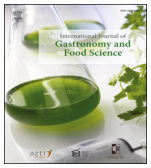

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Culinary concept

Nettle cheese: Using nettle leaves (*Urtica dioica*) to coagulate milk in the fresh cheese making process

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Abstract

Nettle (*Urtica dioica*) is a wild plant from the Urticaceae family. It is commonly used in several countries as an edible and medicinal wild herb (China), an anti-asthmatic and an astringent (Spain) as well as a diuretic (Greece). Moreover, it is used either as a steamed vegetable or a regular ingredient in many preparations such as in pastas, omelettes (Basque country). In this article, we show that the stinging nettle acts as alternative vegetable coagulant "rennet". It uses lactic acid bacteria from fresh nettle leaves to inoculate milk where milk curd is then obtained to make fresh cheese. The results are discussed in terms of organoleptic and gastronomical qualities of cheese products and the addition of an ingredient with natural acetylcholine for future analysis. The introduction of the stinging nettle as an ingredient in gastronomy could increase the sensory appeal of vegetarian cheeses and yogurts, supporting the creation of new recipes and a new way to produce lactic fermented products.

Keywords: Nettle; *Urtica dioica*; Milk; Cheese; Curd

Introduction

Stinging nettle (*Urtica dioica*) is an herbaceous perennial flowering plant of the *Urticaceae* family that can be found on every continent. It has a long history of medicinal use in the Basque country. It also acts as a food and fiber source for fabrics. It is especially important in the elaboration of "Mamia", a very traditional Basque dessert made with sheep's milk curd and rennet that is usually served with honey or sugar. In this elaboration, nettle is used as a strainer to clean the impurities of the milk (Lapitz, 2000), mainly because of its abundance as well as the content of the stinging hairs that are used as a fine mesh adding a characteristic flavor.

Nettles are commonly used for eating its leaves, both raw or blanched, slightly steamed or fried in different preparations such as quiches, pesto, soups, purées, sauces, cookies, gelatines and jams, etc. (Bertrand and Bertrand, 2001; Frabro et al., 2008; Irving, 2009). Since the Bronze Age, the Roman civilization and the Middle Ages, nettle has had a long history in its use as a staple food, a medicine, a fiber, a dye and a nutritious addition to the diet (Brill and Dean, 1994; Letcher, 2010). Moreover, in World War I, German uniforms were made with 85% nettle fiber (Vance, 2013).

The plant is an anti-asthmatic, an astringent, a depurative, a diuretic, a galactogogue, a homeostatic, a hypoglycaemic, a blood purified and a stimulating tonic. For medicinal purposes, the plant is best harvested during the spring in Europe as it is becoming a flower and is dried for later use (Bown, 1995; Grieve, 1973).

Searching ways to use wild herbs such as nettle and its relationship with traditional preparations like "mamia", we aim to use nettle stings to inoculate whole make in order to make curd for fresh cheese.

Since the period of Pliny the elder, who referred to the first cheese preparations (Bostock and Riley, 1857), fermentations and milk curds have been a main part of gastronomic history. It

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is now a reference point for many restaurants like Mugaritz who conduct investigations with molds and fermentations such as in "Uses of *Rhizopus Oryzae* in the kitchen" (Cantabrana et al., 2015) as well as investigation centers such as The Nordic Food Lab in Copenhagen (Salminen, 2014).

Milk possesses a unique protein structure called casein, that enables coagulation allowing the maintenance of milk as a food source in the form of cheese. Casein is not coagulated by heat, but precipitates when milk is acidified to a pH 4.6 (isoelectric point) making a curd or separating the solids (curds) from liquids (whey) (Law and Tamime, 2010). In conventional cheese making, rennin (chymosin) in the form of rennet (a proteolytic enzyme that coagulates milk) is used to coagulate milk. In our experimentation, the chemical content found in nettles is used to acidify the milk and lower its pH in order to make the curd.

Using nettle as a vegetable "rennet" to make milk curds or fresh cheeses, is accepted by consumers which improves their organoleptic capabilities, is also useful for new culinary preparations and helps increase the value of a product using edible wild herbs.

Materials and methods

Materials used: whole cow's milk (3.6 mg fat material, UHT, pH 7.3), *Urtica dioica* leaves, sea salt flakes (non-iodized sodium chloride), calcium chloride (Calcic E509). Stinging nettle plants (*Urtica dioica)* were grown during spring in the Miramon park field (43°17′22.7″N 1°59′18.6″W). Leaves were collected and stored in a plastic bag and were taken to the laboratory of the Basque Culinary Center and were subsequently cleaned and separated into "edible" and "refuse portion" categories. The latter generally consists of older leaves and fibrous stems that are removed during normal food preparation. Edible leaves were stored at 4.0 ± 0.5 °C for 24 h until the time of processing (Renna and Gonnella, 2012).

First, a sample study preparations for milk coagulation and second, a study on the production of fresh cheese.

Samples preparation

3 Control cups of 100 g of whole cow's milk were used, 6 sample cups with 1 g of fresh *Urtica dioica* leaves were used in the sample preparation. This amount of nettle leaves was decided because of the minimum quantity in previous experiments (no show data).

All 9 cups were covered with plastic film and stored in controlled temperature conditions (37 °C for 24 h) using a Digitronic oven (Brito et al., 2002).

After this period, all 9 cups were examined. The nettles were removed from the 6 sample cups leaving only the milk curd to be compared to the control cups.

3 Control cups pH remained with the same texture and pH (7.26) as the initial milk.

6 Samples with fresh nettle leaves have a lower pH from 7.4 to 4.3 with a texture of greek yogurt before making cheese and putting them in a brine (Table 1).

Cheese production

2 l of whole cow's milk in a sterilized plastic container with 20 g of *Urtica dioica* leaves covered with plastic film, stored in controlled temperature conditions (37 °C for 24 h).

After this period of time, the nettle leaves were removed leaving the curd in a strainer lined with a cheese cloth. The curd was strained for 24 h at 4 °C.

The cheese was placed in 6 molds of 100 g each. It was lined with a cheese cloth, and a weight of 300 g. was placed on top of the cheese molds as the whey drained out.

The cheeses rested for 24 h at 4 °C in a gastronorm grid on top of another gastronorm pan. Every 4 h, the cheeses were turned over in the same mold and this helped to make the cheese uniform in both texture and shape (Karling, 2011).

Brine: 2.5 l whey, 10% (250 g) salt and 0.2% (5 g) of calcium chloride, boiled and chilled at 10 °C (Davies, 2012; Karling, 2011; Walker-Tisdale, 2005). Cheeses were soaked in the brine for 1 h and stored ad 4 °C with 75–80% relative humidity.

The brine enhances the flavor of the cheese and acts as a preservative by suppressing the growth of undesirable bacteria and fungus (Carroll, 2002).

Blanched nettle leaves were used to cover the cheeses to enhance their flavor and improve the esthetics (Fig. 1).

Cheese analysis

Preliminary physical–chemical parameters were determined by standard procedures at the laboratory and kitchen of Basque Culinary Center.

Titratable acidity: the acidity was determined with a standardized solution of 0.1 N sodium hydroxide (4.00 g of NaOH per liter) and taking 10 g of fresh cheese adding 100 ml of distilled water with added phenolphthalein indicator (prepared at 1% in ethanol at 95%) and titrated until the first dye of light pink is permanent. Acidity is expressed as percentage of lactic acid (1 ml of 0.1 N NaOH = 0.009 g lactic acid) (Wehr and Frank, 2004) (Fig. 2).

pH: pH's were measured with a HI98127 Waterproof pH Temperature Tester Hanna Instruments according to standard procedure as describes in AOAC 14th 981.12 (Association of Official Analytical Chemists., 1984) (Fig. 3).

Sensory analysis

The sensory analysis was performed with a consumer panel consisting of 53 untrained consumers from San Sebastián – Donostia (28 females and 25 males between 20 and 52 years old), using a structured 9-point hedonic scale ranging from 1 (disliked it extremely) to 9 (liked it extremely). Two dishes were prepared, one sweet and one savory evaluated for smell, color, taste and texture (Figs. 4 and 5).

Approximately 30 g of each sample dish was placed in a 50 ml disposable plate which was coded with three-digit different numbers; first one (number 669) "nettle cheese ice cream with almond sand and black cherry gel" (Fig. 6), and second one (number 429) "nettle cheese croquette, sautéed

Table 1
List of samples and controls, pH and visual aspect.

Sample	Milk (cc)	Nettle (g)	Initial pH	*T* (°C)	Final pH	Time (h)	Aspect
Control 1	100	0	7.26	37	7.45	24	Liquid milk
Control 2	100	0	7.26	37	7.43	24	Liquid milk
Control 3	100	0	7.26	37	7.42	24	Liquid milk
1	100	1	7.26	37	4.38	24	Greek yogurt
2	100	1	7.26	37	4.36	24	Greek yogurt
3	100	1	7.26	37	4.30	24	Greek yogurt
4	100	1	7.26	37	4.30	24	Greek yogurt
5	100	1	7.26	37	4.30	24	Greek yogurt
6	100	1	7.26	37	4.34	24	Greek yogurt

Fig. 1. Nettle cheese cover with blanched nettle leaves.

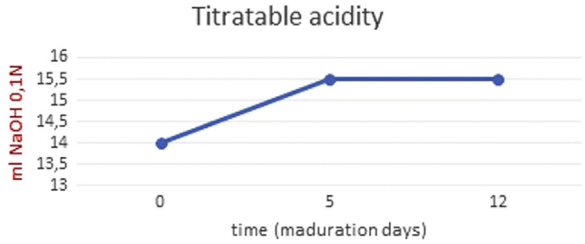

Fig. 2. Titratable acidity on nettle cheese.

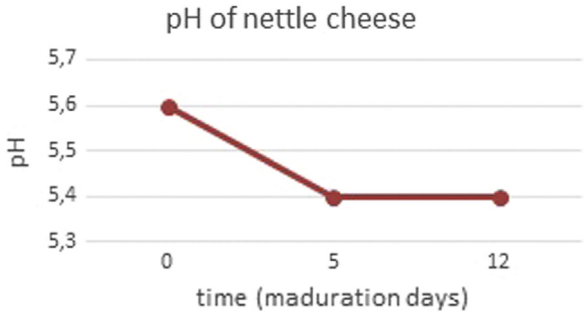

Fig. 3. pH of nettle cheese.

vegetables mixed with nettle cream cheese, roasted sunflower seeds and nettle oil" (Fig. 7).

The panelists performed the analysis in a chamber and had no specific information about the experimental design with the preparations.

Results and discussion

Cheese analysis

Titratable acidity

As seen in Figs. 2 and 3 the chemical evolution of our fresh nettle cheese is similar to a regular lactic acid fresh cheese showing an increasing of acidity and a reduction of pH until cheese stabilization.

Sensory evaluation

The sensory evaluation was carried out by the panelists in a hedonic scale range (1: dislike extremely, 2: dislike very much, 3: dislike moderately, 4: dislike slightly, 5: neither like nor dislike, 6: like slightly, 7: like moderately, 8: like very much and 9: like extremely). The *Urtica dioica* was recognized as a very acceptable new ingredient for gastronomical applications. This is shown in the high scores given by panelists to sensory properties, which were all above average.

In the sweet preparation which consisted of nettle cheese ice-cream with almonds, cherries, crispy nettle and black cherry gel, all smell scores were around 5 (5=nor like nor dislike), therefore it had an average smell with no specific inputs. Color held scores between 5 and 9, with a tendency towards 9 (9=extremely good). Taste and texture had the most voted score (7) and was perceived to have a good ice-cream taste and texture (7=like moderately) (Fig. 4).

The savory preparation consisted of a nettle cheese croquette, sautéed vegetables mixed with nettle cream cheese, roasted sunflower seeds and nettle oil.

Smell scores were mixed, some of the consumer gave dislike scores (less than 5 point) while others gave like scores (more than 5 points). Overall there were more likes and dislikes but the result was generally mixed. Color was accepted by consumers with more than half scores between 6 and 9. Taste

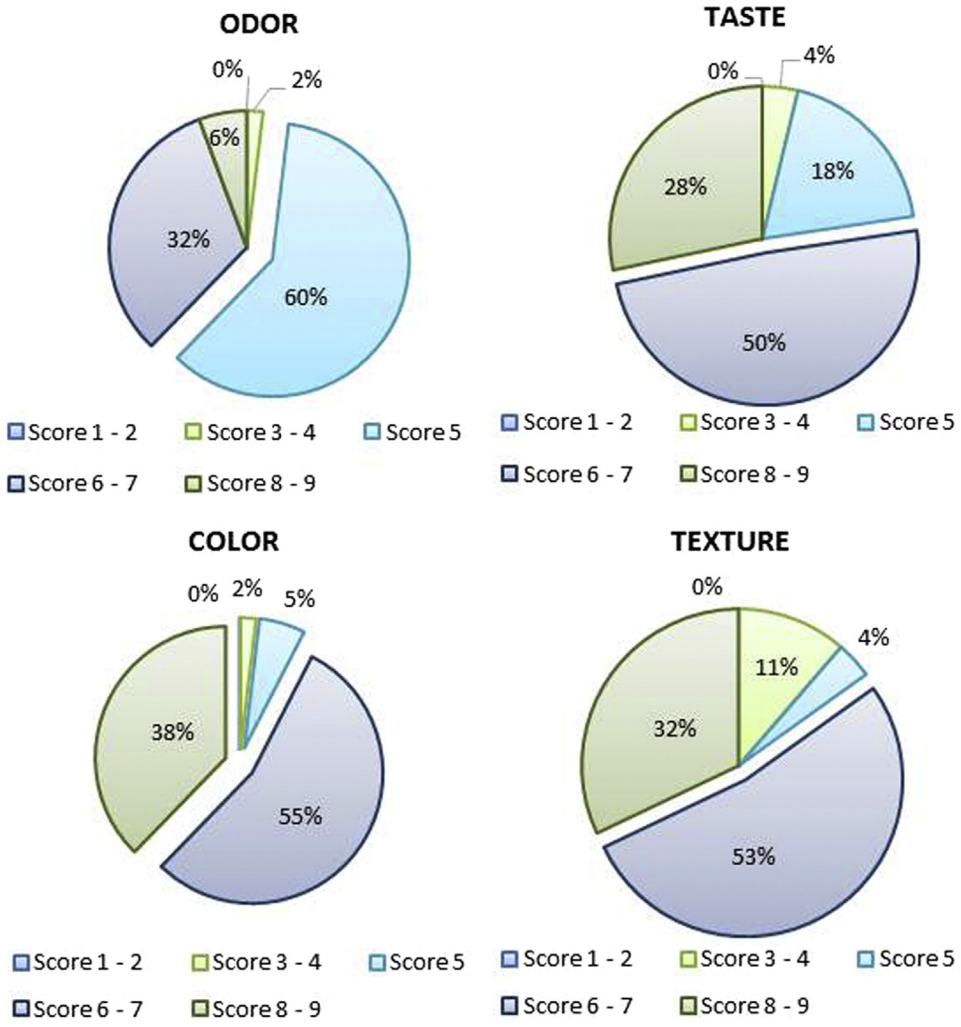

Fig. 4. Sensory evaluation: nettle cheese ice cream with almonds, cherries, crispy nettle and black cherry gel.

had positive and negative votes with mixed scores, half better than 5. Texture also had very mixed scores with almost the same score between like and dislike.

In all cases nettle fresh cheese preparations had good acceptability in consumers, because most scores are between 5 and 9 (neither like nor dislike, like extremely).

Cuisine applications

Nettle cheese is an ingredient that can be used in different preparations, as common fresh cheese or in any other recipe that uses cream cheese. However, it holds distinctive nutty, herbaceous, acidic and silky flavor and characteristics. As seen in the sensory evaluation, the nettle cheese was tested with two culinary applications, one sweet and one savory as showing in the following examples:

1. Nettle cheese ice cream with almonds, cherries, crispy nettle leaves and black cherry gel: using the nettle cheese in an ice cream to improve its texture as other types of fresh cheeses, nettle also has a distinct nutty flavor enhanced with the almonds and pair the acidity of the nettle cheese and cherries (Fig. 6).
2. Nettle cheese croquette, sautéed vegetables mixed with nettle cream cheese, roasted sunflower seeds and nettle oil: using nettle cheese as binding agent to make a creamy mixture of toasted sunflower seeds, fresh nettle cheese filled croquettes breaded and fried, all season with nettle oil (equal parts of fresh nettle leaves and sunflower oil) (Fig. 7).

Discussion

Researching different papers and books about nettle and its relationship with milk, we saw the possibilities of nettle cheese as a functional food for the addition of acetylcholine and histamine in milk during the elaboration process (Wessler et al., 2001). The presence of acetylcholine and histamine are mostly content in the stinging hair of both species of nettle (dioica and urens) (Emmelin and Feldberg, 1949).

In a different microscope picture, we can see how the stinging hairs were filled with milk in the elaboration process so we can assume that acetylcholine can be transferred to the nettle cheese.

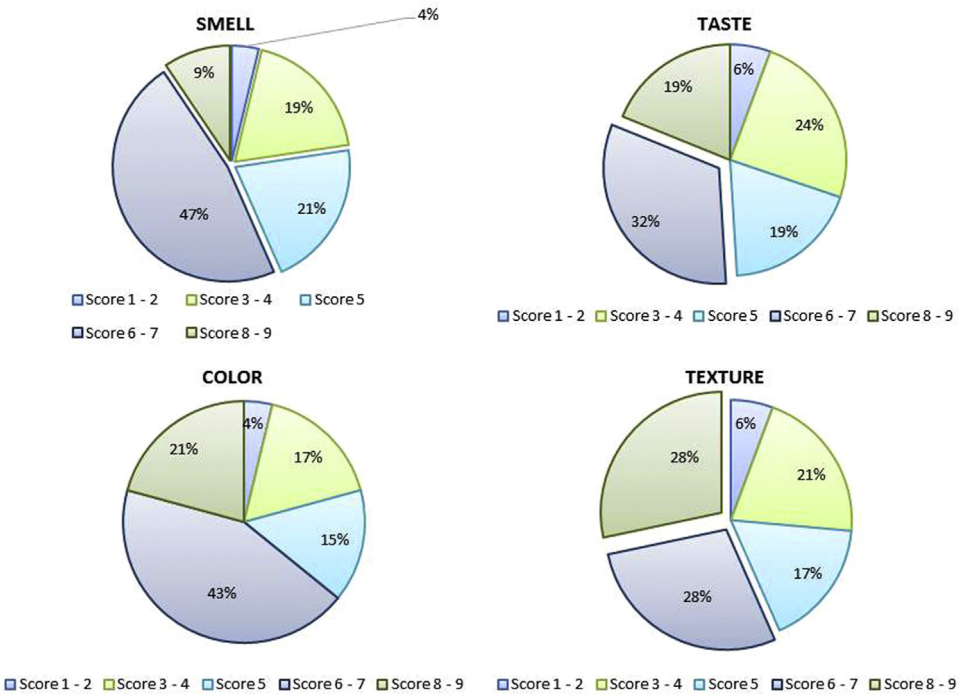

Fig. 5. Sensory evaluation: nettle cheese croquette, sautéed vegetables mixed with nettle cream cheese, roasted sunflower seeds and nettle oil.

Fig. 6. Nettle cheese ice cream with almonds, cherries, crispy nettle and black cherry gel.

Fig. 7. Nettle cheese croquette, sautéed vegetables mixed with nettle cream cheese, roasted sunflower seeds and nettle oil.

We are waiting future analysis on that subject to measure the amount of acetylcholine in the cheese (Figs. 8 and 9).

Conclusions

With regards to applying natural products as an alternative vegetable coagulant "rennet" for milk, the nettle showed special characteristics in this specific use, as a method to coagulate milk using more than just a simple edible wild herb, helping to revalue foraging for this kind of ingredients as a food source such as nettle. This has recently been also attempted with other wild herbs in different countries like "dittany of crete" (*Origanum dictamnus* L.) in Italy (Krigas et al., 2015) or "douglas fir" (*Pseudotsuga menziesii*) in Denmark (Redzepi, 2013), aiming to improve the use of wild herbs in common dietary.

Natural products derived from plants show a great appeal for consumers proving the acceptability of this kind of product. Fresh nettle cheese opens possibilities for other wild plants with different range of flavors and aromas. This adds gastronomical value to any preparation and different possibilities of cuisine applications used in modern gastronomy. It holds a wide new range of products to apply in many directions as functional foods that can be linked to many medicinal properties that wild herbs and fermentation have. It also adds a different research in the future to improve health and value to our current palate of ingredients using fermented milk products (Pérez and Sánchez, 2005). Thus it shows us possibilities to

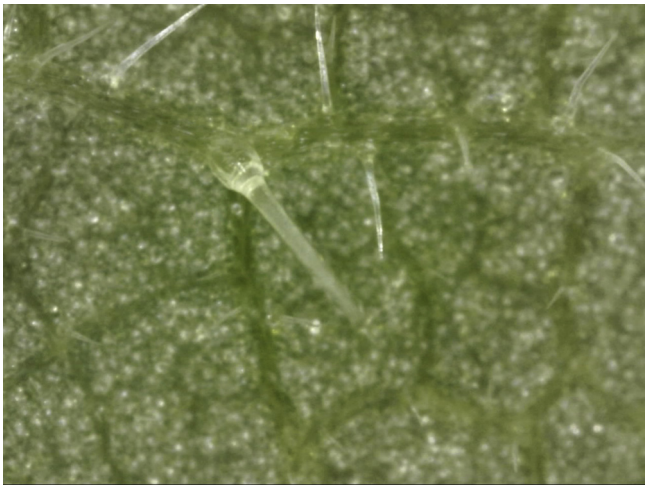

Fig. 8. Stinging hairs of nettle filled with acetylcholine before milk curd process.

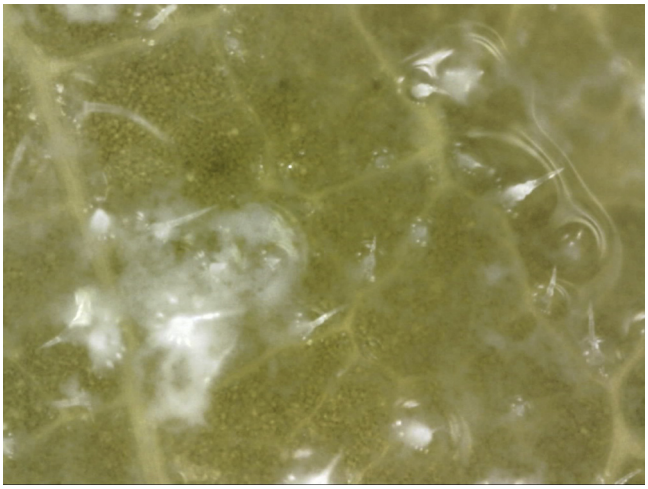

Fig. 9. Stinging hairs of nettle filled with milk after milk curd process.

use other wild herbs to approach other methods of milk coagulation. In short, this new ingredient can provide many different gastronomical applications.

References

Association of Official Analytical Chemists, 1984. Official Methods of Analysis of the AOAC, 14th ed. Arlington, VA, USA.

Bertrand, A., Bertrand, B., 2001. Saveurs d'ortie. Editions De Terran, France.

Bostock, J., Riley, T.H., 1857. Bohn, H.G. (Ed.), 3 ed. The Natural History of Pliny, vol. 3. London Bell.

Bown, D., 1995. Encyclopedia of Herbs and Their Uses. Dk Publications, England.

Brill, S., Dean, E., 1994. Identifying and Harvesting Edible and Medicinal Plants in Wild (and Not So Wild) Places. William Morrow Paperbacks, United States.

Brito, C., Méndez, P., Haydée, L., Pinto, M., 2002. Desarrollo De Queso Chanco De Reducido Tenor Graso Utilizando Proceso De Homogeneización De La Leche. Agro Sur 30 (1).

Cantabrana, I., Perise, R., Hernández, I., 2015. Uses of *Rhizopus oryzae* in the kitchen. Int. J. Gastron. Food Sci. 2 (2), 103–111. http://dx.doi.org/10.1016/j.ijgfs.2015.01.001.

Carroll, R., 2002. In: Cutillo, Dianne, Levy, Karen (Eds.), Home Cheese Making: Recipes for 75 Homemade Cheeses (3ª ed.). Storey Books.

Davies, S., 2012. The Cheesemaker's Apprentice: An Insider's Guide to the Art and Craft of Homemade Artisan Cheese, Taught by the Masters. Quarry Books, United States.

Emmelin, N., Feldberg, W., 1949. Distribution of acetylcholine and histamine in nettle plants. New Phytol. 48 (2), 143–148. http://dx.doi.org/10.1111/j.1469–8137.1949.tb05116.x.

Frabro, M., Melanesio, H., Robert, L., Speranza, J., Murphy, M., Rodríguez, G., Castañeda, R., 2008. Determinación de. acidez en. leche fluida: Comp. de. Result. obtenidos por dos. Metodol. analíticas Distint. ⟨Http://Www.Portalechero.Com/Innovaportal/V/191/1/Innova.Front/Acidez-En-Leche:-Comparacion-De-Tecnicas.Html⟩.

Grieve, M., 1973. A Modern Herbal. Random House Publishers., England.

Irving, M., 2009. The Forager Handbook: A Guide to the Edible Plants of Britain. Ebury, London.

Karling, M., 2011. Cheese Making at Home: Techniques & Recipes for Mastering World-Class Cheeses. Ten Speed Press, United States.

Krigas, N., Lazari, D., Maloupa, E., Stikoudi, M., 2015. Introducing dittany of crete (*Origanum dictamnus* L.) to gastronomy: a new culinary concept for a traditionally used medicinal plant. Int. J. Gastron. Food Sci. 2 (2), 112–118. http://dx.doi.org/10.1016/j.ijgfs.2015.02.001.

Lapitz, J.J., 2000. Los caserios la cocina popular vasca. Lungwerg, Barcelona.

Law, B., Tamime, A.Y., 2010. In: Law, Barry A., Tamime, A.Y. (Eds.), Technology of Cheese Making. (Segunda ed.). Wiley-Blackwell, United Kingdom.

Letcher, K., 2010. The Complete Guide to Edible Wild Plants, Mushrooms, Fruits, and Nuts: How to Find, Identify, and Cook Them, 2nd revised edition Falcon Guides,Estados Unidos.

Pérez, D., Sánchez, L., 2005. Leches fermentadas: Apectos nutritivos, tecnológicos y probióticas más relevantes. Agencia Aragonesa de Seguridad Alimentaria.

Redzepi, R., 2013. A Work in Progress, 4th ed. Phaidon Press.

Renna, M., Gonnella, M., 2012. The use of the sea fennel as a new spice-colorant in culinary preparations. Int. J. Gastron. Food Sci. 1 (2), 111–115. http://dx.doi.org/10.1016/j.ijgfs.2013.06.004.

Salminen, E., 2014. There Will be Slime. Retrieved from ⟨http://nordicfoodlab.org/blog/2014/3/there-will-be-slime⟩.

Vance, K., 2013. Herbal Legacy: History of Stinging Nettle. Retrieved from ⟨http://www.herballegacy.com/Vance_History.html⟩.

Walker-Tisdale, C., 2005. The Practice of Soft Cheese Making – A Guide to the Manufacture of Soft Cheese and the Preparation of Cream for the Market. Read Country Book, United Kingdom.

Wehr, H., Frank, J., 2004. Standard methods for the examination of dairy products, 17th ed. American Public Health Association, EEUU, Washingtong, DC..

Wessler, I., Kilbinger, H., Bittinger, F., James, C., 2001. The non-neuronal cholinergic system – the biological role of non-neuronal acetylcholine in plants and humans. Jpn. J. Pharmacol. 85 (1), 2–10.