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in

Baumont R. (ed.), Carrère P. (ed.), Jouven M. (ed.), Lombardi G. (ed.), López-Francos A. (ed.), Martin B. (ed.), Peeters A. (ed.), Porqueddu C. (ed.).
Forage resources and ecosystem services provided by Mountain and Mediterranean grasslands and rangelands

Zaragoza : CIHEAM / INRA / FAO / VetAgro Sup Clermont-Ferrand / Montpellier SupAgro
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 109

2014
pages 297-300

Article available on line / Article disponible en ligne à l'adresse :

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To cite this article / Pour citer cet article

Giaccone D., Coppa M., Revello-Chion A., Galassi L., Bianchi P., Tabacco E., Borreani G. **Sensory characteristics and fatty acid composition of Raschera PDO cheese according to the production system.** In : Baumont R. (ed.), Carrère P. (ed.), Jouven M. (ed.), Lombardi G. (ed.), López-Francos A. (ed.), Martin B. (ed.), Peeters A. (ed.), Porqueddu C. (ed.). *Forage resources and ecosystem services provided by Mountain and Mediterranean grasslands and rangelands.* Zaragoza : CIHEAM / INRA / FAO / VetAgro Sup Clermont-Ferrand / Montpellier SupAgro, 2014. p. 297-300 (Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 109)

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Sensory characteristics and fatty acid composition of Raschera PDO cheese according to the production system

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Abstract. The Raschera is a PDO semi-cooked and pressed cheese made from partially skimmed milk, which is produced within the Cuneo Province, in North-West Italy. Aiming to explore the widest variation in production conditions and cheesemaking technology, twenty Raschera cheeses were sampled (ten in winter, W; and ten in summer, S) from ten dairy plant producing almost all of the total PDO Raschera cheese production. The cheeses were divided in three production systems: (i) raw milk (IR) or (ii) pasteurized milk (IP) cheeses from intensive farming system, feeding cows mainly on maize silage and concentrates, and (iii) raw milk cheese from extensive farming system (ER), feeding cows mainly with hay in winter or fresh herbage in summer. The principal component analysis (PCA) performed on sensory attributes clearly separate summer from winter cheeses, the first being characterized by stronger notes. Within summer cheeses, ER were clearly separated from IP and IR cheeses, being the ER cheeses characterized by stronger, herbaceous and vegetables notes, and the IP and IR by more cream and butter notes. The FA composition of the cheeses also allowed to a similar differentiation, but the separation between the season was evident only for ER system. The research highlighted that the sensory properties and FA composition of Raschera PDO cheese depend on the production system and on its seasonal variations.

Keywords. Farming system – Cheesemaking technology – Milk fatty acids – Sensory properties – Raschera PDO cheese.

Caractéristiques sensorielles du fromage Raschera AOP selon les systèmes de production

Résumé. *Le Raschera est un fromage AOP à pâte pressée et demi-cuite, fabriqué à partir du lait partiellement écrémé et produit dans le département de Cuneo, dans le nord-ouest de l'Italie. Pour explorer la plus large variation des conditions de production et de technologie fromagère, vingt formes de Raschera ont était échantillonnée (dix en hiver, W ; dix en été, S) dans les 10 fromageries qui produisent presque la totalité de Raschera AOP. Les systèmes de production et de fabrications des fromages ont été classés dans trois groupes : (i) fromage au lait cru (IR) et (ii) au lait pasteurisé (IP) issus de systèmes d'élevage intensives, dans lesquels les vaches laitières sont nourries principalement avec de l'ensilage du maïs et des concentrées, et (iii) fromages au lait cru issu de systèmes d'élevage extensives (ER) dans lesquels les vaches laitières sont nourries principalement avec du foin en hiver et au pâturage en été. L'analyse des composants principaux (PCA) faite sur les descripteurs sensoriels séparait clairement les formages d'hiver et d'été, ces derniers caractérisés de notes plus fortes. Parmi les fromages d'été, les fromages ER ont était nettement séparée des fromages IR et IP, en montrant les ER des notes plus fortes, des notes d'herbe et des végétaux, et les IR et IP avaient des note de crème et de beurre plus marquées. Comme pour les caractéristiques sensorielles, la composition en acides gras différenciait aussi ces fromages, mais la séparation entre saisons était évidente seulement pour les fromages ER. Ce travail montre que les caractéristiques sensorielles et la composition en acides gras du fromage Raschera AOP dépend du système de production en lien avec ses variations saisonnières.*

Mots-clés. *Système de production – Technologie fromagère – Acides gras du lait – Caractéristiques sensorielles – Fromage Raschera AOP.*

I – Introduction

Most of the milk produced in Northern Italy is transformed into traditional and typical cheeses, which are often granted with PDO label. Among them, the Raschera is a PDO semi-cooked and pressed cheese made from partially skimmed milk (raw or pasturized), which is produced within the Cuneo Province, in North-West Italy, and which is ripened for a minimum period of 60 days. However, the Raschera PDO cheese specifications do not include restrictions on composition of animal diets, which can vary from extensive to intensive dairy systems. Consequently, the sensory properties of the resulting cheese can be expected to vary widely because of the broad range of milk production conditions and cheese-making practices (Martin *et al.*, 2005). Similarly, a large variation can also be expected for cheese fatty acid (FA) composition, which has important implication for human health and cheese sensory properties (Givens, 2010; Coppa *et al.*, 2011b). Among several factors, the major impacts on cheese FA composition are related to the farming system and to its seasonal variation in cow feeding (Chilliard *et al.*, 2007). The aim of this research was to highlight the relationships between the production conditions and their seasonal variations according to the farming system applied and the sensory and FA profiles of Raschera PDO cheese.

II – Materials and methods

Aiming to explore the widest variation in production conditions and cheesemaking technology, twenty samples of 60-day ripened Raschera were collected from ten dairy plant producing more than 80% of total Raschera PDO cheese production. One cheese was sampled in winter (W) and one in summer (S), per each dairy plant. The production condition applied in the dairy farms from which derived the milk used for each cheesemaking were recorded through on-farm surveys, according to Borreani *et al.* (2013). Cheesemaking technology was also characterized. To describe the sensory properties of cheese, a Quantitative Descriptive Analysis (QDA) was performed on cheeses of each factory for both winter and summer seasons. Ten expert panellists were selected to form the panel, subjected to a training period for QDA and involved in the definition of a list of attributes for texture, odour, taste and aroma of cheese. Attributes generated from each assessor were characterised and agreed on a round table-meeting involving sampling taste and collective discussion to create the final list of attributes which described the cheese sensory profile. Subsequently, in the test, attributes were evaluated on an intensity scale from 1, when the attribute was defined as not perceptible, to 9, when the attribute had the maximal expression. Each cheese was sub-sampled and analysed for the FA methyl esters by gas chromatography, as reported by Revello Chion *et al.* (2010). Aiming to explore the relationship between production conditions and sensory or FA profiles, two principal component analyses (PCA) were performed, one on data of cheese sensory descriptors, the other on cheese FA concentrations, using the SPSS for Windows software package (version 17.0; SPSS Inc., Chicago, IL).

III – Result and discussion

The farms from which dairy plants collected the milk used to produce the Raschera PDO cheese covered overall a wide variation in production conditions (i.e. cow diet composition and milk production level). However, within each dairy plant, the characteristics of the farms that supplied milk were quite homogeneous. Some plants collected milk almost from intensive farms, feeding cows mainly on maize silage and concentrates, whereas, other plants mainly from extensive dairy farms, feeding cows mainly with hay in winter or fresh herbage in summer. Within the dairy plants collecting milk from intensive farms, some produced Raschera PDO from raw milk (IR), others from pasteurized milk (IP), whereas the dairy plants collecting milk from extensive farms only produced Raschera PDO from raw milk (ER).

On the plot of PCA performed on data of sensory descriptors, the Raschera PDO cheeses were separated according to the season of production by both principal components (PC) 1 and 2 (Fig. 1). The summer cheeses (S) were characterized by higher notes for odour and aroma of rennet, strong toasted, barn, garlic, bread a, boiled vegetable, smoked, hazelnut, grass, and for silage odour and soft toasted aroma. Summer cheeses had a less melting texture. Systems were in average scarcely differentiated: except for ER cheeses produced in summer, which were clearly separated from all the other samples. These cheeses were characterised by lower cream and butter odours. The ER summer cheeses also have higher strong toasted odour and aroma, silage odour, barn odour and aroma, smoked odour and aroma, hazelnut odour and bitter taste. These results are in agreement those presented by Coppa *et al.* (2011b) and by Martin *et al.* (2005) when comparing conserved forages derived cheese to pasture derived cheeses. The stronger notes found for pasture-derived cheeses were explained by the effect of fresh herbage in cow diet on milk fat and FA composition (Martin *et al.*, 2005). In particular the stronger notes were related to the odour active compounds generated by the oxidation of polyunsaturated FA (PUFA), more abundant in pasture derived cheeses, during ripening, and to their interaction with the microbial flora (Coppa *et al.*, 2011a,b).

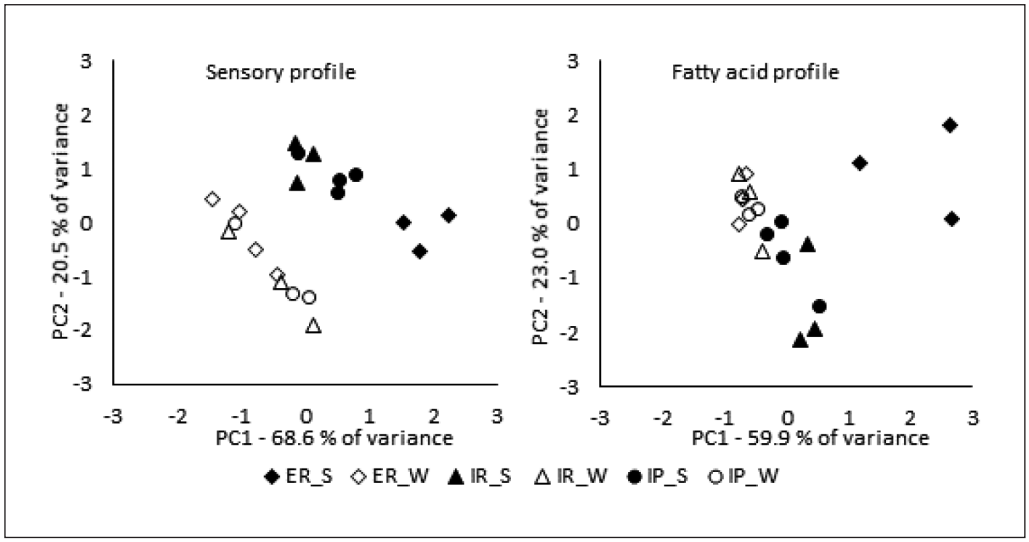

Fig. 1. Principal component analysis (PCA) performed on sensory descriptors (on the left) and on milk fatty acid concentrations (on the right). Plot of sample distribution according to production system and season[1] projected on the two principal components (PC1 and PC2). ER = Extensive faming system, raw milk; IR = Intensive farming system, raw milk; IP = Intensive farming system, pasteurised milk; S = summer; W = winter.

[1] LD = long duration of paddock utilisation on heterogeneous pasture; MD = medium duration of paddock utilisation on intensively managed pastures; b = beginning; m = middle; e = end; 1 and 2 in MD indicated the paddocks; BCFA = branched-chain FA; C18:1t = Σ of trans C18:1isomers; LA/ALA = C18:2n-6/C18:3n-3; MUFA = monounsaturated FA; OA/PA = C18:1c9/C16:0; PUFA = polyunsaturated FA; SFA = saturated FA; t10/t11 = C18:1t10/C18:1t11 ratio; HM = high mature patches; HV = high vegetative patches; SV = short vegetative patches; CP = simulated bites crude protein; G = simulated bites grasses proportion; L = simulated bites legumes proportion; L/S = simulated bites grasses leaf to stem ratio; NDF = simulated bites neutral detergent fibre; OMD = simulated bites organic matter digestibility.

The PCA performed on cheese FA composition showed a sample distribution similar to those of cheese sensory profile, however summer and winter cheeses were weakly separated, especially for IP W and S cheeses, which were confounded (Fig. 1). On the contrary, the PCA on milk FA profile showed a clear separation of ER Raschera PDO cheeses produced in summer, as for the PCA based on cheese sensory profile. The ER summer cheese were characterized by higher concentration of C18:1t11, CLAc9t11, C18:3n-3, odd and branched chain FA (OBCFA), and by lower concentrations of C14:0, C16:0, and C18:2n-6. A similar FA profile is in agreement with FA composition of milk derived for pasture fed cows (Coppa *et al.*, 2013). Fresh herbage being richer in C18:3n-3 resulted in milk richer in this FA and in all intermediate products of its ruminal biohydrogenation, such as CLAc9t11,and C18:1t11 (Chilliard *et al.*, 2007). Similarly, feeding cows with fresh herbage increase the proportion in milk of OBCFA, deriving from ruminal bacteria responsible for fiber digestion (Vlaemink *et al.*, 2006). Lower C18:2n-6 and saturated FA (SFA) concentrations in milk when cows were fed pasture instead of maize silage and concentrate based diets has also been observed (Coppa *et al.*, 2013; Chilliard *et al.*, 2007).

IV – Conclusions

In conclusion, this research highlighted that the sensory properties and FA composition of Raschera PDO cheese depend on the production system applied in the farms that supply the milk. Seasonal variations in production conditions have an important effect on cheese sensory properties and FA composition, especially in extensive farming systems.

Acknowledgments

The research was funded by the Regione Piemonte Project: “Qualità degli alimenti, gestione degli animali e tecnologia di caseificazione: esempio di filiera produttiva di alcuni formaggi DOP tipici piemontesi in zona montana”.

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