



Cheese ART²⁰⁰⁴

6th International Meeting
on Mountain Cheese

Dairy Food biodiversity: flavour and health properties

Ragusa, Donnafugata Castle, June 1st-2nd, 2004

CONTENTS

ABSTRACTS OF ORAL PRESENTATIONS

SESSION 1: Livestock, Feeding, Production Technologies, and Product Quality Systems

Changes in Terpene Composition from Pasture to Cheese

H. Schlichtherle-Cerny, M. I. Imhof, E. Fernández -García, and J. O. Bosset 1

Both Grass development Stage and Grazing Management Play a Major Role on Milk Terpene Content

G. Tornambé, A. Cornu, B. Martin, P. Pradel, and M. Petit 2

Relationship Between Quality of Ewe's Cheese and Technology of Production: Traditional vs Industrial

J. Golecký 3

Terpenes in Milk and Toma Cheese in Different Forage Diets During Winter and Summer in an Alpine Valley

G. Battelli, G. Borreani, E. Tabacco, P.G. Peiretti, and D. Giaccone 4

CLA Isomers in Milk Fat from Cows Fed Diets with High Levels of Unsaturated FA

M. Collomb, R. Sieber, and U. Bütikofer 5

Winter Feeding Systems and Dairy Cows Breed Have an Impact on Milk Composition and on Flavour of Camembert PDO Cheese in Normandy

C. Hurtaud, D. Berthelot, L. Delaby, and J. L. Peyraud 6

Measurements of Volatile Organic Compounds from Feed to Cheese: Source of Origin and Flavour Properties

M. Pompe, G. Tompa, R. Susič, and I. Rogelj 7

Effects of Feeding on Nutritional and Aromatic Characteristics of Caciocavallo Palermitano Cheese

A. Bonanno, A. Di Grigoli, G. Tornambè, B. Formoso, M. L. Alicata, G. Procida, P. Manzi, S. Marconi, and L. Pizzoferrato 8

SESSION 2: Microbiological, Nutritional, and Aromatic Characteristics

Comparative Study of Lipolysis of Spanish Ovine Milk Cheeses Protected by a Designation of Origin. Seasonal Variation

E. Fernández-García, M. Carbonell, J. Calzada, and M. Nuñez 9

Nutritional Composition of Milk: Effects of Altitude and Seasonal Variation on FA and Vitamins

C. Agabriel, A. Ferlay, C. Sibra, C. Journal, D. Teissier, P. Grolier, J. C. Bonnefoy, E. Rock, Y. Chilliard, B. Martin 10

Use of Lactic Bacteria in the Production of Lben Marocain

T. Belaiche and A. Haimour 11

Effect of Cheese Technology on the Characterization of Dominant Microflora in Traditional Cheeses Produced in the Lombardy Region

M. Brasca, S. Morandi, R. Todesco, and R. Lodi 12

Differences in Quality Among Zebu or Goat Cheese Manufactured from Grazing or Indoor Animals	13
<i>M. A. Galina</i>	
Volatile Profile of Artisanal and Industrial Piacentinu Ennese Cheese	14
<i>T. Rapisarda, C. carpino, J. Horne, and G. Licitra</i>	
Biodiversity Analysis of Microbiota of Cheese Produced in Alpine Pastures	15
<i>P. S. Cocconcelli and F. Cappa</i>	
Genetic Diversity of Strains of <i>Streptococcus Thermophilus</i> Isolated by Fontina Cheese	16
<i>A. Chatel, A. Barmaz, G. Turille, C. Andrighetto, and A. Lombardi</i>	
The Effect of Milk Type, Feed and Cheese Making Conditions on the Flavor Characteristics of Halloumi Cheese of Cyprus	17
<i>M. Neocleous</i>	
Effects on Aroma Profile of Piacentinu Ennese Cheese Using Different Tools Material During Cheese Making	18
<i>S. Mallia, C. Carpino, T. Rapisarda, L. Corallo, L. Luminello, R. Rosabrina, A. Difalco, and G. Licitra</i>	
Effect of the Altitude on Chemical and Nutritional Characteristics of Oscypek Cheese	19
<i>M. Pizzillo, S. Claps, A. Drozd, G. F. Cifuni, R. Rubino, and V. Fedele</i>	
SESSION 3: Sensory and Healthy Properties, and Life Quality	
Combined Influence of Cow Diet and Pasteurisation of the Milk on sensory Properties of French PDO Cantal Cheese	20
<i>B. Martin, I. Verdier-Metz, S. Hulin, A. Ferlay, P. Pradel, and J.B. Coulon</i>	
Technological, Chemical, and Sensory Characterization of Piedmont Cheeses	21
<i>G. Zeppa, L. Rolle, G. Tallone, and V. Gerbi</i>	
Relationships Between Milk and Cheese Fatty Acids Having a Potential Nutritional Interest	22
<i>A. Lucas, B. Martin, I. Verdier-Metz, and A. Ferlay</i>	
Acceptability and Sensory Distinctiveness of Typical Food Products	23
<i>E. Monteleone</i>	
Nutrients and Micronutrients of Cheeses: Influence on Human Health	24
<i>E. Rock</i>	
Microbial Characterization of AOC Salers Cheese and its Sensory Properties	25
<i>F. Duthoit, C. Callon, and M. C. Montel</i>	
Relationship Between Traditional Tools and Sensory Properties in Pecorino Silano	26
<i>S. Claps, M. Pizzillo, R. Rubino, G. F. Cifuni, and G. Morone</i>	
Mass Spectrometry in the Dairy Industry	27
<i>S. Foti</i>	

ABSTRACTS OF POSTER PRESENTATIONS

Characteristics of Natural Pasture for Cheese Production in Central Slovakia <i>M. Zimková and M. Michalec</i>	28
“Caprino” Fresh Cheese: Composition, Hygiene and Flavour <i>F. Conte, A. Verzera, M. Barreca, V. Romeo, and M. Ziino</i>	29
Relationship Between Geographic Area of Production and Sensory Properties of Caciocavallo Podolico <i>M. Pizzillo, S. Claps, R. Rubino, and G. F. Cifuni</i>	30
Biodiversity and Quality of Life. The “biological consumers” Judgment to Evacuate Biodiversity <i>A. Pirani</i>	31
Mass Spectrometric Identification and Characterization of Beta-Casein Variants in Milk <i>V. Cunsolo, S. Foti, F. Galliano, R. Saletti, D. Marletta, and S. Bordonaro</i>	32
Milk Fat Globules in Jersey Cows: Relationship to Quality Milk <i>M. Martini, F. Cecchi, A. Summer, and C. Scolozzi</i>	33
Evaluation of Morphometric Characteristics of Milk in Grazing Ewes <i>M. Martini, C. Scolozzi, F. Cecchi, F. Salari, and P. Verità</i>	34
The Pastoral Vegetation Types of the Alps of Piedmont: a Basic Tool for the Characterisation of Alpine Cheeses <i>A. Cavallero, M. Brachet Contol, A. Gorlier, M. Lonati, B. Martinasso, M. Corgnati, and M. Soster</i>	35
The Pastoral Cadastre as a Tool for Linking the Typical Dairy Products with their Land of Origin <i>P. Aceto, A. Cavallero, D. Cugno, G. Lombardi, and C. Tagliatori</i>	36
Analysis by SSCP Method of the Microbial Diversity of Milk Flora <i>I. Verdier-Metz, V. Michel, C. Delbès, and M. C. Montel</i>	37
Characterization and Use of Natural Lactic Bacteria in the Production of Toma Piemontese Cheese, a Traditional Cheese <i>P. Dolci, M. G. Fontina, G. Zeppa, A. Acquati, and A. Gandini</i>	38
How Volatile Compound Profiles are Modified by Indigenous Milk Microflora in Hard Cooked Cheese? <i>S. Buchin, L. Tessier, F. Berthier, J. C. Salmon, and G. Duboz</i>	39
List of authors	40

CHANGES IN TERPENE COMPOSITION FROM PASTURE TO CHEESE

H. Schlichtherle-Cerny^{1*}, M. I. Imhof¹, E. Fernández-García², and J. O. Bosset¹

¹Agroscope Liebefeld-Posieux, Swiss Federal Research Station for Animal Production and Dairy Products (ALP), Schwarzenburgstrasse 161, 3003 Berne, Switzerland, and ²National Institute for Agricultural and Food Technology (INIA), 28040 Madrid, Spain
hedwig.schlichtherle-cerny@alp.admin.ch

Terpenes are secondary plant metabolites and often reason for the biological activity of plants and culinary herbs. Terpenes, mostly optically active, are mainly present in vegetable products and belong to the key odorants in essential oils. For some years, terpenes proved useful as “terroir” markers to trace the geographical origin of highland and lowland dairy products. However, only few studies were conducted on the enantiomeric proportions in milk and dairy products. Hence, the objective of the present study was to track the monoterpene composition and their enantiomeric ratios from pasture to cheese using purge and trap gas chromatography coupled to mass spectrometry (GC-MS) employing the chiral stationary phase CP-Chirasil-Dex CB. We were particularly interested to study whether the enantiomeric ratios of the terpenes found in pasture are maintained in the milk and in cheese produced from the same milk, and to which extent the rumen microflora influences terpene composition. Some terpenes such as β -myrcene and β -trans-ocimene were degraded, whereas new compounds were formed during incubation with rumen contents. The results show that the terpene composition changes significantly from pasture to cheese.

BOTH GRASS DEVELOPMENT STAGE AND GRAZING MANAGEMENT PLAY A MAJOR ROLE ON MILK TERPENE CONTENT

G. Tornambé^{1,3*}, A. Cornu¹, B. Martin¹, P. Pradel², and M. Petit¹

¹INRA-URH, Clermont-Theix, 63 122 Saint-Genès Campanelle, France; ²INRA, Domaine de la Borie, 15 190 Marcenat, France; and ³Università degli Studi di Palermo – Dipartimento S.En.Fi.Mi.Zo - Facoltà di Agraria – Viale delle Scienze - 90100 - Palermo –Italy
tornambe@clermont.inra.fr

A diversified grassland located in the Cantal mountains (1100 m elevation) was exploited from the 31th of May to the 30th of June and from the 1st to the 6th of October (re-growth). In June, the development stage of *Dactylis glomerata* varied from the jointing to fructification stage. The parcel was divided in two equivalent parts exploited by 6 dairy cows (5 Montbéliarde and 1 Tarentaise) in two different ways; strip grazing (SG), the strip limits moving ahead every 2 days or paddock grazing (PG), paddock being changed every 10 days. Bulk milk was sampled twice a week. Volatile compounds were extracted from the milk fat by Purge and Trap Dynamic Head Space, separated by gas chromatography and terpenes were selectively detected by mass spectrometry using their characteristic fragments at 93, 136, 161 and 204. Monoterpenes were semi-quantified by integrating the 93 ion chromatographic peaks between 25 and 40 min and sesquiterpenes by integrating the 161 ion between 50 and 70 min.

In SG milk obtained in June, the sum of terpenes varied linearly from $33 \cdot 10^6$ to $260 \cdot 10^6$ arbitrary units (a.u.) for mono- and from $9 \cdot 10^6$ to $76 \cdot 10^6$ a.u. for sesqui- terpenes. Milk terpene content was positively correlated to the time ($R^2=0.90$ and 0.73 for mono- and sesqui- terpene respectively). At the entrance of cows in each paddock, PG milk milk terpene content increased from 81 to $120 \cdot 10^6$ a.u. and from 25 to $45 \cdot 10^6$ a.u for mono- and sesqui- terpenes respectively. During the paddock grazing, both mono- and sesqui- terpene decreased from -16 to -56% according to the paddock. The lowest mono- and sesqui- terpene contents (29 and $7 \cdot 10^6$ a.u. respectively) were observed in milks obtained on re-growth grassland. Those original results underline, for a given grassland the primary importance of grass development stage but also, secondarily of the grazing management on milk terpene content.

RELATIONSHIP BETWEEN QUALITY OF EWE'S CHEESE AND TECHNOLOGY OF PRODUCTION: TRADITIONAL VS INDUSTRIAL

Jaroslav Golecky*

Grassland and Mountain Agricole Research Institute, Mladeznicka 36, 974 21 Banska Bystrica,
Slovakia
golecky@vutphp.sk

L'élevage ovin: la situation en Slovaquie.

Dans les régions de montagne de Slovaquie, les prairies permanentes traditionnelles représentent plus de 60% de la terre agricole (855 000 ha). Ce territoire a toujours été pâturé par du bétail bovin et ovin.

Chez les ovins, on utilise traditionnellement le système de l'estivage en "chalets". Le plus tôt possible, au printemps, les bergers commencent à faire pâturer leur troupeau - au début en vallée puis de plus en plus haut. Á la montagne, il existe un système de chalets (à différentes altitudes) où vivent les bergers pendant la saison estivale. Á la fin de la saison, les troupeaux descendent progressivement vers la vallée. Pendant la saison estivale, les brebis sont traitées à la main deux fois par jour. Sur place, au chalet, on fabrique du caillé de brebis. Une fois par semaine, les blocs de caillé sont descendus dans la vallée. Une petite partie est consommée directement, et les autres sont transportés à la fromagerie. Dans la fromagerie, les blocs de caillé de brebis sont utilisés comme base pour la production de bryndza, ostiepok, parenica, kaskaval, feta. Les blocs de caillé de chaque région présentent des caractéristiques typiques, influencées par la composition botanique, la race de brebis et par la saison.

Aujourd'hui la situation s'est modernisée. L'élevage des troupeaux de brebis laitières s'est intensifié. On fait pâturer les animaux sur prairie artificielle avec clôture électrique, et pour augmenter la production de lait, on utilise le croisement entre nos races et des races étrangères. Depuis les dernières années, les machines à traire sont de plus en plus utilisées pour la traite des brebis, et le lait est immédiatement pasteurisé. Les fromageries achètent uniquement du lait.

Bien que la production traditionnelle représente encore plus de 50 % de la production totale, elle régresse d'année en année. Et peu à peu les "blocs de caillé de brebis" perdent leur caractère de produit typique Slovaque.

La différence entre les blocs de caillé de brebis produits par technologie traditionnelle et ceux produits par technologie moderne est grande. Il y a une grande différence de caractéristiques microbiennes et sensorielles.

TERPENES IN MILK AND TOMA CHEESE IN DIFFERENT FORAGE DIETS IN AN ALPINE VALLEY

G. Battelli^{1*}, G. Borreani², E. Tabacco², P.G. Peiretti³, and D. Giaccone⁴

¹ISPA – CNR, Milano; ²Dipartimento di Agronomia, Selvicoltura e Gestione del Territorio – Università di Torino; ³ISPA – CNR, Torino; ⁴Associazione Regionale Produttori Latte del Piemonte
giovanna.battelli@unimi.it

Scopo del lavoro è stato quello di valutare l'effetto della tipologia di alimentazione delle bovine sulla variazione del contenuto in terpeni nel latte e nel formaggio prodotti in un ambiente alpino. La prova è stata condotta presso la Stazione Alpina Sperimentale di Sauze d'Oulx (TO) a 1.850 m s.l.m.. Il latte prodotto, da una mandria di 60 vacche di razza valdostana con una produzione media annuale di circa 4.000 kg/latte, è stato caseificato in diversi momenti dell'anno a Toma. In alcune prove di caseificazione sono stati valutati i profili terpenici dei latti e dei formaggi in funzione di due aspetti: l'effetto di razioni invernali a base di fieno o fieno silo e l'effetto del momento di pascolamento nel periodo estivo di alpeggio. I terpeni sono stati valutati mediante P&T-GC/MS. I valori sono stati espressi in percentuale di abbondanza dello ione quant caratteristico di ogni singolo composto.

I terpeni presenti in maggior quantità sono risultati i seguenti: α -pinene, camphene, β -pinene, δ 3-carene, β -mircene, β -ocimene, allo-cimene e D-limonene. Nei latti e nei formaggi prodotti nel periodo di pascolamento questi terpeni sono risultati molto più elevati rispetto a quelli derivati da un'alimentazione a base di foraggi conservati. Ad eccezione del D-limonene, il pascolo estivo precoce presenta dei valori di terpeni nettamente più elevati del pascolo autunnale con vegetazione caratterizzata da un avanzato stadio di maturazione. Fatto 100 il valore in abbondanza dello ione quant misurato sui campioni del pascolo precoce, il pascolo tardivo ha presentato valori compresi tra il 13% del δ 3-carene e l'80% del camphene. Per quanto riguarda il confronto tra l'alimentazione invernale a base di fieno oppure di fienosilo emergono differenze solo per il contenuto in α -pinene e β -pinene, più elevato nel latte della tesi fieno.

In conclusione è stato osservato che a partire da razioni invernali caratterizzate da alte percentuali di foraggio (70-80% sul secco) prodotto localmente, il latte e i formaggi prodotti presentano un contenuto apprezzabile in terpeni, ovviamente più basso rispetto a quello estivo, ma più elevato rispetto al latte prodotto con razioni di pianura a base di silomais e concentrati.

Inoltre emerge che con il pascolamento su formazioni pastorali alpine giovani, il contenuto terpenico del latte e dei formaggi risulta essere molto più elevato rispetto ai prodotti ottenuti da un pascolamento tardivo.

CLA ISOMERS IN MILK FAT FROM COWS FED DIETS WITH HIGH LEVELS OF UNSATURATED FA

M. Collomb*, R. Sieber, and U. Bütikofer

Swiss Federal Research Station for Animal Production and Dairy Products (ALP), CH-3003 Berne,
Switzerland
marius.collomb@fam.admin.ch

The contents of CLA isomers was determined in milk fat from cows fed a control diet constituted of hay *ad libitum* and 15 kg fodder beet, and supplemented with oilseeds containing either high levels of oleic acid (rapeseed), linoleic acid (sunflowerseed) or α -linolenic acid (linseed), using Ag⁺-HPLC. High significant ($P \leq 0.001$) correlations were found between the daily intakes of oleic acid and the concentration of the CLA isomer *trans*-7,*cis*-9 in milk fat, of linoleic acid and the CLA *trans*-10,*trans*-12, *trans*-9,*trans*-11, *trans*-8,*trans*-10, *trans*-7,*trans*-9, *trans*-10,*cis*-12, *cis*-9,*trans*-11, *trans*-8,*cis*-10 and *trans*-7,*cis*-9 and of α -linolenic acid and the CLA isomers *trans*-12,*trans*-14, *trans*-11,*trans*-13, *cis* *trans*/*trans* *cis* 12,14, *trans*-11,*cis*-13 and *cis*-11,*trans*-13. The CLA contents were also determined in milk fat from cows grazing in the lowlands (600-650 m), the mountains (900-1210 m) and the highlands (1275-2120 m). The concentrations of only three CLA (*cis*-9,*trans*-11, *trans*-11,*cis*-13 and *trans*-8,*cis*-10) increased almost linearly with elevation. Therefore, these three CLA isomers, and particularly the CLA isomer *trans*-11,*cis*-13, the second most important CLA in milk fat from cows grazing at the three altitudes, could be interesting indicators for the origin of *Alpine* milk products.

Keywords: Milk fat, CLA distribution, Ag⁺-HPLC, Oilseed, Grass

WINTER FEEDING SYSTEMS AND DAIRY COWS BREED HAVE AN IMPACT ON MILK COMPOSITION AND ON FLAVOUR OF CAMEMBERT PDO CHEESE IN NORMANDY

C. Hurtaud*, D. Berthelot, L. Delaby, and J. L. Peyraud

UMR INRA-ENSAR Production du Lait, 35590 SAINT-GILLES, France
hurtaud@st-gilles.rennes.inra.fr

The reduction of costs of production and the research of a larger diversity of PDO cheeses becomes a crucial objective in Normandy. There is increased interest in grazing systems with reduced concentrate input. The future objective of the PDO in Normandy is to promote the Normande (No) breed, which is currently outnumbered by the Holstein (Ho) breed. In this experiment, we studied the relation between feeding system and dairy cow breed and its consequence on milk yield, composition and physical and sensorial properties of Camembert cheeses. The experiment was a 2x2 factorial arrangement of treatments with 2 feeding systems and 2 cow breeds. A restricted grass diet (fed as big bale haylage) with a low level of concentrate feeding (15%) (GLc) was compared to maize silage diet with a high level of concentrate feeding (30%) (MHc). Sixty eight Ho and No cows in early lactation were assigned to one of two feeding systems for a six weeks period: Ho-MHc, Ho-GLc, No-MHc, No-GLc.

No interaction between system and breed was observed except for milk fatty acids. Cows on the GLc feeding system had lower milk yield, fat and protein contents as a result of the lower dry matter intake. Normande cows had lower milk yield but higher milk protein content. Milk fatty acid composition and structure was altered by the GLc feeding system and No breed : mono-unsaturated fatty acids and linolenic acid increased, but short-chain fatty acids decreased with GLc compared to MHc. Linolenic acid and fat globule size increased with No breed. GLc feeding system and No breed produced a yellower cheese colour. Feeding systems (GLc or MHc) had limited effects on the firmness of Camembert measured with a texturometer. The Camembert was judged less firm and more melting with Ho breed and GLc feeding by trained panellists. Sensory analysis demonstrated that global intensity of taste increased with Ho breed and GLc feeding system, mainly due to stronger aromatic impact in the category of ammoniac, acidity, "blue cheese" and salty. Feeding systems and breed had limited effects on cheese odour-active compounds. The quantity of flavour substances did not change with breed and feeding. 1-octen-3-ol, 2-and 3-octanone identified as mushroom flavour significantly decreased with GLc and No breed and methyl-ketones and secondary alcohols identified as "blue cheese" flavour tended to reduce with No breed.

MEASUREMENTS OF VOLATILE ORGANIC COMPOUNDS FROM FEED TO CHEESE: SOURCE OF ORIGIN AND FLAVOUR PROPERTIES

M. Pompe^{1*}, G. Tompa², R. Susič¹, and I. Rogelj²

¹Faculty of Chemistry and Chemical Technology, University of Ljubljana, Aškerčeva 5, 1000 Ljubljana, Slovenia; ²Biotechnical Faculty, Zootechnical Department, University of Ljubljana, Groblje 3, 1230 Domžale, Slovenia
matevz.pompe@Uni-Lj.si

A new technique of double preconcentration for the profiling of volatile organic compounds in dairy products was developed. We have achieved fair reproducibility, which ranged from 24 to 50 %, for β -Pinene and Limonene, respectively. The most probable major source of the variability was the initial purging step that will need further improvements.

The developed procedure was used for monitoring terpene composition in animal feed, milk, and cheese (Nanoški cheese) during its three months ripening process. In all three instances, the same dominant terpenes were found. Based on the constancy of the concentration ratios between extracted terpenes, we concluded that their relative concentrations in cheese during the ripening period do not change significantly.

At the end, we tested whether the information on VOC profile of the individual cheese samples could provide sufficient tool for the determination of cheese origin. Terpenes represent characteristic grazing pastures and were clearly distinguished in the GC/MS data, so they are the compounds of special interest for unequivocal identification and tracing the origin of milk derived foods. Together with other compounds, which are more likely linked to specific manufacturing practices rather than location, they feature a unique chemical profile for distinguishing the original cheeses from possible surrogates.

EFFECTS OF FEEDING ON NUTRITIONAL AND AROMATIC CHARACTERISTICS OF CACIOCAVALLO PALERMITANO CHEESE

A. Bonanno^{1*}, A. Di Grigoli¹, G. Tornambè^{1,2}, B. Formoso¹, and M. L. Alicata¹, G. Procida³, P. Manzi³, S. Marconi³, and L. Pizzoferrato³

¹Dipartimento S.En.Fi.Mi.Zo., sezione di Produzioni Animali, Università degli Studi di Palermo, facoltà di Agraria, Viale delle Scienze, 90128 Palermo, Italy; ²INRA-URH, Clermont-Theix, 63 122 Saint-Genès Campanelle, France; and ³Istituto Nazionale di Ricerca per gli Alimenti e la Nutrizione (INRAN), Roma.
abonanno@unipa.it

The aim of this research, in the typical Cinisara cow-breeding area, was to highlight the effects on cheese quality characteristics, of a diet based exclusively on pasture exploitation and its integration with concentrates varying in ruminal degradation speed. In a typical, coastal farm in the province of Palermo, 24 Cinisara cows were distributed in four groups, homogeneous for parity, stage of lactation and milk yield, and were fed different diets: continuous natural pasture (**P**); continuous natural pasture with 5 kg/head/d slow degradable concentrate (60% corn, 20% broad bean, 20% fine bran) (**PSD**); continuous natural pasture with 5 kg/head/d rapid degradable concentrate (60% barley, 20% chick pea, 20% fine bran) (**PRD**); hay of "sulla" (*Hedysarium coronarium* L.) *ad libitum* with 7 kg/head/d of farm concentrate (65% broad bean, 35% fine bran) (**H**). The P, PSD and PRD cows were grazed during the day and only moved to cowsheds for milking and concentrate administration; the cows from H group were housed in a half-open cowshed. Individual milk yield was recorded four times (29 April, 19 May, 2 and 9 June); the bulk milk from each group was utilised for making Caciocavallo Palermitano cheese. Bulk milk samples were analysed for pH, titratable acidity, fat, protein, lactose, somatic cells count, bacterial count, urea, total N, non-casein N, non-protein N. After 2 months of ripening, the cheese samples were analysed for dry matter, fat, total and soluble N, ash, cholesterol, vitamins and fatty acids. Analysis of volatile fraction was carried out for both milk and cheese by the headspace-cold trap method. Cheeses produced on 19 May and 2 June were examined by triangular test.

The decrease in milk yield in cows fed only with pasture was determined by the progressive worsening of forage quality. Both concentrate supplements limited the slowing down of milk yield in the period of low forage availability. The slow degradable concentrate reduced protein and casein milk content, whereas the rapid degradable concentrate reduced milk and cheese fat. Cheese from P group was higher in α -tocopherol and lower in fat cholesterol in comparison with H cheese. Terpens were detected in larger quantities in milk and cheese from P group in comparison the H group. The concentrate supplement reduced the terpens content, but at a higher level than H group. The 19 May cheese from P milk differed greatly from the others at the triangular test.

**COMPARATIVE STUDY OF THE LIPOLYSIS OF SPANISH OVINE MILK
CHEESES PROTECTED BY A DESIGNATION OF ORIGIN.
SEASONAL VARIATION**

E. Fernández-García*, M. Carbonell, J. Calzada, and M. Nuñez

Departamento de Tecnología de Alimentos. Instituto Nacional de Investigación y Tecnología Agraria
y Alimentaria (INIA) Carretera de La Coruña, Km 7, Madrid, 28040 Spain
Tel: 34 913476771
fgarcia@inia.es

The extent and peculiarities of the lipolysis underwent by three different PDO cheeses, namely Manchego, Zamorano and La Serena cheeses, manufactured throughout the year from raw ewes milk have been studied by GLC of the underivatised free fatty acids.

All individual FFA concentrations increased significantly with the ripening time in all three cheese types. The season of manufacture was significant almost for all FFA. Six months old Manchego cheeses, 4 months old La Serena cheeses, and Zamorano cheeses at any ripening time manufactured in spring showed higher concentrations of most FFA. The percentages of short chain fatty acids (SCFA) in the total amount of FFA were lower in Manchego cheeses made in summer and winter, in La Serena cheeses made in summer, and in Zamorano cheeses made in summer and autumn. The percentages of medium chain fatty acids (MCFA) were lower, and the percentages of long chain fatty acids (LCFA) were higher, in the three cheese varieties made in summer compared with the other seasons.

Eighty five percent of the Manchego cheeses, 93 % of La Serena cheeses, and 92 % of the Zamorano cheeses were correctly classified by the 2 functions in the discriminant analysis. In respect to seasonality of the FFA content, 100 % of the 6-month-old Manchego cheeses and of the 8-month-old Zamorano cheeses were correctly classified for the season of manufacture in the discriminant analysis.

In all three cheeses the concentrations of acids 2:0 to 6:0 were positively correlated with odour intensity and aroma intensity. The intensity of the attribute 'rancid' correlated with the acetic acid concentration, and the attribute 'pungent' with the concentration of all acids from 4:0 to 18:2. A positive correlation was found between flavour quality with the ratio SCFA/LCFA in Manchego cheese, and a negative correlation with the percentage of LCFA in the total amount of FFA in both Manchego and Zamorano cheeses.

NUTRITIONAL COMPOSITION OF MILK: EFFECTS OF ALTITUDE AND SEASONAL VARIATION ON FA AND VITAMINS

C. Agabriel^{1*}, A. Ferlay², C. Sibra¹, C. Journal¹, D. Teissier³, P. Grolier⁴,
J. C. Bonnefoy², E. Rock⁴, Y. Chilliard², B. Martin²

¹Unité Elevage et Productions des Ruminants, soutenue par l'INRA, ENITA Clermont, 63370 Lempdes, France; ²Unité de Recherches sur les Herbivores, INRA, 63122 Saint Genès Champanelle, France; ³Chambre d'Agriculture de Haute-Loire, 43000 Le Puy en Velay, France; ⁴Unité Maladies Métaboliques et Micronutriments, INRA, 63122 Saint Genès Champanelle, France.
agabriel@enitac.fr

Des travaux récents, menés en conditions expérimentales, ont montré que les teneurs de certains constituants des laits d'intérêt nutritionnel (acides gras, vitamines et caroténoïdes) varient avec des régimes alimentaires très différents ou dans des situations de terrain très contrastées.

L'objectif de cette étude était de valider ces résultats avec des laits de mélange valorisés par l'industrie laitière et produits dans 5 zones de Haute-Loire (France) distinctes par l'altitude et le système fourrager.

Du lait, issu de 2 tournées délimitées au sein de chacune des 5 zones, a été collecté 2 fois en hiver et 3 fois pendant la saison de pâturage. Un échantillon de lait représentatif a été prélevé dans les 50 citernes pour analyse des teneurs en acides gras, vitamines et caroténoïdes. Les conditions de production du lait (en particulier l'alimentation des animaux) ont été enregistrées dans les 206 exploitations concernées.

Les caractéristiques des laits diffèrent selon la saison de production (hiver ou pâturage) et pour chaque saison selon la provenance des laits (plaine ou montagne).

Les acides gras insaturés (acides ruménique, oléique et linolénique) et acides gras de forme trans (acide vaccénique) présentent des teneurs plus élevées au pâturage (ration basée sur la prairie permanente) qu'en hiver, et plus élevées en montagne qu'en plaine. A l'inverse, les acides gras saturés (acides laurique et palmitique) sont présents en plus grande quantité dans les laits d'hiver que dans ceux de pâturage, et dans les laits de plaine (ration basée sur le maïs) que dans ceux de montagne.

Les laits de pâturage sont un peu plus colorés et légèrement plus riches en carotènes et vitamine E que les laits d'hiver. Les laits de montagne sont un peu plus jaunes et contiennent un peu plus de lutéine que les laits de plaine. Ces écarts demeurent cependant faibles. La teneur des laits en vitamine A n'a pas varié en fonction de l'altitude ou de la zone de production.

Les différences observées sont d'abord liées à la nature des fourrages consommés par les animaux, en particulier à la présence en quantité significative de maïs dans les zones de plaine et à l'utilisation majoritaire d'herbe dans les zones de montagne et au pâturage, et non à un effet direct de l'altitude ou de la saison.

Cette étude a permis de valider la majorité des résultats obtenus en conditions expérimentales. La variabilité des constituants a été, dans l'ensemble, aussi importante que celle observée sur des laits individuels de vaches nourries avec des régimes extrêmes.

USE OF LACTIC BACTERIA IN THE PRODUCTION OF "LBEN" MAROCAIN

T. Belaiche* and A. Haimour

Département de Technologie Alimentaire, Ecole Nationale d'Agriculture de Meknès, B.P., S/40,
Meknès, Maroc
tbelaiche@yahoo.com

Ce travail présente les résultats des travaux de recherches concernant:

- La comparaison de l'aptitude acidifiante de trois ferments lactiques, le lben marocain, le yaourt et le ferment commercial β 4DL1;
- La comparaison des caractéristiques physico-chimiques des fromages élaborés avec du lben et du ferment commercial respectivement;

Les résultats obtenus ont montré que:

- Après 16 heures d'incubation, les acidités des laitsensemencés respectivement par le ferment commercial, le ferment Yaourt et le ferment Lben, ne présentent pas de différences significatives. Par contre les cinétiques d'évolution du pH différent pour le ferment Lben.
- Sur le plan micro-biologique, les analyses ont montré la richesse du Lben en flore d'intérêt technologique (flore lactique, levures et moisissures).
- L'analyse physico-chimique des fromages élaborés avec un ferment de commerce et celui élaboré avec un ferment Lben, a montré, des teneurs en matières sèches, matières grasses, cendres, et chlorures voisines. La différence entre les deux fromages concerne particulièrement le pH et les matières azotées totales.

Mots clés: Lben en tant que ferment; aptitude acidifiante; fromage frais et affiné; composition physico-chimique et micro-biologique.

EFFECT OF CHEESE TECHNOLOGY ON THE CHARACTERIZATION OF DOMINANT MICROFLORA IN TRADITIONAL CHEESES PRODUCED IN THE LOMBARDY REGION

M. Brasca, S. Morandi, R. Todesco, R. Lodi*

CNR-Istituto di Scienze delle Produzioni Alimentari, Sez. Milano, Via Celoria, 2 20133 Milano
roberta.lodi@ispa.cnr.it

La tecnologia di produzione dei formaggi tradizionali, punto cruciale della loro tipicità, costituisce un serbatoio ancora incontaminato di biodiversità microbica. Ma difficoltà legate alla mancanza di strutture e di condizioni igieniche adeguate potrebbero far perdere numerosi formaggi tradizionali inconfondibili, a causa di innovazioni ed ammodernamenti che coinvolgono non solo i sistemi di trasformazione, ma anche quelli di produzione e stoccaggio della materia prima.

Tutto questo ha modificato enormemente il panorama lattiero-caseario della tradizione italiana, poiché per il medesimo prodotto vi possono essere soluzioni tecnologiche differenti (uso di latte crudo o pastorizzato, uso o meno di innesti, ecc.) a seconda che esso venga trasformato direttamente in azienda o no, determinando così la comparsa di uno stesso formaggio con profili qualitativi assai differenti.

Sulla base di risultati sperimentali ottenuti nel corso di ricerche eseguite su formaggi a latte crudo prodotti nelle valli lombarde, vengono presentati tre esempi.

Termizzazione del latte nella produzione di Scimudin, formaggio a pasta molle della Valtellina. Il compromesso tra pastorizzazione ed impiego di latte crudo è rappresentato dalla termizzazione, eseguibile anche in piccole realtà artigianali. Con un trattamento a 65°C per 15 secondi è migliore la qualità igienica del prodotto, pur rimanendo elevato il contenuto in batteri lattici e batteri aromatizzanti quali Enterococchi e Propionici, consentendo di ottenere prodotti con caratteristiche sensoriali più simili a quelli dei formaggi "a latte crudo", preferiti dal consumatore.

Temperatura di "cottura" nella produzione di Valtellina Casera DOP. Il disciplinare di produzione prevede una fase di cottura della cagliata ad una temperatura compresa tra 40 e 45°C, ma alcuni produttori, timorosi di un'eccessiva contaminazione, eseguono trattamenti più drastici (>52°C), che portano ad un impoverimento della microflora casearia autoctona e quindi ad un formaggio con un profilo della componente aromatica particolarmente "piatto" e dalle caratteristiche sensoriali giudicate decisamente povere sotto tutti i punti di vista.

Microflora lattica dominante della Formagèla Valseriana, formaggio a pasta molle dell'omonima valle bergamasca. Prodotti di fondovalle e d'alpeggio presentano una ricca microflora lattica, decisamente più elevata e più varia sotto il profilo qualitativo in questi ultimi. Tali differenze sono da imputarsi al diverso ambiente produttivo, alla qualità delle materie prime ed alla pressione selettiva operata dalle diverse tecnologie impiegate.

DIFFERENCES IN QUALITY AMONG ZEBU OR GOAT CHEESE MANUFACTURED FROM GRAZING OR INDOOR ANIMALS

Miguel A. Galina*

Facultad de Estudios Superiores de Cuautitlan UNAM, México

miguelgalina@correo.unam.mx

Abstract: Cheese and milk products from grazing animals that have showed a higher content of mono-terpenes, sesqui-terpenes, unsaturated fatty acids, CLA and the anti-oxidants, than cheese from indoor ruminants. Most cheese with improved quality related to human health comes from grazing animals. All pastures change their chemical composition during the year given cheese different nutritive properties and flavor during different seasons. Each plant has a different chemical composition and nutritive value. Cheese from grazing animals will have at least 5 advantages (i) better non saturated fatty acid profile diminishing cardiovascular disease and obesity. (ii) Improved conjugated linoleic acid that has been proved to control cancer growth and accumulates particularly in cheese. (iii) Cheese from grazing animals has less cholesterol and higher antioxidant components accompanied by alcohol derivatives as monoterpenes that reduce tumoral cell formation. (iv) Aromatic component of grazing cheese is higher than the one manufactured from indoor milk improving flavor and (v) most pharmacological properties of herbs overpass to cheese improving composition and health properties to human consumers. A number of metabolites have been reported from various species most of them good for human health, including amines and alkaloids, cyanogenic glycosides, cyclitols, fatty acids and seed oils, fluoroacetate, gums, non protein amino acids, terpenes (including essential oils, diterpenes, phytosterol and triterpene) hydrolyzable tannins, flavonoids and condensed tannins. A study compare cheese manufactured from grazing goats in the semiarid environment en from Zebu cattle in the tropics in Mexico in the mountains. During 2003 in the spring and summer we monitored for quality related to fatty acids content and therapeutic pharmacological components in cheese made from grazing Zebu cattle or Alpine goats or cheese made from milk from indoor animals. Monoterpenes and sesquiterpenes on pasture Zebu cheese were 360 and 520 ng/l respectively. Indoors cattle had 65 and 210 ng/l. Total fat and cholesterol diminished from grazing cattle from 22g/100 g cheese and 245 mg/100 g fat, in grazing ruminants compared to 37g/100 g and 387 mg/100 fat in the indoors cattle made cheese. Grazing accounted to higher tocopherol in cheese from 127 mg/100 mg DM compared to 77mg/100 g DM in indoors cattle cheese. In goats Monoterpenes and sesquiterpenes on pasture goat cheese were 380 and 500 ng/l respectively. Indoors goats had 70 and 80 ng/l. Total fat and cholesterol diminished from goats grazing from 26g/100 g cheese and 290 mg/100 g fat, in grazing goats compared to 35g/100 g and 380 mg/100 fat in the indoors cheese. Grazing accounted to higher tocopherol in cheese from 120 mg/100 mg DM compared to 90mg/100 g DM in indoors goat cheese. Grazing goats pastured 40 has of shrubland with *Acacia artesian*, *Acacia Schaffer*, *Bounteous Aristida adscensionis*, *Setaria parviflora*, *Urochloa fasciculata*; leguminosas: *Prosopis laevigata*, *Mimosa biuncifera*; matorrales: *Celtis pallida*, *Jatropha dioica*, *Zalazania augusta*, *Verbasina serrata*, *Opuntia spp* supplemented with slow intake urea mixture. 2003). Artisan cheese was made from non pasteurized raw milk. Cheese quality relegated to human health was improved in artisan cheese made from grazing goats or cattle particularly browsing in *Acacias* or tropical trees. Milk production was sustained by supplement feeding when forage growth was reduced, thus avoiding over-grazing of the rangeland, and economical production of cheese by the farmer was maintained. Cheese quality relegated to human health was improved in artisan cheese made from grazing cattle or goats browsing tropical or semiarid trees. It is concluded that milk from grazing was better than that produced indoors regarding the feeding system in Zebu cattle or Alpine goats.

VOLATILE PROFILE OF ARTISANAL AND INDUSTRIAL PIACENTINU ENNESE CHEESE

T. Rapisarda^{1*}, S. Carpino¹, J. Horne¹, and G. Licitra^{1,2}

¹*CoRFiLaC*, Regione Siciliana, S.P. 25 km 5, 97100 Ragusa Italy; ²Dipartimento di Scienze Agronomiche, Agrochimiche e delle Produzione Animali, Catania University, 95100 Catania Italy
teresa@corfilac.it

Piacentinu is one of the many traditional cheeses of Sicily. Produced in the province of Enna, it is a pressed ewes' milk cheese with peppercorns and saffron that gives it a typical spicy/floral flavours and a characteristic yellow colour. The objective of this study was to determine whether changing the traditional conditions under which Piacentinu cheeses are made affects their volatile organic compounds (VOC). Cheeses were obtained from seven different farms, three of which used raw milk, no starters, and artisanal lamb and/or kid rennet (R). Four other farms used pasteurized milk, commercial LAB starter cultures and commercial lamb rennet (P+S). Cheeses were ripened from 2 to 6 months. VOC fractions were extracted onto SPME fibers using a retronasal aroma simulator (RAS). Gas chromatography/olfactometry (GC/O) and mass spectrometry (GC/MS) were used to identify VOC. R cheeses contained a more diverse group of VOC, especially among terpenes which points to the importance of pasture in promoting flavor development of traditional cheeses. Differences among other groups of volatiles were likely due to the unique microbial communities and enzymes found in R cheeses that differed from those found in P+S cheeses. R cheeses also had significantly stronger aroma intensities in most categories except fruity. Principal components analysis on VOC data separated R and P+S cheeses by their VOC "fingerprints".

Keywords: Piacentinu cheese, Gas chromatography/olfactometry.

BIODIVERSITY ANALYSIS OF MICROBIOTA OF CHEESE PRODUCED IN ALPINE PASTURES

P. S. Cocconcelli and F. Cappa*

Istituto di Microbiologia, Centro Ricerche Biotecnologiche, Università Cattolica del Sacro Cuore, via Emilia Parmense 84, 29100, Piacenza, Italy.
fabrizio.cappa@unicatt.it

The quality and sensorial properties of dairy foods are strongly associated with specific attributes of raw milk, with the climate and environmental conditions, with the cheesemaking technologies and with the microbiota responsible for the fermentation process and ripening. Biodiversity of these microorganism is considered valuable for the quality of dairy products. The study of biodiversity has been considerably improved by application of nucleic acid based methods, efficient tools in addressing new questions concerning the complex microbial communities of dairy products.

The first approaches to the DNA-based analysis of microbial population were the study of restriction fragment pattern. These development of a number of PCR techniques, such as RAPD, ERIC, REP-PCR and AP-PCR increased the sensitivity of the molecular methods, being able to discriminate at strain level. The application of these techniques allowed the monitoring of population dynamics during fermentation and ripening of cheese produced from raw milk in alpine pastures of Italian alps. In particular were studied the bacterial communities of Fontina, Fromadzo, Nostrano di Primiero, Spessa and Bettelmatt. Since the biodiversity studies require efficient identification of microbial species, different methods based on the analysis of genes coding for ribosomal RNA have been developed and applied. Molecular techniques, 16S rRNA sequencing, ARDRA and DGGE, were used for the identification and phylogenetic analysis of bacteria isolated from the above cited traditional cheeses.

In the last few years a collection of lactic acid bacteria was underwent to genomic sequencing and analysis. The genome sequencing of more than 15 different species, comprising the most interesting bacteria for dairy application, are under analysis or has been completed. The information deriving from the efforts to determine the genome sequence of a representative collection of lactic acid bacteria provide new possibility for the biodiversity analysis of dairy microorganisms. The new approach of DNA arrays gives a wide range of information on gene expression allowing a function analysis of dairy lactic acid bacteria. A study on transcriptional analysis of genes coding for technological relevant properties has been conducted on strains isolated the alpine cheese, revealing the presence of higher genetic diversity if compared to dairy industrial starter cultures.

GENETIC DIVERSITY OF STRAINS OF *STREPTOCOCCUS THERMOPHILUS* ISOLATED BY FONTINA CHEESE

A. Chatel¹, A. Barmaz^{1*}, G. Turille¹, C. Andrighetto², and A. Lombardi²

¹Institut Agricole Régional, Reg. La Rochère 1/A, 11100, Aosta, Italy; ²Istituto per la Qualità e le Tecnologie Agroalimentari, Veneto Agricoltura, Via San Gaetano 74, 36016, Tione (VI), Italy
a.barmaz@iaraosta.it

Con la tecnica randomly amplified polymorphic DNA (RAPD)-PCR sono stati caratterizzati geneticamente 120 ceppi di *Streptococcus thermophilus* isolati da 49 cagliate provenienti da lavorazioni svolte presso 22 alpeggi valdostani in cui non erano mai state utilizzate colture starter per produrre Fontina DOP che è un formaggio a pasta semi-cotta (48°C), a base di latte crudo intero di una sola mungitura, stagionato 3 mesi. Le differenze tra i profili RAPD-PCR ottenute con i primers M13 e D11344 hanno messo in evidenza una significativa eterogeneità all'interno della specie *Streptococcus thermophilus*. La stessa caratterizzazione è stata estesa a 218 ceppi, di cui 40 isolati da Fontina, provenienti da quattro formaggi italiani a denominazione di origine protetta. L'analisi randomly amplified polymorphic DNA-PCR ha in questo caso permesso di discriminare una parte dei ceppi di *Streptococcus thermophilus* in base alla zona di origine.

Infine sono stati individuati dei ceppi con profilo RAPD-PCR molto simili ai profili di due *Streptococcus macedonicus* di riferimento, mettendo in evidenza la presenza di questi streptococchi anche in formaggi italiani.

Parole chiave: *Streptococcus thermophilus*; *Streptococcus macedonicus*; RAPD-PCR; Caratterizzazione; Formaggio

THE EFFECT OF MILK TYPE, FEED AND CHEESE MAKING CONDITIONS ON THE FLAVOR CHARACTERISTICS OF HALLOUMI CHEESE OF CYPRUS

Maria Neocleous*

Nature and Culture (NGO), Limassol 4011, Cyprus
Mir3mn@spidernet.com.cy

Halloumi cheese, the traditional cheese of Cyprus, has been produced in the island for many years. It is a soft to semi-hard, elastic cheese, with a white to yellow color, a close texture with no holes and with no obvious skin/rind. It is consumed either as fresh or as mildly matured in salt whey. According to the Cypriot standards, the fresh Halloumi cheese composition should be 46% moisture, 43% fat on a dry basis and 3% salt. Halloumi cheese should be produced from goat or sheep's milk or from a mixture of these two (with or without cow's milk). The cheese making procedure is characterized by the cooking stage during which the curd is cooked at a temperature higher than 90°C for at least 30 min. This paper will give an overview of the effect of milk type, feed and cheese making conditions on the flavor characteristics of Halloumi cheese.

First, the flavor of Halloumi cheese is affected by the type of milk used in the cheese making. The fatty acids present in the milk, for example the significant amounts of caproic, caprylic, and capric acids in caprine milk, give a characteristic flavor to the Halloumi cheese. Moreover, different types of milk result in different microflora found in the final Halloumi cheese, which results in different maturation patterns and thus different flavors. Second, the feeding of animals (both during grazing or when in stable) affects the flavor properties of the cheese due to the transfer of plant chemical constituents/volatiles from the pasture into the cheese. In Cyprus, due to the morphology of the island, there are differences in pasture composition between areas, with more shrubs (bushes) in the upland mountainous areas and more grass-like plants in the lowland plain areas. Therefore, depending on the site where grazing takes place, this difference in pasture can be observed in the flavor of the cheese. Finally, the cheese making conditions can greatly affect the flavor properties of Halloumi cheese. Specifically, milk pasteurization prior to Halloumi cheese making is an important stage as it is generally accepted that raw milk cheeses develop a more intense flavor than pasteurized cheeses. The cooking stage also plays a crucial role in the flavor development of the final cheese as it can cause losses in volatiles and eliminate many microorganisms which contribute to the process of maturation for flavor development.

EFFECTS ON AROMA PROFILE OF PIACENTINU ENNESE CHEESE USING DIFFERENT TOOLS MATERIAL DURING CHEESE MAKING

S. Mallia¹, S. Carpino¹, L. Corallo¹, L. Tuminello¹, R. Gelsomino, and G. Licitra^{1,2}

¹*CoRFiLaC*, Regione Siciliana, S.P. 25 km 5, 97100 Ragusa, Italy; ²Dipartimento di Scienze Agronomiche, Agrochimiche e delle Produzioni Animali, Catania University, 95100 Catania, Italy
silviamallia@corfilac.it

Piacentinu Ennese is a traditional pressed ewes' cheese of Sicily, characterized by addition of peppercorns and saffron, which gives yellow color and special sensory and health properties to this cheese. Solid phase microextraction (SPME) coupled to gas chromatography/mass spectrometry/olfactometry (GC/MS/O) was used to determine volatile organic compounds (VOC) in Piacentinu cheese, produced by traditional (wood/copper) and stainless steel tools. Cheeses made by wood's tools showed a richer aroma profile, containing 2,3-butanedione, 3-hydroxy-2-butanone, 1,2-dimethyl hydrazine, limonene, copaene, α -caryophyllene and 2,6-dimethyl-3-ethyl pyrazine, that were not found in copper-cheese and steel-cheese. Odours described by the sniffers as "buttery", "earthy", "woody", "roasty", "green" and "mint" characterized the wood-cheese, whereas "fruity", "sweet", "honey" odours were detected especially in copper/steel cheeses. In conclusion, natural microflora of the wooden vat, used during cheese-making may influence and enrich the volatile profile of Piacentinu Ennese cheese.

Keywords: Piacentinu cheese, volatile compounds, olfactometry.

EFFECT OF THE ALTITUDE ON CHEMICAL AND NUTRITIONAL CHARACTERISTICS OF OSCYPECK CHEESE

M. Pizzillo^{1*}, S. Claps¹, A. Drozd², G. F. Cifuni¹, R. Rubino¹, and V. Fedele¹

¹Istituto Sperimentale per la Zootecnia – Via Appia – Bella Scalo – 85054 Muro Lucano (PZ);
National Research Institute of Animal Production- 32-38 Balice (Polonia)
michele.pizzillo@isz.it

L'obiettivo di questo lavoro è stato quello di valutare l'influenza delle aree di produzione, a diversa altitudine, sulle caratteristiche chimiche, organolettiche e nutrizionali del formaggio Oscypek. Il formaggio Oscypek, prodotto da latte crudo di pecore di razza autoctona, ha una forma a fuso ed un colore variabile dal giallo paglierino all'arancio scuro a seconda delle modalità di affumicatura. La ricerca è stata condotta in aziende localizzate, nel sud della Polonia, a diverse altitudini (650 s.l.m., 900 s.l.m e 1250 s.l.m). L'analisi floristica del pascolo ha evidenziato che, passando da 650 a 900 m. di altitudine, il contenuto delle graminacee diminuisce e contemporaneamente aumentano le percentuali di leguminose e delle "altre"specie. Il pascolo a 1250 m di altitudine ha presentato una minore diversità floristica (solo 20 specie).I formaggi provenienti dalle aziende localizzate in montagna hanno evidenziato un più alto contenuto di proteina ($P<0.001$) e ceneri ($P<0.001$) ed un minore contenuto di grasso ($P<0.05$) rispetto a quelli provenienti dalle aziende localizzate a 650 e 900 m di altitudine. L'analisi sensoriale quantitativa e descrittiva, non ha permesso di differenziare in maniera netta i formaggi prodotti alle diverse altitudini. Tutti i formaggi sono risultati caratterizzati da un sapore di fumo, di salato e di acido che tendono a mascherare gli altri attributi sensoriali. Le aree di produzione, a diversa altitudine, hanno influenzato notevolmente il profilo acidico dei formaggi. In particolare è stato osservato che i formaggi provenienti dalle aziende localizzate a 1250 m di altitudine presentano un maggior contenuto di acidi grassi polinsaturi ($P<0.05$) e, tra questi, di acido linoleico ($P<0.01$) e di acido linolenico ($P<0.001$). Le correlazioni effettuate tra la percentuale delle famiglie botaniche, identificate nei differenti pascoli, ed il contenuto di singoli acidi grassi osservati nei diversi formaggi, hanno evidenziato una marcata influenza della composizione floristica del pascolo sulle caratteristiche dietico-nutrizionali dei formaggi. In particolare è stata evidenziata una correlazione positiva tra il contenuto di "altre" specie nei pascoli ed il contenuto degli acidi grassi linoleico (0.97; $P<0.001$) e linolenico (0.97; $P<0.001$). I risultati preliminari ottenuti hanno evidenziato che le aree di produzione, a diversa altitudine, hanno una notevole influenza sulle caratteristiche chimiche e dietico-nutrizionali del formaggio Oscypek.

COMBINED INFLUENCE OF COW DIET AND PASTEURISATION OF THE MILK ON SENSORY PROPERTIES OF FRENCH PDO CANTAL CHEESE

B. Martin^{1*}, I. Verdier-Metz², S. Hulin³, A. Ferlay¹, P. Pradel⁴, J.B. Coulon¹

¹INRA-URH, Clermont-Theix, 63 122 Saint-Genès-Champanelle, France; ²INRA- LRF, 36 rue de Salers, 15 000 Aurillac, France; ³Comité Interprofessionnel des Fromages, BP 124, 15 000 Aurillac, France; and ⁴INRA, Domaine de la Borie, 15 190 Marcenat, France
bmartin@clermont.inra.fr

In order to quantify the respective influence of the cow diet and the heat treatment of the milk on sensory and chemical properties of cheeses, we processed milk under experimental conditions and analysed four months aged PDO Cantal cheeses. In that trial, we also aimed at checking the possible interactions between the heat treatment of the milk and the cow's diet. Thirty-two Montbeliarde cows, divided in two equivalent groups either grazed a diversified natural grassland (G) or received a diet composed of 35% of natural grassland hay and 65% of barley and soya-bean meal mixture (HC). The milk of the 2 groups of cows was processed in experimental conditions in French PDO Cantal cheeses using raw or pasteurised (72°C, 30 s.) milk. Five replicates were achieved. The HC cheeses were very firmer than the G cheeses, probably because of their higher content of long chain-saturated fatty acids and their lower content of unsaturated C18 fatty acids. For texture, we didn't observed any interactions with milk pasteurisation. The G cheeses were also more yellow, "eggy", "fermented" and "animal" than the HC one which were more "greasy", "creamy", "bitter" and "rancid". These differences were mainly observed for raw milk and not for pasteurised milk. In comparison to the diet influence on cheese sensory properties, the influence of the heat treatment of the milk was stronger. Raw milk cheeses had stronger flavour characteristics (as "fermented", "cow", "pungent") than pasteurised cheeses which were more "vanilla" and also firmer. Sensory differences are probably due to proteolysis. In conclusion, the effect of pasteurisation was more important than the diet one which is mainly observed in the case of raw milk cheeses. The heat treatment of the milk also modifies cheese sensory properties and may hide partly the effect of diet.

TECHNOLOGICAL, CHEMICAL AND SENSORY CHARACTERISATION OF PIEDMONT CHEESES

G. Zeppa^{1*}, L. Rolle¹, G. Tallone², and V. Gerbi¹

¹Università degli Studi di Torino, Dipartimento di Valorizzazione e Protezione delle Risorse Agroforestali, Sezione Microbiologia e Industrie agrarie, Grugliasco (TO), Italy; ²Istituto Lattiero Caseario e delle Tecnologie Alimentari, Moretta CN
giuseppe.zeppa@unito.it

Il Piemonte è caratterizzato da ampie superfici a prato ed a pascolo e questo giustifica la grande importanza che il settore lattiero-caseario ha sempre rivestito nella Regione. Le prime tracce risalgono, infatti, all'epoca del neolitico, tra il 5000 e il 2000 a.C. e di certo si sa che quando Annibale con le sue truppe attraversò il Piemonte, scendendo dalle Alpi verso Roma, nel 218 a.C., utilizzò le torme di allora per sfamare i Cartaginesi dopo un viaggio così lungo e dal difficile approvvigionamento. Venendo ai giorni nostri la rilevanza per il Piemonte del comparto lattiero-caseario è evidenziata dalla presenza di oltre 50 formaggi tradizionali e di ben 10 DOP di cui 6 caratteristici del solo territorio piemontese. Nel caso dei formaggi tradizionali si tratta di un grande patrimonio in larga misura poco conosciuto e quindi poco tutelabile e valorizzabile. Lo scopo di questo lavoro è stato quindi quello di colmare in parte questa lacuna definendo per una decina di questi scelti fra i maggiormente rappresentativi le rispettive caratteristiche tecnologiche, compositive e sensoriali. Lo studio tecnologico si è sviluppato mediante il rilievo diretto presso tutte le aziende produttrici della tecnologia produttiva mentre quello compositivo e sensoriale ha interessato un numero significativo di campioni rappresentativi di tutte le diverse realtà produttive. In particolare lo studio sensoriale ha cercato di definire mediante l'applicazione dell'Analisi Quantitativa Descrittiva i profili sensoriali dei diversi prodotti in studio. Nel caso dell'Ossolano e del Saras del Fèn lo studio ha interessato altresì i componenti volatili e la frazione grassa evidenziando sia la dipendenza del prodotto dalle particolari condizioni di produzione che soprattutto dal territorio di origine. In particolare nel caso del Saras del Fèn la frazione volatile ed in particolare quella di natura terpenica si è dimostrata addirittura in grado di differenziare i differenti alpeggi di produzione del prodotto permettendo la predisposizione di una 'carta di identità' dello stesso prodotto. Molto interessante a questo fine si è dimostrata altresì la componente acida che utilizzata nella costruzione di Reti Neurali Artificiali ha evidenziato una buona capacità nella discriminazione dei formaggi esaminati. I risultati ottenuti hanno evidenziato quindi la presenza di un elevato potenziale produttivo che necessita però, pur nel rispetto della soggettività aziendale, di un accurato intervento di 'standardizzazione' che contenga la variabilità spesso eccessiva consentendo così una efficace promozione e diffusione del prodotto.

SUMMARY

The dairy industry is a very important sector for the Piedmont economy. Among the thirty Italian cheeses POD, nine are from Piedmont and there are 55 Traditional cheese in Piedmont. Some of these are very interesting for their quantity or technological, chemical and sensory characteristics therefore these cheeses can qualify for the POD petition. The aim of this work was the technological and chemical characterisation of the more important (Ossolano, Murianengo, Cevrin di Coazze, Tomino di Talucco, Tuma 'd Trausela, Toma del lait brusc, Saras del Fèn).

RELATIONSHIPS BETWEEN MILK AND CHEESE FATTY ACIDS HAVING A POTENTIAL NUTRITIONAL INTEREST

A. Lucas^{1,2*}, B. Martin¹, I. Verdier-Metz³, and A. Ferlay¹

¹INRA-URH, Clermont-Theix, 63 122 Saint-Genès Campanelle, France; ²Institut Technique Français des Fromages, 74801 La Roche sur Foron, France. ³Unité de Recherches Fromagères, INRA, 36 rue de Salers, 15000 Aurillac, France.
alucas@clermont.inra.fr

In order to study the relationship between milk production conditions and cheese nutritional interesting fatty acid composition, it is necessary to know the impact of cheese-making process on fatty acid composition of milk fat. This paper presents the results obtained in 2 studies in which we checked the relationship between milk and cheese nutritional interesting fatty acid composition, in different cheese varieties (n=6), with or without milk pasteurisation. In the first study, milk produced from 32 Monbéliarde cows in an experimental farm was processed under experimental conditions either in Cantal or in Saint-Nectaire PDO cheese using raw or pasteurised (72°C, 30 s) milk. Five replicates were achieved for each cheese variety studied. The second study was led under real livestock managing conditions, on the scale of the herd. Four raw milk farmhouse PDO cheese varieties were studied: Abondance cheese, Tomme de Savoie cheese, Salers cheese and Rocamadour cheese. Thirty-seven milk samples were collected in vats at first, and then a ripened cheese sample, corresponding to each previously collected milk sample, was taken. The cheese-making process seems to modify milk fatty acid composition only in a very small extent. In the experimental trial, neither the heat treatment (raw milk vs pasteurised milk) nor the cheese variety (Cantal vs Saint-Nectaire) had a significant effect on the fatty acid composition of cheese. These results were confirmed with cheeses produced under real production conditions in the second study, in which cheese fatty acid composition was very similar to that of milk, whatever the cheese variety is. These results show that the variability of cheese nutritional interesting fatty acid composition is directly related to that of milk which is well known to depend on milk production conditions.

ACCEPTABILITY AND SENSORY DISTINCTIVENESS OF TYPICAL FOOD PRODUCTS

Erminio Monteleone*

Università degli Studi della Basilicata, Potenza, Italy
monteleone@unibas.it

La valutazione dei profili sensoriali dei prodotti alimentari è considerata un'attività potenzialmente di grado di guidare i processi di ottimizzazione di prodotto. Le informazioni che essa produce devono consentire di stimare l'appropriatezza di un profilo alle prestazioni attese. La descrizione degli attributi e la quantificazione della loro intensità necessita di essere affiancata ad una stima del loro peso sull'impatto sensoriale complessivo del prodotto ed alla definizione degli intervalli di intensità che determinano detto peso. Gli studi delle relazioni tra preferenza e profilo sensoriale dei prodotti alimentari, sono prevalentemente orientati all'identificazione dei cosiddetti *drivers* dell'accettabilità. Questo approccio risulta poco appropriato per l'ottimizzazione del profilo dei prodotti tipici ed è dunque necessario definire nuove strategie di indagine. Questo lavoro rappresenta una riflessione critica in tal senso. Esso si basa sull'ipotesi che occorra ottimizzare i profili sensoriali in funzione dell'impatto dei singoli attributi sull'idoneità e la riconoscibilità dei prodotti tipici, cioè sul processo che consente all'utilizzatore di un determinato prodotto di accettare questo ultimo come appartenente ad una determinata tipologia ed al tempo stesso di percepirne la peculiarità. Tre sono i principali elementi sui quali viene focalizzata l'attenzione: l'analisi critica delle metodologie utilizzate per la stima delle prestazioni sensoriali dei prodotti tipici; le criticità nella scelta delle condizioni di acquisizione dei giudizi di gradimento e nell'analisi dei dati; il processo identificativo degli attributi sensoriali che determinano l'idoneità e la riconoscibilità dei prodotti alimentari.

NUTRIENTS AND MICRONUTRIENTS OF CHEESES: INFLUENCE ON HUMAN HEALTH

Edmond Rock*

INRA Unité Maladies Métaboliques et Micronutriments 63 122 Saint Genès Champanelle, France
rock@clermont.inra.fr

Il est important de considérer que tout aliment interagit avec l'organisme et donc de le placer dans un contexte santé, sans pour autant déprécier les conséquences de cette interaction sur les sens et donc sur les plaisirs à l'ingérer.

Dans ce contexte, les produits laitiers sont reconnus comme un aliment plaisir et une source importante pour les protéines, la vitamine A et le calcium donnant une connotation santé à cet aliment. Ils sont également des sources de minéraux et oligo-éléments mais aussi en vitamine K, et pour les produits fermentés en vitamines B. Ces apports de minéraux sont d'autant plus importants à considérer que les données épidémiologiques montrent qu'un pourcentage non négligeable de la population Française a un apport inférieur aux apports nutritionnels conseillés. Pour les caroténoïdes et les polyphénols, les données sont plus éparpillées et des travaux initiés à l'INRA apporteront quelques précisions. Les effets santé des micronutriments des produits laitiers sont essentiellement connus pour le calcium et le phosphore. Cependant, les autres minéraux et phyto-micronutriments devront être pris en considération notamment pour la lutte contre le stress oxydant. Les produits laitiers contiennent aussi des lipides parmi lesquels certains pourraient avoir un effet santé intéressant comme les acides linoléiques conjugués (CLA). A côté des nutriments présentant des effets favorables, il en existe certains pouvant avoir un rôle néfaste comme des contaminants et d'autres comme les acides gras saturés ou les acides gras *trans*, supposés être à l'origine des maladies cardiovasculaires.

Compte tenu des modifications de composition susceptibles d'être apportées par une meilleure maîtrise de la matière première (le lait) qui dépend largement de l'alimentation de la vache et éventuellement des procédés de fabrication, il serait fort utile de réaliser une analyse socio-économique afin de préciser, dans le cadre des consommations actuelles des produits laitiers, la contribution de ces derniers dans l'alimentation et leur place dans la nutrition préventive. Cette dernière nécessitera des études de biodisponibilité des micronutriments et de leurs interactions. De ces études, il pourra être conseillé d'inclure les produits laitiers dans le cadre d'un mode alimentaire équilibré pour disposer d'un bon statut en micronutriments.

MICROBIAL CHARACTERIZATION OF AOC SALERS CHEESE AND ITS SENSORY PROPERTIES

F. Duthoit, C. Callon, and M. C. Montel*

Unité de recherches fromagères INRA 15000Aurillac
cmontel@clermont.inra.fr

Microorganisms play an important role in the elaboration of sensorial qualities. The aim of this work was to link the microbial dynamics of presence and activity during the fabrication and the ripening of Registered Designation of Origin Salers cheese to the sensorial characteristics of the ripened cheese.

Bacterial dynamics was followed by Single-Strand Conformation Polymorphism analysis. Nucleic acids were extracted from milk and cheeses. Parts of 16S rDNA and rRNA were amplified by PCR and RT-PCR using two sets of universal primers, and one set that was specific of high GC% Gram positive bacteria. PCR products were analyzed by SSCP analysis. Peaks of SSCP patterns were assigned with reference to a clone library. The sensorial characteristics were tested by ten trained panelists. Microbial data were linked to sensorial data by Partial Least Square regression.

Sequences related to lactic acid bacteria, which dominated during manufacturing and ripening, to enterobacteria, bacteria belonging to the high GC% or low GC% Gram Positive groups were identified. Comparison of the SSCP patterns derived from RNA and DNA analysis indicated a substantially different degree of metabolic activity for the microbial groups detected. The correlations between sensorial and microbial data were rather complex. Microbial data explained from 14% to 54% of each sensorial descriptor variance. Several microbial groups, as well as unidentified peaks were correlated to each sensory variable.

This work pointed out the necessity to take into account the bacterial dynamics of presence and activity. More integrated approaches, including the interactions with the matrix, the specific activity of microorganisms would help us to better understand the elaboration of the sensorial qualities of raw milk cheeses.

RELATIONSHIP BETWEEN TRADITIONAL TOOLS AND SENSORY PROPERTIES IN PECORINO SILANO

S. Claps*, M. Pizzillo, R. Rubino, G. F. Cifuni, and G. Morone

Istituto Sperimentale per la Zootecnia - Via Appia - Bella Scalo - 85054 Muro Lucano (PZ)
salvatore.claps@isz.it

Il Pecorino di Filiano è un formaggio a latte crudo e a pasta dura prodotto, soprattutto a livello aziendale e in sistemi di tipo estensivo, in 32 comuni della Basilicata nord-occidentale.

In questo lavoro si riportano i risultati, riferiti al primo anno di attività, di un progetto di ricerca, coordinato dal CoRFiLAC di Ragusa, relativi all'effetto delle attrezzature tradizionali sulle peculiarità organolettico-sensoriali del Pecorino di Filiano.

Nella prima fase dell'attività è stata effettuata una indagine relativa all'impiego delle attrezzature tradizionali nel processo produttivo. Nella seconda fase, invece, sono stati prelevati campioni di formaggio provenienti da tipologie diverse (con o senza l'impiego di attrezzature tradizionali). Nella terza, ed ultima, fase è stato effettuato un confronto tra formaggi ottenuti con tecniche diverse (con o senza l'impiego della termizzazione e/o pastorizzazione).

Tutti i formaggi sono stati stagionati, per circa 6 mesi, presso la casera dell'Istituto Sperimentale per la Zootecnia.

Sui formaggi, a 6 mesi di stagionatura, sono state effettuate le analisi chimico-fisiche, il profilo dei componenti volatili e l'analisi sensoriale.

La definizione del profilo sensoriale del prodotto è stata effettuata in due fasi: generazione dei termini descrittivi e analisi quantitativa descrittiva. Sono stati eseguiti, inoltre, dei test triangolari al fine di verificare la capacità di discriminazione, da parte del panel, dei formaggi ottenuti con attrezzature differenti.

In tutti i casi, con il test triangolare, i degustatori hanno discriminato i formaggi ottenuti con attrezzature tradizionali rispetto a quelli ottenuti con altre tecniche. L'analisi quantitativa descrittiva, invece, non ha permesso di discriminare in maniera netta le differenti tipologie di formaggi (confronto tra formaggi ottenuti con attrezzature tradizionali e non). I degustatori, in pratica, pur discriminando i prodotti non sono riusciti a definire, soprattutto per l'odore e l'aroma, per quali parametri sono differenti. Tra i formaggi a latte crudo e quelli pastorizzati, invece, le differenze, soprattutto a livello di alcuni descrittori del gusto (amaro e piccante), dell'odore (lattico fresco, lattico cotto, frutti secchi tostati e pungente) e dell'aroma (lattico cotto e pungente) sono risultate significative. L'accettabilità, forse sorprendentemente, è risultata sempre più elevata per i formaggi pastorizzati. Questo è da mettere in relazione, probabilmente, al fatto che quando non si è "informati" l'assaggiatore preferisce prodotti più anonimi rispetto a prodotti con odori e gusti più spiccati e marcati.

MASS SPECTROMETRY IN THE DAIRY INDUSTRY

Salvatore Foti*

Dipartimento di Scienze Chimiche, Università di Catania, Viale A. Doria, 6, 95125 Catania
sfoti@unict.it

The introduction of new ionization techniques such as Electrospray Ionization (ESI)¹ and Matrix-Assisted Laser Desorption/Ionization (MALDI)² has determined a breakthrough in the application of mass spectrometry to polypeptides structure elucidation. In the last years, these powerful techniques have increasingly applied to the characterization of milk and cheese proteins for a number of applications including:

- Identification and characterization of caseins and whey proteins in milk³⁻⁶.
- Identification of phytoestrogen⁷ and antibiotics^{8,9} in milk.
- Determination of protein fingerprint in milk and cheese^{10,11}.
- Determination of structural modifications induced on milk proteins by industrial processes^{12,13}.
- Detection of bioactive^{14,15} or taste¹⁶ peptides in cheese.

Examples applications of mass spectrometric methods to the detection of bioactive peptides in cheese and to cheese quality control will be presented.

CHARACTERISTICS OF NATURAL PASTURE FOR CHEESE PRODUCTION IN CENTRAL SLOVAKIA

Mária Zimková* and Milan Michalec

Grassland and Mountain Agriculture Research Institute, Mládežnícka 36, 974 21 Banská Bystrica,
Slovakia
zimkova@vutphp.sk

According to their origin grasslands in Slovakia (about 880 000 ha) can be divided into natural, semi-natural and so-called sown or recultivated (renovated) grasslands. The majority of grasslands in Slovakia are seminatural and in mountain regions, in higher altitudes (> 800 m a.s.l.) they are called mountain natural pastures. Central Slovakia is mostly mountainous country and for hundreds years its natural pastures were used by grazing in an environmentally friendly way and thus their high biodiversity and ecological stability was supported.

Sheep grazing in Central Slovakia has a very long tradition. Sheep were milked by hands and special mountain smoked cheese was made directly in mountain chalets. Nowadays the cheese making is partly done in the chalets in the mountain and partly in cheese factories in the villages which can cause the differences in cheese quality. Also the new EU hygienic and technological rules for milk processing (e.g. pasteurisation) brought changes in sheep cheese production in Central Slovakia.

“CAPRINO” FRESH CHEESE: COMPOSITION, HYGIENE AND FLAVOUR

F. Conte^{1*}, A. Verzera², M. Barreca³, V. Romeo², and M. Ziino²

¹Dipartimento di Sanità Pubblica Veterinaria, Università di Messina – Italia; ²Dipartimento Chimica Organica e Biologica, Università di Messina – Italia; ³Medico Veterinario, Gangi (PA) – Italia
Francesca.Conte@unime.it

Caprino is traditional as fresh cheese goat cheese in some areas of Northern Italy; it's not usually produced in Sicily. The cheese is mainly appreciated for its sensory qualities and has a good and increasing consumer demand. As a consequence of previous investigations on the quality of an experimental caprino fresh cheese the authors supposed it could represent a good potentiality for the economy of Sicily. Besides, further studies are necessary for its characterization.

The present study takes into account the evaluation of two experimental caprino fresh cheese obtained from pasteurized goat milk and characterized by a mainly lactic curd (mesophilic starters cultures).

During a 28 days refrigeration period the following physical, chemical and microbiological parameters were considered: acidity, activity water, total nitrogen, fat, moisture and solids; volatile compounds; standard and psychrotrophic plate count; enumeration of coagulase positive staphylococci, enterococci, coliforms, *Escherichia coli*, lactic acid bacteria, yeast, moulds and sulphite reducing anaerobes. Flavour is one of the most important quality criteria of fresh cheese and an important marker for cheese characterization. During processing and ripening, a wide range of organic compound possessing various polarity and reactivity occur depending on the milk used, production technology, ect.

Physical and chemical parameters delineated a low fat product, with a good percentage of protein, high humidity percentage and with a pleasant, lightly acid taste.

Caprino cheese showed a good microbiological stability during the storage period; some groups of microorganism were reduced; lactic acid bacteria counts were high until 10-15 days.

The flavour of caprino cheese was studied by SPME-HRGC/MS and fifty volatile components were identified in the cheese analysed (free fatty acids from C2 to C12, methyl ethyl, propyl, butyl and hexyl esters, alcohols, chetones, aldehydes, aromatic compounds, hydrocarbons, lactones and monoterpenes) by spectral data, linear retention indices, injection of standards and literature information. Quantitative results on the identified free fatty acids are reported in the sample.

A good correlation was observed between lactic acid bacteria and the flavour development in caprino fresh cheese.

RELATIONSHIP BETWEEN GEOGRAPHIC AREA OF PRODUCTION AND SENSORY PROPERTIES OF CACIOCAVALLO PODOLICO

M. Pizzillo*, S. Claps, R. Rubino, and G. F. Cifuni

Istituto Sperimentale per la Zootecnia – Via Appia – Bella Scalo – 85054 Muro Lucano (PZ)
michele.pizzillo@isz.it

Il Caciocavallo Podolico, formaggio stagionato a pasta filata, rappresenta una tra le tecnologie casearie più antiche e viene prodotto esclusivamente in quattro regioni dell'Italia meridionale (Puglia, Basilicata, Campania e Calabria).

La vastità dell'area di produzione, dal livello del mare alle vette più elevate dell'Appennino meridionale, con le più disparate situazioni, sia in termini di sistema di allevamento e sia in termini di composizione floristica del pascolo, rappresenta un elemento di notevole variabilità.

La definizione delle caratteristiche organolettico-sensoriali di questo prodotto, in base alla provenienza, rappresenta un fondamentale elemento di valorizzazione e caratterizzazione.

I formaggi, provenienti da aziende rappresentative, per dislocazione geografica delle diverse aree di produzione del Caciocavallo Podolico, sono stati stagionati presso la casera dell'Istituto Sperimentale per la Zootecnia. Sui formaggi, 10 per ogni tempo di stagionatura considerato, sono state effettuate le seguenti determinazioni: analisi chimico-fisiche, acidi grassi liberi e analisi sensoriale. Sono emerse differenze significative, tra le diverse aree di produzione, sia in termini di composizione chimica (grasso, proteine, etc.) e sia in termini acidi grassi liberi. Gli acidi grassi liberi a catena corta, in genere, sono risultati, in tutti i tempi di stagionatura considerati (6 e 12 mesi), più elevati nei Caciocavalli prodotti in Calabria.

Tra le diverse regioni, inoltre, sono state osservate differenze significative in termini di descrittori sensoriali.

I Caciocavalli provenienti dalle regioni Basilicata, Campania e Puglia sono risultati caratterizzati da note più evidenti di fruttato e di erbaceo. I Caciocavalli provenienti dalla Calabria, invece, hanno evidenziato note meno gradevoli, già a 6 mesi di stagionatura, attribuibili al rancido e al sentore di medicinale. L'analisi sensoriale quantitativa descrittiva ha permesso di discriminare i Caciocavalli, a seconda della provenienza, in base ai seguenti attributi: lattico cotto, lattico acido, erbaceo e pungente (odore e aroma); amaro, piccante e acido (caratteristiche gustative).

L'area geografica di provenienza, quindi, con le molteplici variabili ad essa associate, caratterizza, dal punto di vista organolettico-sensoriale, in maniera differente i prodotti.

BIODIVERSITY AND QUALITY OF LIFE. THE "BIOLOGICAL CONSUMERS" JUDGMENT TO EVACUATE BIODIVERSITY

Alberto Pirani*

Dipartimento di Economia e politica agraria, agroalimentare e ambientale, Università degli Studi di
Milano
alberto.pirani@unimi.it

A partire dagli anni '90, dal momento in cui l'agricoltura biologica è divenuta un segmento rilevante del settore alimentare, sono state avviate numerose indagini sui consumatori di prodotti "naturali", per conoscerne aspettative e necessità. Le informazioni acquisite durante il decennio in tutti i settori di vendita, hanno permesso di focalizzare la figura del consumatore "tipo" in un soggetto giovane, con scolarizzazione medio-alta e con un elevato potere di spesa, che, nel corso del tempo, ha finito per perfezionare le proprie scelte d'acquisto. Difatti, in una prima fase, tale figura ha mostrato un interesse esclusivo alla ricerca della salubrità del prodotto, con l'obiettivo di tutelare la propria salute contro l'uso eccessivo di prodotti chimici, propri di un'agricoltura intensiva; successivamente, ha rivolto maggiore attenzione alle tematiche ecologiche, in particolare dirette alla difesa dell'ambiente e al benessere degli animali in allevamento. Tale evoluzione si è verificata a seguito della contemporanea "crescita culturale" del consumatore sul biologico che ha indirizzato il suo interesse all'approfondimento di ulteriori aspetti del fenomeno. In particolare, ha ricercato cibi biologici che, oltre a garantire la sua salute, soddisfacessero anche le sue esigenze di gusto. Per questo aspetto dalle indagini risulta, infatti, che una parte dei consumatori si è dichiarata delusa, in quanto gli alimenti biologici non rispondevano alle attese in termini di gusto e di sapore.

In questo contesto, la presenza, sempre più ampia, di prodotti tipici e agro-artigianali che rispondono ai principi alla base della biodiversità, ha dato la possibilità di riscoprire e di realizzare le attese di un cibo che dia appagamento e soddisfazione. Invero, tramite simulazioni previsionali condotte sulle informazioni acquisite, è stato possibile ipotizzare un'evoluzione delle scelte dei consumatori biologici verso i concetti espressi; ciò indirizzerà le "forme" di consumo da un lato e quelle di produzione dall'altro, verso la rivalutazione e la riutilizzazione delle biodiversità, che costituiscono una nuova frontiera alimentare verso la quale focalizzare le proprie preferenze. In questa ottica, l'agricoltura biologica è destinata a porsi come futuro compito il recupero e la diffusione di quelle diversità biologiche, per lungo tempo trascurate, con lo scopo di soddisfare sia le esigenze del consumatore biologico in termini di gusto sia le necessità di utilizzare specie più rustiche e stabili, in grado di garantire una produzione libera dall'utilizzo di coadiuvanti di sintesi e, quindi, il più facile conseguimento di un'agricoltura "pulita".

MASS SPECTROMETRIC IDENTIFICATION AND CHARACTERIZATION OF β CASEIN VARIANTS IN MILK

V. Cunsolo¹, S. Foti¹, F. Galliano^{1*}, R. Saletti¹, D. Marletta², and S. Bordonaro²

¹Dipartimento di Scienze Chimiche, Università degli Studi di Catania, Viale A. Doria, 6, 95125 Catania; ²DACPA, Sezione di Scienze delle Produzioni Animali, Università di Catania, via Valdisavoia 5, 95123 Catania.
sfoti@dipchi.unict.it galliano@unict.it

Caseins, the main fraction of milk proteins, are a family of phosphoproteins divided in four groups designed as α_{s1} , α_{s2} , β and κ -caseins on the basis of their electrophoretic mobility. In goat, the casein fraction presents an extensive heterogeneity due to post-translational processing, alternative splicing or genetic polymorphisms¹. This heterogeneity is correlated with changes in milk composition and it has been shown that protein composition and milk technological properties are related². Particularly, studies performed at different levels (protein and DNA) on goat casein fraction have shown an extensive qualitative polymorphism of α_{s1} - and α_{s2} -casein². It has been demonstrated that α_{s1} - and α_{s2} -caseins are composed of multiple protein forms, differing in internal deletions of peptides or aminoacidic residues.

In recent years, matrix assisted laser/desorption ionization-time of flight mass spectrometry (MALDI-TOF-MS)³ and electrospray ionization mass spectrometry (ESI-MS)⁴ coupled with reversed phase high-performance liquid chromatography (RP-HPLC), have emerged as powerful tools for the detection of genetic variants, characterisation of isoforms and characterisation of post-translational modifications in caseins.

In this work we report the casein fraction characterization by MALDI-TOF-MS and RP-HPLC/ESI-MS of three different milk samples obtained from Sicilian goat reared in the same herd and with different genotype at CSN1S2 locus (CSN1S2^{NN}, CSN1S2^{N0} and CSN1S2⁰⁰ with N=A,B,C,E,F).

This investigation resulted in the identification of two new β -casein variants. Chemical and enzymatic cleavage coupled with MALDI-TOF and ESI/MS-MS demonstrated that each of the new variants differ from a known β -casein (NCBI Access. number P33048) for a single point mutation, i.e. a Val¹⁷⁷→Ala substitution in one and Asn²⁰⁷→Val in the other. Other components of the fractions were identified as fragments of α_{s1} and β -caseins, probably originated by of endogen and/or esogen enzymes.

MILK FAT GLOBULES IN JERSEY COWS: RELATIONSHIP TO QUALITY MILK

M. Martini¹, F. Cecchi^{1*}, A. Summer², and C. Scolozzi¹

¹Dipartimento di Produzioni Animali, Viale delle Piagge 2, 56124 Pisa, Italy;

²Dipartimento di Produzioni Animali, Biotechnologie Veterinarie, Qualità e Sicurezza degli Alimenti, Via del Taglio 8, 43100 Parma, Italy.
mmartini@vet.unipi.it

In this study we evaluated the relationships between the morphometric characteristics of milk fat globules (number of globules/ml milk, average diameter, and percentage of globules divided according to size) from nine subjects of the Jersey breed, and the qualitative characteristics of their milk. The standard chemical analysis (dry matter, fat, protein and lactose) the morphometric analysis of fat globules, the fatty acids of milk fat, SCC (somatic cell count), TBC (total bacterial count), titratable acidity, pH and rheological parameters (r , k_{20} , a_{30} and a_{45}) were performed on milk samples obtained during the morning milking. Fat globules were divided into nine size classes of 1.5- μ m class widths (from 1.5 μ m to >13.5 μ m) and were further classified into small (1.5-3 μ m), medium (3-6 μ m) and large (>6 μ m). Results showed that the size and number of fat globules were closely correlated, presenting an inverse relationship as previously shown in studies performed on other species used in milk production; furthermore, it was confirmed that a relationship exists between the morphometric characteristics of fat globules and the chemical properties of the milk.

In particular, milk samples that presented higher percentages of large globules, compared to those with greater quantities of small globules, are associated with milk with a higher percentage of dry matter, total lipids and somatic cells, and lower content of polyunsaturated fatty acids.

EVALUATION OF MORPHOMETRIC CHARACTERISTICS OF MILK IN GRAZING EWES

M. Martini, C. Scolozzi, F. Cecchi, F. Salari*, and P. Verità

Dipartimento di Produzioni Animali, Viale delle Piagge 2, 56124 Pisa, Italy.
mmartini@vet.unipi.it

We performed a physical evaluation (number of globules/ml, diameter, and percentage of globules divided according to size) of milk fat globules from the milk of 25 secondiparous Massese ewes belonging to a single farm in northwestern Tuscany and raised according to traditional methods.

For each subject, the qualitative analyses of the milk were carried out in groups of ewes during the spring and summer, according to the rate of deliveries. Milk samples from each subject were taken at 10, 30 and 90 days after giving birth, for a total of 75 samples.

The milk fat globules determination involved the use of a Burkner chamber and fluorescent optic microscope equipped with a system for semi-quantitative image analysis (Quantimet 500 Leika).

Results regarding the total reading of 34102 fat globules divided into small (2 micrometers), medium (from 2 to 5 micrometers) and large (>5 micrometers) categories, were analysed using a model of repeated measure analysis and showed that during the first 3 months of lactation the percentages of the different types of globules changed. It was shown that the percentage of large fat globules increased during the first 30 days of lactation, while during the phase of decreasing milk production (90 days) an increase in small- and medium- sized globules took place.

THE PASTORAL VEGETATION TYPES OF THE ALPS OF PIEDMONT: A BASIC TOOL FOR THE CHARACTERISATION OF ALPINE CHEESES

A. Cavallero¹, M. Brachet Contol¹, A. Gorlier^{*1}, M. Lonati¹, B. Martinasso¹,
M. Corgnati², and M. Soster²

¹Università degli Studi di Torino - Dipartimento di Agronomia, Selvicoltura e Gestione del Territorio;

²Regione Piemonte - Settore Politiche Forestali e Settore Servizi Sviluppo Agricolo
alessandra.gorlier@unito.it

Finalità del progetto qui presentato è la descrizione e la localizzazione dei ricchi e diversificati *tipi pastorali* delle Alpi occidentali: essi costituiscono un “*unicum*” non facilmente riscontrabile in altre catene montuose, in grado di conferire ai prodotti caseari derivati particolari caratteristiche di pregio e di identificazione. Agli aspetti conoscitivi si somma la necessità di conservare la biodiversità specifica (ecosistemica e paesaggistica) e di mantenere l'attività agro-pastorale, entrambe a supporto delle attività economiche montane. Nel complesso, dall'inizio del progetto (1999) sono stati indagati circa 190.000 ha di superficie pastorale ed eseguiti oltre 3000 rilievi ecologico-vegetazionali, in seguito ordinati e classificati statisticamente (*Cluster Analysis*).

Le metodologie impiegate hanno permesso di individuare insiemi di rilievi a crescente grado di similarità, utilizzati per la definizione dei *tipi pastorali*, formazioni omogenee per composizione vegetazionale, caratterizzate dalla dominanza di poche (1-3) specie, risultanti del condizionamento ambientale e gestionale. Entro i tipi sono state in seguito distinte varianti o *facies*, che descrivono in dettaglio la vegetazione dei pascoli.

Nei distretti alpini piemontesi fino ad ora studiati sono stati individuati 72 *tipi* e 414 *facies* vegetazionali dei piani montano, subalpino, alpino e nivale, localizzati in dettaglio su elaborati cartografici, fondamentali per qualunque progetto di conservazione e valorizzazione delle risorse pastorali alpine e dei prodotti derivati.

Al termine di questo lavoro la Regione Piemonte sarà dunque dotata di uno strumento per la conoscenza e la pianificazione di notevole potenzialità ed ampiezza, che non trova riscontro in altre situazioni italiane su superfici così estese come l'intero arco alpino occidentale, e che sarà utilizzabile come base per la caratterizzazione su vasta scala dei prodotti caseari tipici regionali di montagna.

THE PASTORAL CADASTRE AS A TOOL FOR LINKING THE TYPICAL DAIRY PRODUCTS WITH THEIR LAND OF ORIGIN

P. Aceto, A. Cavallero, D. Cugno, G. Lombardi, and C. Tagliatori*

Dipartimento di AGRO.SELVI.TER -Università degli studi di Torino, 10095 Grugliasco, To, Italy
chiara.tagliatori@unito.it

Nell'areale alpino occidentale sono presenti sistemi pastorali assai diversificati per formazioni vegetazionali e tipologie di allevamento. Tali sistemi possono fornire produzioni tipiche importanti dal punto di vista delle ricadute economiche e della conservazione delle superfici pastorali.

In questo contesto le produzioni casearie d'alpeggio possono essere adeguatamente difese e valorizzate attraverso il *Catasto foraggero-pastorale*, che si propone quale strumento indispensabile per definire il legame tra territorio e prodotto a partire dalla risorsa foraggera alimento per gli animali, e per ottenere una certificazione di origine e qualità. In particolare la conoscenza delle formazioni vegetazionali e degli aspetti gestionali di ogni alpeggio diviene premessa per la definizione delle "unità catastali di pascolo" necessarie per quantificare ed esaltare le differenze dei prodotti lattiero-caseari ottenibili nei diversi periodi della stagione di pascolamento.

Nel 2002 il Dipartimento Agroselviter ha redatto un primo modello di catasto per alcune zone di produzione del formaggio Ossolano d'Alpeggio (progetto Interreg II "Caratterizzazione del formaggio Ossolano"). Attualmente è in corso di verifica la possibilità di applicare tale modello in alcune zone di produzione di Toma Piemontese (Valli di Lanzo) e Sarass del Fèn d'Alpeggio (Val Pellice).

Mediante il metodo fitopastorale è stata quantificata *in primis* la diversità della vegetazione all'interno dei differenti areali e dei singoli settori di ciascun alpeggio. Quindi sono state individuate le *unità catastali di pascolo*, omogenee per copertura erbacea, carico animale sostenibile, e in grado di fornire un prodotto caseario determinato, valorizzabile anche come *cru* produttivo nel caso di superfici sufficientemente estese e di particolare pregio vegetazionale.

Il confronto tra i carichi animali mantenibili, calcolati a partire dalla vegetazione, e quelli effettivamente adottati ha consentito di valutare il livello attuale di utilizzazione degli alpeggi; allo stesso modo le differenze riscontrate tra le produzioni casearie potenziali calcolate nel catasto e quelle reali verificate nel corso dello studio, spiegabili in termini di minore efficienza nella gestione delle risorse, hanno permesso di individuare margini di incremento produttivo. Laddove la produzione reale era prossima a quella potenziale, si è potuta invece confermare l'affidabilità del modello proposto preconizzando la sua applicazione a più ampi areali.

ANALYSIS BY SSCP METHOD OF THE MICROBIAL DIVERSITY OF MILK FLORA

I. Verdier-Metz¹, V. Michel², C. Delbès¹, M. C. Montel²

¹Unité de Recherches Fromagères, INRA, 36 rue de Salers, 15000 Aurillac, France; ²GIS Alpes du Nord -SUACI Montagne, Chambéry, France
iverdier@sancy.clermont.inra.fr

The milk microbial composition is a key factor in sensory and sanitary cheese qualities and it is largely dependent on milk production factors. The aim of this study was to evaluate microbial diversity of milks according to the milk production practices.

The milk of 90 dairy farms of Savoie and Haute-Savoie was analysed according to its microbial count (numeration of total flora and coagulase positive *Staphylococcus*). A global view of milk microbial community was obtained by molecular method without culturing microorganisms, the Single Strand Conformational Polymorphism (SSCP) method after PCR amplification of two variable regions (V2 and V3) of 16S rDNA. The Shannon diversity index was calculated from the results obtained with this molecular method.

Milks were divided in three groups according to microbial composition:

- the first group (G1) comprised 35 milks characterised by less than 3,7 log(CFU/mL) of germs and between 1,6 and 2,1 log(CFU/mL) of coagulase positive *Staphylococcus*.
- the 35 milks of the second group (G2) had between 4,17 and 4,47 log(CFU/mL) of germs and between 1,6 and 2,1 log(CFU/mL) of coagulase positive *Staphylococcus*.
- the third group (G3) contained 20 milks that had between 4,17 and 4,47 log(CFU/mL) of germs and between 2,54 and 2,78 log(CFU/mL) of coagulase positive *Staphylococcus*.

Milks were also classified according their SSCP patterns whose number of peaks varied between 5 to 30. Group G2, previously described by microbial count, was the most diversified. Groups G1 and G3 were less diversified and dominated by only about 7 to 10 peaks. In these groups, the diversity can be hidden by the dominance of some peaks.

Some studies are in progress to identify the peaks on the SSCP patterns. Then the microbial data should be correlated to milk production practices. In the future, it will be interesting to monitor the evolution of this diversity through different cheese technologies.

CHARACTERIZATION AND USE OF NATURAL LACTIC BACTERIA IN THE PRODUCTION OF TOMA PIEMONTESE CHEESE, A TRADITIONAL CHEESE

P. Dolci^{1*}, M. G. Fontina², G. Zeppa¹, A. Acquati¹, and A. Gandini¹

¹Università degli Studi di Torino, Dipartimento di Valorizzazione e Protezione delle Risorse Agroforestali, Sezione Microbiologia e Industrie agrarie, Grugliasco (TO), Italy

²Università degli Studi di Milano, Dipartimento di Scienze e Tecnologie Alimentari e Microbiologiche, Sezione Microbiologia Industriale, Milano, Italy
paola.dolci@unito.it

In recent years several studies have been carried out to isolate and identify autochthonous lactic bacteria from both raw milk and artisanal cheese, in order to select new strains to be used as autochthonous starter cultures. The objective of this work was to study the natural bacterial population of a traditional cheese from Piedmont (Northwest Italy) and to select strains to be used as starters in large-scale production. Isolates collected from curd and ripened artisanal cheeses were identified by genetic methods.

Acidification and proteolytic activity and aroma production by SPME-GC-MS technique were also determined for each isolate. On the basis of obtained results five strains were selected and combined in five starters used by some dairy farms in Piedmont, in Toma piemontese cheese-making trials with both raw and pasteurised milk. Good results have been obtained by using in particular starters 3 and 5; the performance of these strains suggest the possibility to standardize and improve the production with raw milk. We obtained products characterized by very good chemical-physical composition and very interesting sensory features concerning typical taste and aroma. The results suggest the possibility to use these new starters as efficient alternative to commercial starters.

HOW VOLATILE COMPOUND PROFILES ARE MODIFIED BY INDIGENOUS MILK MICROFLORA IN HARD COOKED CHEESES?

S. Buchin*, L. Tessier, F. Berthier, J.C. Salmon, and G. Duboz

INRA, Station de Recherches en Technologie et Analyses Laitières, France
buchin@poligny.inra.fr

Indigenous milk microflora is generally considered to contribute largely to the diversity observed in the sensory characteristics both within each cheese (richness) and within a cheese variety (variability among cheeses). Modification of the volatile profiles is probably one of the major ways for generating this diversity. But studies are needed to investigate properly the impact of different levels and compositions of indigenous milk microflora on the richness and variability of volatile profiles, and to link the volatile profiles with the composition and the dynamics of cheese microflora.

An experimentation was designed in which only the population density (2 levels: undetectable, 10^4 cfu ml⁻¹) or the strain composition of indigenous milk microflora (3 levels) varied in the manufacture of twelve hard cooked cheeses. Volatile compounds were analysed by GC-MS after 2.5, 4 and 6 months of ripening.

The three indigenous milk microflora differed totally at strain level, and partially at species level for the two major groups of microorganisms which grow later in cheese. The dynamics of cheese microflora and sensory characteristics differentiated the four types of cheese.

In all cheeses, some volatile compounds accumulated or disappeared rather before 2.5 months, some others all over the ripening, and the others rather after 2.5 months of ripening. Cheeses with and without an indigenous milk microflora exhibited the same volatile molecules, but their balance and/or dynamics were very different until 6 months of ripening. The overall composition of volatile compounds of cheeses without indigenous milk microflora showed little evolution between 2.5 and 6 months. The global level of volatile compounds of these cheeses remained lower than that of cheeses with indigenous milk microflora aged 2.5 months. In the contrary, cheeses with indigenous milk microflora exhibited a global increase of volatile compounds until 6 months. The overall balance and evolution speed of volatile molecules observed with indigenous milk microflora was partially and specifically affected by each microflora composition. Correlation between the profiles of volatile molecules and cheese microflora (composition, dynamics) allowed to investigate the dynamics of cheese ecosystem and the possible sources of diversity of the characteristics of mature cheeses. Volatile composition was related to some sensory characteristics, showing that the indigenous milk microflora should contribute to the diversity of these cheeses.

Keywords: volatile molecules, hard cooked cheese, indigenous milk microflora, diversity

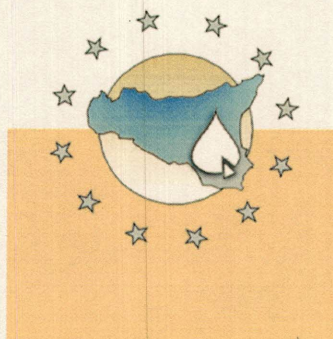
LIST OF AUTHORS

A		D	
Aceto, P.	36	Delaby, L.	6
Acquati, A.	38	Delbès, C.	37
Agabriel, C.	10	Difalco, A.	18
Alicata, M. L.	8	Di Grigoli, A.	8
Andrighetto, C.	16	Dolci, P.	38
		Drozd, A.	19
		Duboz, G.	39
		Duthoit, F.	24
B		F	
Ballot, N.	23	Fedele, V.	19
Barmaz, A.	16	Ferlay, A.	10, 20, 22
Barreca, M.	29	Fernández-García, E.	1, 9
Battelli, G.	4	Fontina, M. G.	38
Belaiche, T.	11	Formoso, B.	8
Berthelot, D.	6	Foti, S.	27, 32
Berthier, F.	39		
Bonanno, A.	8		
Bonnefoy, J. C. A.	10		
Bordonaro, S.	2		
Borreani, G.	4	G	
Bosset, J. O.	1	Galina, M. A.	13
Brachet Contol, M.	35	Galliano, F.	31
Brasca, M.	12	Gandini A.	38
Buchin, S.	39	Gelsomino, R.	18
Bütikofer, U.	5	Gerbi, V.	21
		Giaccone, D.	4
		Golecky, J.	3
C		Gorlier, A.	35
Callon, C.	24	Grolier, P.	10
Calzada, J.	9		
Cappa, F.	15	H	
Carbonell, M.	9	Haimour, A.	11
Carpino, S.	14, 18	Horne, J.	14
Cavallero A.	35, 36	Hulin, S.	20
Cecchi, F.	33, 34	Hurtaud, C.	6
Chatel, A.	16		
Chilliard, Y.	10		
Cifuni, G. F.	19, 26, 30	I	
Claps, S.	19, 26, 30	Imhof, M. I.	1
Cocconcelli, P. S.	15		
Collomb, M.	5	J	
Conte, F.	29	Journal, C.	10
Corallo, L.	18		
Corgnati, M.	35	L	
Cornu, A.	2	Licitra, G.	14, 18
Coulon, J. B.	20, 23	Lodi, R.	12
Cugno, D.	36	Lombardi, A.	16
Cunsolo, V.	32	Lombardi, G.	36

Lonati, M.	35	Rock, E.	10, 24
Lucas, A.	22	Rolle, L.	21
M		Romeo, V.	29
Mallia, S.	18	Rubino, R.	19, 26, 30
Manzi, P.	8	S	
Marconi, S.	8	Salari, F.	34
Marletta, D.	32	Saletti, R.	32
Martin, B.	2, 10, 20, 22	Salmon, J. C.	39
Martinasso, B.	35	Schlichtherle-Cerny, H.	1
Martini, M.	33, 34	Scolozzi, C.	33, 34
Michalec, M.	28	Sibra, C.	10
Michel, V.	23, 37	Sieber, R.	5
Montel, M. C.	25, 37	Soster, M.	35
Monteleone, E.	23	Summer, A.	33
Morandi, S.	12	T	
Morone, G.	26	Tagliatori, C.	35
N		Tallone, G.	21
Neocleous, M.	17	Teisseir, D.	10
Nuñez, M.	9	Tessier, L.	39
P		Todesco, R.	12
Peiretti, P.G.	4	Tornambè, G.	2, 8
Petit, M.	2	Tuminello, L.	18
Peyraud, J. L.	6	Turille, G.	16
Pirani, A.	31	V	
Pizzoferrato, L.	8	Verdier-Metz, I.	20, 22, 37
Pizzillo, M.	19, 26, 30	Verità, P.	34
Pompe, M.	7	Verzera, A.	29
Pradel, P.	2, 20	Z	
Procida, G.	8	Zeppa, G.	21, 38
R		Ziino, M.	29
Rapisarda, T.	14, 18	Zimková, M.	28

CoRFiLaC

Consorzio
Ricerca
Filiera
Lattiero
Casearia
• Ragusa •



S.P. 25 Km 5 Ragusa Mare (RG)
Tel.: 0932 660 418 Fax: 0932 660448
E-mail: carpino@corfilac.it

Web site: <http://www.corfilac.it> – <http://www.cheeseart.com>