due to seasonality and weather conditions that might affect product freshness and availability, but as a result, customers are offered very natural and healthy food options at their best.

Case studies

As mentioned above, the starting point of this new culinary concept is the idea of taking advantage of fruits for developing new and stimulating desserts without adding any sugar. The case studies presented below have all the same starting point but different motives and histories.

Pear, hazelnut, garmillas' cheese extract and elder

This idea started with two concepts associated to the traditional use of fruits in desserts. On one hand, baked apples served with other ingredients such as cinnamon or cream, has traditionally been used as a technique for enhancing apple sweetness. On the other hand, cheeses started to be considered as a dessert in French cuisine as a way of showing their wide variety of cheeses (Ferguson, 2004). Also, when a selection of cheeses is served as a dessert, fresh pear slices have traditionally been served as the perfect marriage for finishing a meal (Montanari, 2010).

At this point, two questions were launched: (i) why crunchiness is associated with fresh fruit and softness with baked fruit, (ii) if cheese would be part of a dessert, why does it have to be the protagonist?

The answer to these questions was obtained by playing with taste memory; and the result was the starting point of a new concept of desserts. The idea of baked pears with a crunchy texture was considered to be the surprising motive; furthermore, linking cheese notes to the fruit without adding a piece of cheese would also contribute to the element of surprise.

Preliminary trial and error essays were carried out with different pear varieties at different ripening stages. Vacuum cooking (sous-vide) pear with hazelnut oil was selected as the cooking technique for this purpose because products are cooked under controlled conditions of temperature and time inside heat stable vacuumized pouches (Schellekens, 1996). A vacuum packer VAC-205 (Edesa, Spain) was used to seal the pouches (PA/90, Combivac, Girona, Spain). The conclusion was that pears were also sweet and, depending on variety, had also acid notes, being texture the most interesting attribute about pears.

Once pear variety and ripening stage was defined, further results showed that the optimum temperature and time for the desired crunchy texture was 60 °C 18 min. However, at these conditions temperature at the core of the pear was measured using temperature probes (Lacor, Bergara, Spain) and it was slightly lower due to heat transfer losses and consequently the polyphenol oxidases, enzymes responsible for browning after slicing, were not inactivated and brown colors appeared. Montgomery and Petropakis (1980) showed that a temperature of approximately 90 °C is required to inactivate polyphenol oxidases and prevent browning in pear pulp and juice in the presence of ascorbic acid; therefore, temperature was increased to 100 °C and time reduced to 4 min; but then pears were overcooked and a kind of pear sauce was obtained, which was the opposite target texture.

The challenge was then to design the appropriate process for obtaining a crunchy texture with a balanced flavor while avoiding browning. A range of temperature–time combinations between 80 to 90 °C and 4 to 15 min were tested. Based on sensory analysis results the desired texture and flavor were obtained when pears where cooked at 83 °C for 15 min. Furthermore, the achieved texture allowed quick reheating (Convoterm oven, Eglfing, Germany) without softening the tissue due to excessive high temperature.

Once the pear concept was designed, the second step was to link cheese notes to the fruit as a way of adding value to the cheese aromas and not to the cheese itself. For this purpose soft cheeses were preferred as they do not have a maturation step and the water content is higher than hard cheeses; consequently, the extraction of water soluble aromas would be easier.

Garmilla's cheese (Santander, Spain) was selected due to its aromatic attributes reminding of hay and fresh cow's milk, typical from French mountain cheeses.

Two techniques for aroma extraction were tested: traditional cooking in boiling water (100 °C), with the disadvantage of aromatic profile changes due to high temperature and process losses due to evaporation; and vacuum cooking. Results showed that less water was needed to obtain the same amount of cheese broth, meaning that more extract was obtained from the cheese under vacuum conditions; and also the aromatic profile was not modified by temperature as occurred with direct heat. Furthermore, cooking under vacuum improves process repeatability.

The cheese extract was prepared by cutting Garmilla's cheese in 20 × 20 mm cubes and adding the same amount of water to a vacuum bag (cheese:water, 1:1). Afterwards, the vacuum bag was sealed under vacuum and it was added to a water bath, previously heated at 62 °C, and cooked for 150 min. The aromatized cheese extract was then strained and clarified by means of freezing–thawing to force syneresis or simply by eliminating fat through phase separation. In addition, the cheese extract was aerated using lecithin for creating a foamy ethereal texture that would add a new type of texture to the dish; different from the crunchiness of the pear and the fluidity of the cheese extract.

In order to enhance the sweet note of the cheese broth, elderflower infusion was used due to its grape-like aroma. The infusion was prepared by slowly heating the cheese extract until it reached 90 °C. Then the elderflower was added and infused for 3 min.

The result is shown in Fig. 1, a dessert with a new pear texture (hot and crunchy) together with the combination of sweet and acid aromas, coming from natural products, without the addition of sugar, was created.

The basics of the dish described above opened a new line for developing desserts at our restaurant, breaking with the concept of finishing a natural and healthy meal with an excess of sugar and/or fat. With this dessert the objectives and the key techniques for new creations with the same philosophy were understood. Vacuum cooking was used as a precision technique for obtaining new textures and standardizing processes.

The ingredients used for the elaboration of this dessert are shown in Table 1.

Frozen grapefruit and chervil soup

As a consequence of different flavor combination trials during a brainstorming session, it was observed that the flavor perceived when combining grapefruit and chervil in one's mouth were not either grapefruit or chervil but grape. The interaction between grapefruit and chervil was on the warm, spicy, sweet, fresh and floral part, which led to an unexpected sweeter identity: grape. The reason might be that chervil is a

Fig. 1.

Table 1
Ingredients and percentages used for elaboration of the dessert named "*Pear*, *hazelnut*, *garmillas' cheese whey and elder*".

Ingredients	%
Pear	
Peeled pear slices	41.3
Cheese whey (1:1 cheese:water)	8.3
Olive oil	0.4
Hazelnut oil for pear covering	–
Cheese whey	
Defatted garmillas cheese whey	44.3
Elderflower infusion	5.7
	100

delicate herb slightly aniseed and grapefruit has bitter and acid notes, all are attributes that can be found in grape skin and grape seed. Once again a surprise element was exploited: the association of two products to achieve the sensory perception of a sweeter one without the addiction of sugar.

The idea was to build something as delicate as grape. The fascinating sensory attributes of grape were considered to be the crunchy bite, the ethereal and aqueous texture, and sweetness.

To achieve a crunchy texture, freezing was one of the techniques that could potentially be used since freezing causes a phase transition in which liquid turns into a solid that makes a sharp noise when bitten. Moisture migration is the principal physical change occurring in frozen foods, affecting the physical, chemical, and biochemical properties, including texture and palatability of the food (Pham and Mawson, 1997).

Nevertheless, in humans, temperature influences taste intensity and quality perception, and thermal stimulation itself may elicit taste sensations (Breza et al., 2006). Excessive low temperatures may cancel any sensory perception apart from cold. For this reason the aim was to obtain an aerated crunchy texture from grapefruit juice with an expanded light volume, similar to frozen merengue, taking advantage of the physical states of water at different temperatures [ambient, −18 °C and −196 °C (liquid nitrogen)] and using them as vehicles that capture aromas.

Grapefruit juice was texturized like a conventional merengue using egg white and gelatin for further freezing into a −18 °C chamber (Fagor, Bergara, Spain). Agitation previous to freezing allows the formation of many small ice crystals that share water molecules avoiding the growth of larger crystals that would be noticed by the tongue (McGee, 2007). The painful feeling of biting something frozen was reduced because the great majority of the bite was air. At the beginning a feeling of cold appeared but after a few seconds the aromas and essential oils were released.

On the other side, grapefruits were peeled and separated into wedges without any fiber. At the moment of consumption wedges were introduced into liquid nitrogen (Air Liquid, Zamudio, Spain) and frozen until solid. Afterwards, they were shaken with a spoon until the smaller wedges that form them were separated in individual "pearls". Because of liquid nitrogen is at −196 °C food freezes very quickly and the size

of the ice crystals formed are smaller than in conventional freezing; hence wedges granules could be individually separated without breaking the whole wedge structure.

Finally, the chervil soup was obtained through a vacuum impregnation process, where chervil leaves were immersed into diluted apple juice and cooked under vacuum at 55 °C for 15 min (Gastrovac, ICC, Girona, Spain). This process allowed the introduction of physiologically active components, such as color and fresh aroma compounds, into the impregnating solution avoiding changes in chervil's aromatic profile as it would occur if product was conventionally infused at higher temperature and ambient pressure (Fito et al., 2001).

Results showed that a fugacious feeling was provoked when tasting two products that were individually recognizable but together reminded of another product (Fig. 2). This synergy between grapefruit and chervil added unexpected potentials to their characteristics.

The ingredients used are shown in Table 2.

Grilled fig, mint and hibiscus flower

In recent years, figs have been part of our desserts because of their relationship with Mediterranean culture and summer evoking memories. However, figs are one of the few fruits that do not have acid notes and sometimes could be excessively sweet. When reflecting about product essentiality one wonders if each characteristic could be separated from the other and assembled together in a different way; for instance, to enhance figs sweet flavor and aroma on one side and figs creamy pulp and crunchy delicate skin on another side. The objective was then to take advantage of product virtues and mask the so-called defects (excessive sweetness) using different techniques in order to create the feeling of having eaten only the fig essence.

Aroma impregnation under vacuum was used to introduce citric and mint aromas into the figs. In this case, the impregnating solution was citrus fruit juice infused with mint. The process involved repeating the steps of ambient pressure-vacuum for five times, in order to create a pore expansion in the figs when decompressing and consequently the absorption of the impregnating solution under vacuum. The excessive sweetness was balanced with the freshness of mint leaves and the acid of the citric juice. The result was a fig with its characteristic sweetness enhanced by new aromatic notes that reminded of traditional medicinal syrup.

Furthermore, following with the concept of linking different aromas to figs, the previously prepared figs where then smoked in oak embers for 25 s as shown in Fig. 3. Apart from adding smoked aromas to the fruit, the heat from the grill melted the pulp highlighting figs honeyed texture.

Finally, to completely extract the essence of the fig, fig juice was prepared by vacuum cooking fresh figs at 100 °C for 1 h. The juice drained during cooking was then strained and aromatized with ginger, clove, cinnamon and fig leaves to evoke the memory of being under a fig tree. Hibiscus flower was also added to balance the excessive fig sweetness with its characteristic acid notes and also to provide a dark ruby color.

Fig. 4 shows the concept of this new dessert, which was "grilled figs in its own juice" with different natural colors and flavors (mint, smoked and acid) that are not found in the fruit.

The ingredients used are shown in Table 3.

Table 2
Ingredients and percentages used for elaboration of the dessert named "*Frozen grapefruit and chervil soup*".

Ingredients	%
Grapefruit juice	68.6
Eggwhite (powder)	0.78
Gelatin	0.41
Xanthan gum	0.12
Chervil leaves	2.74
Apple juice	13.72
Mineral water	13.72
	100

Fig. 2.

Fig. 3.

Fig. 4.

Conclusion

As a conclusion, a new concept for creating healthy desserts without the addition of fat or sugar has been developed involving two basic principles: (i) to take advantage of the natural sweetness of fruits and (ii) to never forget surprise of provocation.

Unlike industrial food production, where the addition of sugar and fat substitutes to low-calorie versions of traditional formulae usually raises its price by enlarging ingredients list, the new concept of dessert described showed that perceived sweetness can be managed without the addition of sweeteners or other ingredients for texturization. It is also a clear example of how gastronomic interests (ripening for pleasure) could be just the opposite as food industry ones (reduce ripening periods for longer preservation times).

The three dishes presented maintained the identity of the product but at the same time allowed a new expression or alter ego of fruits. The adaptation of existing culinary techniques enhanced fruits sensory attributes by extracting most of their essence and minimizing nutritional losses; therefore, creating dishes not only from the empirical point of view but also from reflecting on experience: light dishes, very aromatic, full of soft shades and with a distinctive role of the vegetal kingdom. The concept opens a new approach in our restaurant where vegetables such as potato or pumpkin are being used for developing new desserts without the addition of sugar.

Our patisserie is conceptualized as the end of a natural meal that is consistent with the restaurant philosophy; this is, to understand essentiality by balancing aesthetics, aromas, texture variability and flavor recognition. Therefore, this concept breaks with the traditional idea of dessert and presents it as a

Table 3
Ingredients and percentages used for elaboration of the dessert named "*Grilled fig, mint and hibiscus flower*".

Ingredients	%
Impregnated figs	
Figs	38.5
Mint juice	61.5
	100.0
Mint juice	
Mint leaves	6.0
Orange juice	10.2
Grapefruit juice	10.2
Green lemon juice	10.2
Water	25.1
	61.5
Fig and hibiscus juice	
Fig juice	89.5
Fig leaves	6.7
Hibiscus flower	1.8
Ginger	1.8
Cinammon	0.1
Cloves	0.1
	100

dish that do not necessarily have to break with the harmony of the menu by bringing suddenly high calorie dishes; instead it as another dish aligned with the story told all along the meal experience.

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