

Henrique Castelli
Luiz du Vale
Editors

Handbook on Cheese

Production, Chemistry and
Sensory Properties

Agriculture Issues and Policies

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AGRICULTURE ISSUES AND POLICIES

HANDBOOK ON CHEESE

PRODUCTION, CHEMISTRY AND SENSORY PROPERTIES

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PRODUCTION, CHEMISTRY
AND SENSORY PROPERTIES

HENRIQUE CASTELLI
AND
LUIZ DU VALE
EDITORS



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PREFACE

In this book, the authors present current research in the study of the production, chemistry and sensory properties of cheese. Topics discussed include the technological and chemical characterization of PDO cheeses in Italy; the presence of biogenic amines in cheese; Spanish traditional cheese characteristics; sensorial analysis methodology for goats' cheese made with clotting enzymes; processed cheese flavors and flavor compounds; the dietary and toxicological aspects of cheese; fortification strategies of cheese as a functional food; health issues, reduction and replacement of salt in cheese; cheese ripening and proteolysis; lipid fraction in cheese; engineering properties of Mexican chihuahua cheese; structure and texture determination of dairy products by using spectroscopic techniques coupled with chemometric tools; clostridium in late blowing defect of cheese; analysis of fatty acids in cheese by capillary electrophoresis; valorisation of whey in small and medium dairy industries; conjugated linoleic acid (CLA) in cheese; assessment of natural levels of substances with preservative effects in dairy products; cheese microstructure; and the multifaceted function of cheese and its anticancer effect on human leukemic cell growth in vitro.

Chapter 1 - Italy is one of the main cheese producers in the world, with over 30 Protected Denominations of Origin (PDO) awarded by the European Union, besides hundreds of typical and traditional cheeses. Italy has always supported a recognition policy, institutionalization as well as denomination of its productions, both due to Regional food traditions and for its interest to protect its food products. Therefore, PDO cheeses are a significant resource in Italy where approximately 50% of their milk production is destined for these products. Among these, Parmigiano Reggiano, Grana Padano, Gorgonzola and Mozzarella di Bufala Campana as well as Asiago, Taleggio or Ragusano are some of the best known in the world. Over 30 Italian PDO cheeses, all registered in the EU list (Reg. EC 510/2006), possess typical qualities strictly correlated to the environmental-production conditions. In particular, these cheeses are made using raw or pasteurized milk of cows, goats, sheep and buffalo, high-quality raw materials, in specific geographical areas of production and by using consolidated technologies linked to the 'art' of the cheesemaker. Such characteristics, consolidated over many years, led to obtain products with chemical, microbiological as well as distinctive sensory features, which are unique for each type of cheese.

The aim of this chapter is to summarize the knowledge about Italian PDO cheese, focusing the attention on their cheesemaking rules and particular traits that characterize them. For each cheese a card will be done with technological, chemical and sensory characteristics.

Chapter 2 - Biogenic amines (BAs) are organic, basic nitrogenous compounds of low molecular weight, usually formed by microbial decarboxylation of free amino acid. Removal of the alpha-carboxyl group from a proteinogenic amino acid yields to the corresponding BA. The names of many BAs correspond to the names of their originating amino acids.

The most important BAs found in foods are histamine, tyramine, putrescine, cadaverine, 2-phenylethylamine, tryptamine, spermine and spermidine, which are products of the decarboxylation of histidine, tyrosine, ornithine, lysine, phenylalanine, tryptophan and arginine, respectively.

Putrescine can also be formed through the deamination of agmatine and is a precursor of spermine and spermidine. There are several ways to classify BAs. According to their chemical structure, they can be classified as aliphatic (putrescine, cadaverine, spermine, and spermidine), aromatic (tyramine, 2-phenylethylamine) or heterocyclic (histamine, tryptamine). According to their number of amine groups, they can be classed as monoamines (tyramine, 2-phenylethylamine), diamines (putrescine, cadaverine), or polyamines (spermine and spermidine).

Chapter 3 - Spain has a population of 797,894 milking cows, 1,181,212 milking goats and 2,218,676 milking sheep that produce, respectively, 6,298,720; 466,702 and 503,566 metric tons of milk per year. The 98.2% of the goats' milk and 92.5% of the sheep' milk produced are used for cheese production.

There are in Spain a considerable number of traditional cow, goat and ewe cheeses. Some of them are abundantly produced and are protected by P.D.O. (Protected Denomination of Origin) or P.G.I. (Protected Geographical Indication) regimes; some others are produced at artisanal or semi-industrial level and are commercialized and consumed in very limited areas.

In this chapter, the characteristics and features of the Spanish cow, goat and sheep milk cheeses are described. Studies made and reported on them are also reviewed.

Chapter 4 - Cleaning and disinfection operations in dairies require fast and efficient verification methods. Through these operations, the cross-contamination of cheeses is prevented throughout production steps and especially during curd formation.

Cleanliness and disinfection plans begin with the selection of detergents and disinfectants and culminate in the choice of microbiological control technique most suitable for industrial dairies. In both stages it is necessary to consider the application methods and procedures of the program, which in this case include the application time of detergents, disinfectants and rinse water.

Numerous "sampling tools" are marketed for microbiological control of surfaces. The more applicable are printing techniques, such as those utilising contact agar plates, dipslides or Petrifilm™, in addition to sowing in a plate of the final rinse water or ATP (Adenosine Triphosphate)-bioluminescence, which gives an indirect reading of the number of bacteria on the surface because the result is expressed in Relative Light Units (RLUs). Each of these methods provides a different reading and interpretation of Colony Forming Units (CFU/cm²), so the choice of method should be based on the surfaces and microbiota to be tested. Although there are studies supporting the compatibility of the contact agar plates and dipslide printing methods, which are very similar techniques, these techniques are different from the luminescence technique or rapid kits for protein detection. These techniques are appealing because they are simple tests that can be applied to surfaces and provide immediate feedback to workers, and they have higher sensitivity than the printing techniques.

Thus, the choice of verification method for testing cleanliness and disinfection operations should be considered prior to implementation in dairies. Similarly, the results of the test should be interpreted according to the technique and tested surfaces used.

In terms of guidelines regarding microbiological criteria for foodstuffs, the European Community (EC) has established that the total viable count and total Enterobacteriaceae count on cleaned and disinfected surfaces in meat establishments should be ≤ 10 CFU/cm² and ≤ 1 CFU/cm², respectively.

The suitability of the technique should be established in trials that involve the sampling of various surfaces in the particular processing environment following specific sanitation procedures. Many of the methods are still under evaluation at present, and much experimental validation is still needed before they can be applied for quality control in dairies.

Therefore, the aim of this chapter is to review the most appropriate methods for the microbiological control of surfaces in dairies, as well as the interpretation of results.

Chapter 5 - Sensorial analysis, which examines the organoleptic properties of the product via the sense organs, is a vital tool in the cheese-making industry. It is used in a number of areas and can assist with quality control, evaluation of the ripening process, new product development and adjustments for current products. It is also a useful tool for consumer opinions and to ensure correct product characteristics for a Denomination of Origin label. Taste is the most important element of cheese and is the deciding factor for the consumer at the point of sale; therefore sensory analysis has an important role to play before reaching that point. Cheese sensory analysis is an interaction of the food characteristics and the holistic experience for the taster. Moreover, cheese is subject to physiological and psychological conditions, plus sociological conditions relating to customs, religion, country of origin, etc.

Sensory analysis is defined as a scientific method used to measure, analyse and interpret those responses to products as perceived through the senses. Sensory analysis, when undertaken by trained personnel, is a discipline used to measure, analyse and objectively interpret the characteristics perceived by the senses in a way that is as reliable as using scales to measure weight or thermometer to gauge the temperature. In this chapter the authors examine the role of the senses to perceive and detect the world that surrounds them.

The senses receive stimuli that transmit data to the brain, which interprets it and emits a response. The text also includes a description of different analyses, for example those undertaken when there is variation in the panel's expertise (consumers and professional tasters have different levels of training), tasting environment and material used. In addition it draws attention to the conditions and sequences that should be observed for effective sensory analysis, plus best practice for the preparation of samples.

This is followed by details of the principal tests used to obtain functional data according to a given objective. Whereas a detailed description will need a panel of expert judges, consumer acceptance or preferences can be evaluated by consumer panels. Methods of examining the direction and magnitude of differences between cheeses and preference tasting, which is important for evaluating consumer acceptance, is also discussed. This will include details for descriptive sensory analysis such as the visual characteristics, texture, smell, aroma and flavour.

The chapter ends with a look at the tools necessary to train tasters, including the preparation of descriptors to analyse the parameters in the texture (surface roughness, elasticity, superficial moisture, friability, stickiness, moistness in the mouth, solubility and graininess), smell and aroma (lactic family, vegetable family, fruit family, animal family, etc.)

and basic flavour (sweet, acid, salty, bitter), trigeminal sensations (pungent, hot, astringent, etc.) and aftertaste.

Chapter 6 - Biogenic amines (BAs) are detrimental to health and originate in foods from decarboxylation of the corresponding amino acid by the activity of exogenous enzymes released by various micro-organisms. As the consumption of food containing large amounts of these amines can have toxicological consequences it is generally assumed that they should not be allowed to accumulate.

In fact, although several BAs can play important roles in many human physiological functions their presence in foods is always undesirable because if adsorbed at too high concentration, they may induce, headaches, respiratory distress, heart palpitations, hypo- or hypertension and several allergenic disorders. BAs are present in a wide range of foods, including cheese where they can accumulate in high concentrations (more than 1000 mg per kilogram of cheese). This chapter evaluates the main aspects related with the BAs production in cheese. Moreover, physiologic functions and toxicological effects will be also considered as well as the analytical methods for detecting BAs or BAs-producing microorganisms in cheese.

Chapter 7 - Processed cheese is cheese-based food produced by blending and melting one or more natural cheeses, emulsifying salts and other optional ingredients into a smooth homogeneous blend. Heating and mechanical shear of this mixture is necessary during processing. Optional ingredients, which are determined by the product type, include e.g. dairy ingredients, vegetables, meats, stabilizers, flavors, colors, preservatives and water. High nutritive value, long shelf-life, relatively low cost compared to most natural cheeses and versatility offering wide variety in flavor, texture, cooking attributes, size and shape contribute to the continued growth of the processed cheese consumption worldwide.

Good quality processed cheese should have typical flavor, shiny surface, homogeneous and smooth structure and uniform color. Among these sensory attributes flavor plays a substantial role. The flavor of processed cheese comes from ingredients (especially cheese used) and is probably influenced by many factors during processing and storage.

Sensory analysis is the most valid means of measuring flavor characteristics. Instrumental analysis of flavor is focused on the volatile components because of the major importance of the aroma in overall flavor. This paper summarizes and discusses current knowledge of processed cheese aroma and flavor including the possibilities of sensory evaluation and instrumental methods suitable for assessment of cheese flavor compounds.

Chapter 8 - During the eating of food, the in-mouth process leads to food breakdown which induces the release of flavour compounds. Volatile and non-volatile compounds are released into the saliva, and volatile compounds are transferred into the vapour phase to reach olfactory receptors in the nasal cavity.

The aim of this chapter is to review the effects of changing the composition of cheeses on the mobility, release and perception of flavour molecules (salt, aroma compounds), and to discuss the results with respect to human physiology. Cheese is a good model because it is possible to vary its composition (in lipids, proteins, salt), in order to comply with nutritional guidelines (less salt, less fat) and to study the effects of these changes in composition on its microstructure and texture, and then on flavour (taste and aroma) release and perception, while taking account of in-mouth breakdown.

Papers on this subject have mainly been related to either salt release and perception or aroma release and perception, and few have taken account of the combined effects of cheese

composition on both salt and aroma release and perception. Indeed, recent papers from the authors' research group have shown that the salt and fat contents of cheeses induce modifications to texture and microstructure that affect not only salt release and perception but also aroma release and perception and chewing behaviour.

Chapter 9 - Cheese is an important food in the diet of many countries as this preserves the majority of nutrients present in raw milk, considered the most wholesome food. It is a food rich in good quality proteins, with a varied content in vitamins such as riboflavin and minerals such as calcium and phosphorus, which are very important in growth age. On the contrary, in certain cases, cheeses can be a food with high content in cholesterol and therefore its consumption should be moderate. However, the nutritional value of cheeses depends on numerous factors such as the type of milk used for its elaboration (cow, sheep and goat, mainly), the manufacturing conditions (rennet, draining, salting), and finally the fermentation process. In addition, the capacity of human body to absorb and retain all these nutrients present in cheese depends on other components in food, giving rise to the concept of bioavailability. On the other hand, cheeses can be a source of contaminants and toxic substances. Toxicological contamination (from microorganisms and other sources) is a serious concern for the cheese industry since products can be contaminated in origin or become contaminated throughout the Food Chain, reaching to consumers. Therefore there is a need to develop precise tools to assess food risk derived from consumption of cheese. Given above, the present chapter aims at carrying out an in-depth review of nutritional, toxicological and microbiological aspects derived from consumption of cheeses.

Chapter 10 - Functional food term has been first initiated to use in Japan and constitutes conventional, modified, medical foods. However, fortified foods are in the modified foods category and fortification or enrichment defines the addition of one or more essential nutrients to the food whether or not it is normally contained in a foodstuff. Fortified foods help to fulfill the RDA (recommended daily allowance) and to correct or prevent mineral and vitamin deficiencies which affect the population worldwide when consumed regularly and at effective levels in addition to normal diet. However, the final concentration of fortificant (mineral or vitamin) should not exceed upper intake levels established by scientific risk assessment. The fortificant should not affect organoleptic character of food, should not shorten self-life, must be cost effective and is expected to be in FDA's (U.S. Food and Drug Administration) GRAS (Generally recognized as safe) list or approved by other safety authorities such as EFSA (European Food Safety Authority) in limited usage levels. In addition, the information on characteristics of fortificant such as stability, solubility, interaction with other compounds as well as bioavailability will provide a better processing. On the other hand, the food vehicle should be commonly consumed by the target population. In this context, cheese can be a good source for fortification in terms of being widely consumed and there are studies on fortification of soft, semi-hard, or hard cheeses with some essential nutrients such as zinc, iron, vitamin D, fish oil and omega-3. So, in this chapter, fortification strategies, interactions and effects of fortificant on cheeses will be elucidated.

Chapter 11 - Many chronic diseases are associated with excessive salt intake (NaCl) such as hypertension, strokes, osteoporosis, kidney stones and cardiovascular diseases (CVD). World Health Organisations highly recommended to food manufacturers to reduce the salt in their products. Therefore, reduction of salt in foods becomes an important issue. Cheeses contribute highly to the daily intake of salt. Reduction of salt in cheese has been investigated using different techniques. Simple salt reduction in cheeses without substitution with other

salts has been applied. Most of studies reported several issues related to saltiness perception, cheese texture and safety. Salt (NaCl) replacement, second technique, with other salts (potassium chloride, magnesium chloride and calcium chloride) has been proposed as an alternative to simple techniques. Substitution of NaCl with other salts has proved its ability to maintain the safety and quality of cheeses; however, minor issue related to sensory properties needs further investigation. The mechanism of salt release in cheese is an important factor that needs further investigation in order to improve saltiness taste in low-salt cheeses. This chapter provides scientific and valuable information about: roles of salt in cheese, salt and health issues, salt reduction techniques and summarize the studies have been published, so far, in terms of salt release.

Chapter 12 - Although massively consumed all over the world, cheese, an ancient and much appreciated food, is much more than just a food product. In fact, there are hundreds of different cheese types and many of them reflect the history and cultural identity of a region. Despite being an industrial or traditional food product made using ancient techniques, cheese is a very complex system. Cheese ripening consists of a series of chemical, biochemical and microbiological events that are not only complex but also variable according to the type of cheese being produced. Due to their unique characteristics many cheeses are classified as PDO (Protected Denomination of Origin). These are products of high commercial value subject to legislative and proper labelling regulations and have distinct characteristics associated with several factors such as a geographical area of production, materials and technology used.

As a fermentation product, the dynamics of microbial evolution and their metabolic activity is certainly one important factor to take into consideration, since many of the changes occur in cheese during ripening in an interrelated way, in which initial events give rise to products that are subsequently used or modified.

Proteolysis is one of the most important biochemical events for the development of flavour and texture during ripening of most cheese varieties and any analytical procedure based on protein analysis must take into consideration that proteolytic activity is a key aspect of cheese manufacture. Similar to other analytical approaches, proteolytic profiles can also be a relevant tool for authenticity studies. Each cheese type can be considered a distinct entity due to the microbiological, proteolytic and lipolytic profiles in the finished product that affect its texture and flavour. In this chapter, the major biochemical processes of cheese ripening will be addressed, focusing particularly on the milk proteins and the role of proteolysis on cheese ripening.

Chapter 13 - Fatty acid (FA) profile of cheese is characterized by high content of saturated fatty acids (SFA) and trans FA, and low levels of polyunsaturated fatty acids (PUFA). Overall, SFA and trans FA intake is associated with increase of the risk of cardiovascular disease; and a low consumption of these FA have been recommended by health authorities. However, reduction of cheese consumption in order to reduce the intake of SFA also may limit the intake of several potential health-promoting compound presents in cheeses, namely FA as conjugated linoleic acid isomers (CLA).

To satisfy consumer concerns over potential health effects of cheese is essential improving its FA profile, reducing the SFA content and increasing the beneficial unsaturated FA, particularly CLA and n-3 PUFA. Improving the milk FA composition through change of animal diet appears to be most effective way to manufacture cheeses with enhanced health properties. Nutritional strategies to improve the FA composition of milk fat have been

extensively studies. So, this chapter reviews the nutritional value of the lipid fraction in cheese, the ruminant lipid metabolism and feeding strategies to improve the FA profile of cheese. The sensory impact of improving the nutritional value of cheese is also discussed.

Chapter 14 - Chihuahua cheese or Mexican Mennonite-style is a typical product of the northern of Mexico. It is mildly flavoured semi-hard cheese whose manufacturing protocols resemble those of cheddar cheese. Chihuahua cheese is widely consumed through the retail and food service sectors to prepare cheese-based products and processed cheeses. This chapter presents a critical review of the existence literature on engineering properties of Chihuahua cheese. First, the composition and key process parameters will be reviewed where an industrial process will be described in detail based on the author's experience. This will be followed by a review of sensory, texture and rheological properties. Then, thermal and thermodynamic properties will be reviewed. Finally, highlighted will be the promising future of Chihuahua cheese to be used as ingredient.

Chapter 15 - Structure conditions both textural and flavor properties of dairy products. In recent years, it has become increasingly clear that the application of spectroscopic techniques such as infrared, fluorescence and nuclear magnetic resonance (NMR) can solve relevant problems during the processing and/or distribution of dairy products (ice cream, yogurt, butter, cheese, etc.). Determining the structure of these products and the interactions between the different components (protein, lipid, carbohydrate, mineral, etc.) has been impaired by the lack of techniques. More and more evidence shows that the above mentioned analytical techniques could be used as valuable tools for the determination of the interactions between the different components present in dairy products and hence their structure.

In order to extract information from the spectral collections acquired on dairy products, multivariate statistical methods (e.g. principal component analysis (PCA), common component and specific weights analysis (CCSWA), factorial discriminant analysis (FDA), etc.) have to be used allowing to determine the relation between the structure obtained at the molecular level and the texture observed at the macroscopic level. Besides the potential application of these techniques as on line sensors in dairy products factory allowing to monitor technological process (e.g. coagulation process of milk, ripening stage of cheese, etc.), they are considered as relatively low-cost, pollution free given since the signals are directly acquired on the samples non-destructively and without any extraction step.

Chapter 16 - Butyric acid fermentation, also known as late blowing defect (LBD), is a major cause of spoilage in semi-hard and hard cheeses. It results in the appearance of texture and flavour defects that generate severe economic losses at the cheese industry. *Clostridium tyrobutyricum*, an anaerobe Gram-positive spore-forming bacterium, is considered the primary cause of LBD in cheese, but other clostridial species such as *C. sporogenes*, *C. beijerinckii* and *C. butyricum* have also been shown to significantly contribute to the occurrence of LBD in cheese. *Clostridium* isolates from LBD cheeses exhibit a high genetic diversity when typed by pulsed field gel electrophoresis.

Clostridium spore counts in bovine milk reach their maximum levels in winter, but in ovine milk the maximum counts are recorded in summer. Information on the prevalence of LBD in cheeses is scarce. In Manchego cheese, the highest incidence of this defect has been reported for cheeses made in summer, in concordance with the maximum spore counts in summer milk.

LBD appears as *Clostridium* strains carry out the butyric acid fermentation during cheese ripening. When lactic acid is metabolized, other organic acids, mainly butyric acid, and gases

such as carbon dioxide and hydrogen are produced. The pressure of accumulated gases causes cracks and splits, which are generally accompanied by unpleasant aroma and rancid flavour. Cheeses with LBD show lower levels of lactose, galactose, citric and lactic acids than cheeses without the defect, while acetic and butyric acids, and other volatile compounds such as 2-propanol and 1-butanol are found at higher levels.

Bactofugation and microfiltration of milk, as well as the addition of nitrate or lysozyme, are common strategies to prevent cheese LBD. However, the reduction in spore numbers achieved by bactofugation may be insufficient to impede LBD, microfiltration can only be applied to skim milk because milk fat globules are too large to pass through the membrane pores, and the use of chemicals is precluded by the current increasing demand for additive-free foods. An alternative successful strategy to prevent LBD is the inoculation of cheese milk with bacteriocinogenic lactic acid bacteria (LAB). Irradiation is also being investigated to control LBD in cheese.

Chapter 17 - Lipids consist of a large group of compounds generally soluble in organic solvents and insoluble in water, and most lipids derived from fatty acids (FA) through the formation of esters, being called acyl lipids. FA are aliphatic, typically linear and monocarboxylic acids. The broadest definition includes all chain lengths, but most natural FA have chain lengths between C4:0 and C22:0 (Yildiz 2007).

The lipids present in the milk of all mammals exhibit a wide quantitative interspecific variation (approximately from 20g.L⁻¹ to 500g.L⁻¹). There is also qualitative variability, with more than 400 different types of FA detected in bovine milk, which creates a favorable nutritional profile. The milk lipids act as precursors of desirable flavor compounds as methyl ketones and lactones. On the other hand, they are also precursors to compounds that cause off-flavors (from hydrolytic and oxidative rancidity), and acts as solvents for the compounds in the environment which may cause off-flavors (Fox and McSweeney 1998).

Lipids are a major component in most cheese types, but their level and importance contrasting markedly with variety. Inter- and intra-variety differences in lipid contents are affected by a number of factors, including the milk composition (ratio of protein to fat), and the cheese process making (recipe, manufacturing procedure and technology), which controls the levels of milk fat and moisture retained in the cheese curd and the moisture content of the cheese (Fox et al. 2006).

One of the most significant advances that have been made is the understanding of the importance of dietary FA for human health. The analysis of labeled FA by different techniques became an important part in biosynthetic studies on FA, which includes analyses in several kinds of samples, like dairy products, meat, edible oils and biological samples like serum and plasma.

Chapter 18 - The excellent technofunctional properties of whey proteins such as high solubility, surface activity, gelling properties and water retention capacity, associated with their recognized nutritional benefits make them very attractive ingredients to use in conventional food products. The production of liquid whey protein concentrate (LWPC) and its incorporation in fresh cheese is proposed as a solution for the immediate reutilization of whey produced by small and medium-scale dairy plants, thereby avoiding expensive processing steps (e.g. evaporation and drying) for the recovery of this by-product. LWPCs were therefore incorporated into fresh cheese in order to compare the physicochemical, functional and sensorial properties of the modified products with the conventional ones.

This chapter demonstrates the feasibility of using liquid whey protein concentrates (LWPC) to manufacture a novel dairy food, with similar or better characteristics than those already acceptable to consumers.

Chapter 19 - Cheeses are recognized as major dietary sources of CLA, a group of positional and geometric isomers of linoleic acid (18:2 *cis*9,*cis*12) with potential beneficial effects to human health. Bioactivity of CLA is isomer specific and is related to immune modulation, body fat reduction, and protection against atherosclerosis and cancer. Therefore, analytical methodologies to ensure accurate analysis of CLA contents and detailed distribution of positional and geometrical isomers are required. In this chapter the authors present an overview of the most useful chromatographical techniques, such as Ag⁺-HPLC and GC-MS. They present reported contents of CLA and the distribution of CLA isomers in cheeses obtained from milk of different ruminant species and using varied cheesemaking processes. These data is discussed, and the authors contrast the effects of cheese processing conditions, and the variation in cheese CLA resulting from milk fat composition. These factors in combination might explain at least part of the variation in contents of the fifteen CLA isomers identified in cheese. Concerning the effects of processing, heat treatments, ripening conditions and addition of starter cultures are candidates to explain the variation in CLA composition observed in cheeses. Conversely, milk fat composition might be affected by geographical origin, seasonality, and the animals' diet, which appear to be the major determinant of CLA variation in cheeses. Finally, the authors discuss the contribution of cheeses for the habitual intake of CLA by population groups that is of concern considering the potential health benefits of CLA.

Chapter 20 - In cheese, during ripening, several microbiological and biochemical changes occur. Biochemical changes (lipolysis, proteolysis and metabolism of lactose, organic acids, fatty acids and amino acids) may produce not negligible amounts of substances widely used as food additives, such as benzoic acid and citric acid.

These residues may cause misinterpretations during official controls of dairy products that report "no added food additives" on the label.

This chapter describes the most important results obtained from a series of monitoring carried out on a total of 310 samples of dairy products ("mozzarella" cheeses, cheese spreads, short and lengthy maturation cheeses) without food additives, with the aim to detect quantifiable amounts of five substances commonly used as food additives: sorbic acid, benzoic acid, nitrites, nitrates and citric acid.

The analytical determinations were performed by three different ion chromatography with conductivity detection methods, validated according to the European Normative.

Quantifiable amounts of benzoic acid, nitrates and citric acid were verified.

In all samples with concentrations higher than methods limits of quantification, the residues detected were considered as "natural" because deriving from cheese ripening and not from a fraudulent addition of food additives. Through a statistical elaboration of these data it was possible to estimate and then suggest an "admissible maximum concentration" for benzoic acid and nitrates in dairy products.

Chapter 21 - The microstructure of cheese is a very important analysis technique, which is necessary for a full characterisation of a cheese product. The microstructure significantly affects the functional properties that are considered to be the end-product characteristics, such as texture and flavour properties. There are various techniques used to examine the microstructure of cheese. These techniques include mainly light microscopy (LM), confocal

scanning laser microscopy (CSLM) and electron microscopy techniques, where scanning electron microscopy (SEM) and transmission electron microscopy (TEM) are the most frequently used in the study of cheese microstructure. The importance of the effect of chemical composition, e.g. the content of moisture, protein, fat and salts as essential components for the manufacture, on the microstructure of the cheese has been highlighted. This chapter reviews firstly the various techniques, mainly LM, CSLM and SEM, used in the study of the microstructure of cheese. Secondly, the effect of the chemical composition, such as the presence of calcium and sodium chloride salts, of several types of cheese on the microstructure is also reviewed.

Chapter 22 - Cheese is a well-known fermented dairy product that is widely produced throughout the world from milk of cow, goat or other ruminants. In addition to serving as a fermented dairy product, cheese has been shown to provide a great deal of nutrients beneficial to health. During cheese ripening, the action of bacterial proteolytic and lipolytic enzymes results in generating more complex but deep and favorable taste than available in fresh cheese. Recent studies have demonstrated that certain bioactive compounds found in fermented milk products may exhibit various physiological functions and preventive effects against lifestyle-related diseases such as cardiovascular disorders and cancer. The authors' previous study revealed that highly ripened cheese was capable of demonstrating strong growth inhibition and induction of apoptotic DNA damage on HL-60 human leukemic cell line as a cancer model. In this communication, the authors summarized the available information in ripening and multifaceted function of cheese. The authors further focused on the effects of ripened cheese on the antiproliferative activity and induction of apoptotic DNA damage in human leukemic cells. Functional implications of the cheese ripening are discussed.

Chapter 1

TECHNOLOGICAL AND CHEMICAL CHARACTERIZATION OF PDO CHEESES OF ITALY

**Giuseppe Zeppa, Simona Belviso, Marta Bertolino,
Barbara Dal Bello and Manuela Giordano**

University of Turin, Department of Agricultural, Forest and Food Sciences,
Turin, Italy

ABSTRACT

Italy is one of the main cheese producers in the world, with over 30 Protected Denominations of Origin (PDO) awarded by the European Union, besides hundreds of typical and traditional cheeses. Italy has always supported a recognition policy, institutionalization as well as denomination of its productions, both due to Regional food traditions and for its interest to protect its food products. Therefore, PDO cheeses are a significant resource in Italy where approximately 50% of their milk production is destined for these products. Among these, Parmigiano Reggiano, Grana Padano, Gorgonzola and Mozzarella di Bufala Campana as well as Asiago, Taleggio or Ragusano are some of the best known in the world. Over 30 Italian PDO cheeses, all registered in the EU list (Reg. EC 510/2006), possess typical qualities strictly correlated to the environmental-production conditions. In particular, these cheeses are made using raw or pasteurized milk of cows, goats, sheep and buffalo, high-quality raw materials, in specific geographical areas of production and by using consolidated technologies linked to the 'art' of the cheesemaker. Such characteristics, consolidated over many years, led to obtain products with chemical, microbiological as well as distinctive sensory features, which are unique for each type of cheese.

The aim of this chapter is to summarize the knowledge about Italian PDO cheese, focusing the attention on their cheesemaking rules and particular traits that characterize them. For each cheese a card will be done with technological, chemical and sensory characteristics.

ABOUT THE AUTHORS

Giuseppe Zeppa

Affiliation: University of Turin

Date of Birth: April 14, 1958

Education: Graduated in Agricultural Science at University of Turin

Research and Professional Experience: The research activity is devoted to the study of chemical and sensory analysis of foods. Main topics are the study of wine and cheese flavors, the study of the relationship between technology and chemical/sensorial characteristics of foods, the use of gas-chromatography for food analysis, the food characterization between the sensory analysis, and consumer science.

Professional Appointments: Actually Associate Professor on Food Science and Technology

Publications Last 3 Years:

- Bertolino M., Dolci P., Giordano M., Rolle L., Zeppa G. (2011). Evolution of chemico-physical characteristics during manufacture and ripening of Castelmagno PDO cheese in wintertime. *Food Chemistry*, 129, 3, 1001-1011
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Marta Bertolino

Affiliation: University of Turin

Date of Birth: October 12, 1977

Education: PhD in Agronomy, Forestry and Food Sciences in 2007 and graduated with an MSc degree in Agricultural Science and Technology in 2003.

Research and Professional Experience: Principal research activities have been the study of technologies of dairy-products and bakery products. In the last year her research focused on the possibility of using the food by-products as functional ingredients in food formulation and on the characterization of PDO cheeses or traditional Piedmont cheeses; in particular on the study of the biochemical pathways occurring during their ripening.

Professional Appointments: Researcher in food science and technology

Publications Last 3 Years:

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Manuela Giordano

Affiliation: University of Turin

Date of Birth: November 24, 1970

Education: Degree in Chemistry, PhD in Agronomy, Forestry and Food Sciences at University of Turin

Research and Professional Experience: Main research activity is focused on food chemistry, in particular chemical analysis of fermented dairy products and beverages, applied to the quality and the research of chemical indices for the quality and traceability of these transformed products.

She works on sample preparations, qualitative and quantitative analytical-instrumental aspects, specifically in gas chromatography coupled with mass spectrometry technique, as well as the optimization of analytical methods to evaluate different biochemical markers (low and middle molecular weight metabolites) in food products.

Professional Appointments: Researcher in Food Science and Technology

Publications Last 3 Years:

- Agourram A., Ghirardello D., Rantsiou K., Zeppa G., Belviso S., Romane A., Oufdou K., Giordano M. (2013). Phenolic content, antioxidant potential and antimicrobial activities of fruit and vegetable by-product extracts. *International Journal of Food Properties*, 16, 1092-1104.
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Simona Belviso

Affiliation: University of Turin

Date of Birth: July 16,1976

Education: Degree in Industrial Chemistry (2001) and PhD in Chemical Sciences (2004) at University of Turin

Research and Professional Experience: research activity mainly focused on the development of analytical methods (GC, HPLC, GC-MS and LC-MS) to determine: a) lipids of *Saccharomyces cerevisiae* enological strains during alcoholic fermentation; b) hydrocarbons after degradation processes by selected microbial strains; c) terpenes as biomarkers for traceability of dairy products; d) phenolic compounds as valuable components of fruits, vegetables and agro-industrial by-products.

Professional Appointments: Researcher in Food Science and Technology

Publications Last 3 Years:

- Renna M., Cornale P., Lussiana C., Giordano M., Belviso S., Zeppa G., Battaglini L.M. (2012). Efficacy of fatty acids and terpenoids and weakness of electronic nose response as tracers of Asiago d'Allevo PDO cheese produced in different seasons. *Dairy Science & Technology*, 92, 203-218
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Barbara Dal Bello

Affiliation: University of Turin

Date of Birth: September 13, 1980

Education: PhD in Agronomy, Forestry and Food Sciences

Research and Professional Experience: She works at the Department of Agriculture, Forest and Food Sciences (AGRIFORFOOD) as a postdoctoral collaborator. Main laboratory activities are based on the selection of microorganism bacteriocin producers isolated from artisanal dairy products of the Piedmont region, (hazelnuts, oil, cheeses, etc.) by using gas-chromatography, analysis of fat oxidation, conjugated linoleic acid (CLA), free fatty acids, etc.

Professional Appointments: Postdoctoral research

Publications Last 3 Years:

- Cocolin, L., Dal Bello B., Alessandria V., Dolci P., Rantsiou, K Microbiota autoctoni per il controllo dei microrganismi alteranti e patogeni negli alimenti: il ruolo della bioprotezione (2010). *Int. J. Agron. Riv. Agro*, 4 Suppl: 73-81.
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INTRODUCTION

Italy is the world leader in the dairy sector with a turnover of about 14.8 billion Euros. In Italy in 2010 about 1.75 million cows, 0.245 million buffalos, 7 million ewes and 0.8 million

goats were counted. The production of milk by these animals has been estimated at 10.5 million tons of cow milk, 0.2 millions tons of buffalo milk, 0.4 millions tons of ewe milk and 0.2 millions tons of goat milk. About 2.9 millions tons of cow milk was used for direct consumption while the remaining milk was used to produce about 0.8 million tons of cow cheeses, 0.061 million tons of ewe cheeses, 0.009 million tons of goat cheeses, 0.05 million tons of buffalo cheeses, 0.08 million tons of mixed cheeses and 0.4 million tons of different dairy products such as butter, yogurt, powder milk, etc.

Among the 43 Italian cheeses registered as Protected Designation of Origin (PDO) and produced according to the European rules, the most important PDO cheeses are Parmigiano Reggiano, Grana Padano and Gorgonzola. Moreover data corresponding to the year 2012, registered Parmigiano Reggiano and Grana Padano as cheeses with the highest export both in Europe and in the World at volumes of 38,791 and 61,902 tons, respectively (ISTAT, 2013).

Information about the characteristics of all Italian PDO cheeses, their cheesemaking and composition will be described in this chapter. For each cheese, references (from SCOPUS source) concerning the chemical composition studies carried out over the past 10 years, and the website of the consortium, when available, will also be reported.

ASIAGO

Characteristics (PDO, June 12, 1996 modified on October 15, 2007)

There are two different types of cheeses, pressed Asiago and fostered Asiago. The pressed Asiago has a cylindrical shape (diameter 30-40 cm, height 11-15 cm and weight 11-15 kg) with a thin and elastic rind. The interior paste has marked and characterized by irregular eyes of white or slightly yellow color. It has a delicate and pleasant flavor. According to PDO requirements, the chemical composition of pressed Asiago at 20 days of maturation must be as follows: moisture $39.5 \pm 4.5\%$, protein $24.0 \pm 3.5\%$, fat $30.0 \pm 4.0\%$, sodium chloride $1.7 \pm 1.0\%$, fat in the dry matter must be not less than 44%. The fostered Asiago has a cylindrical shape (diameter 30-36 cm, height 9-12 cm and weight 8-12 kg) with a smooth and regular rind. The interior paste has small and medium eyes with a straw or slightly yellowish color. The taste is sweet in less ripened cheeses while fragrant in those having been aged. According to PDO requirements the chemical composition of fostered Asiago at 60 days of maturation must be as follows: moisture $34.5 \pm 4.0\%$, protein $28.0 \pm 4.0\%$, fat $31.0 \pm 4.5\%$, sodium chloride $2.4 \pm 1.0\%$, fat in the dry matter of not less than 34%.

Production Area

The geographical area of production is the whole territory of the provinces of Vicenza and Trento, and in some municipalities of the province of Padova and in a defined area of the province of Treviso.

Cheesemaking

Asiago is a semi-cooked cheese made with cow's milk. Cows are fed on pasture, with limited concentrate supplementations during the grazing season; during the indoor season the feeding is mainly based on conserved forages with notably higher amounts of concentrates. Feed based on fodder is not allowed in the case of the production of the cheese with the label "product of mountain". Production is divided into two different types of cheese, pressed Asiago and fostered Asiago. For the production of pressed Asiago cheese, raw or pasteurized (72°C, 15 seconds) milk (one or two milkings) can be used. Selected starters or milk cultures, possibly small amounts of sodium chloride and coagulated with bovine rennet at 35-40°C., are added to whole milk. After 15-25 minutes, the curd is cut to produce fine granules about the size of a walnut or hazelnut. The curd is cooked at 44°C and pressed for up to 12 hours. For the production of fostered Asiago, raw or thermised (57/68°C, 15 seconds) milk from one or two milkings, is partially skimmed and selected starters (or milk cultures) and a small amount of sodium chloride are added. Lysozyme can be added (2.5 g/100 kg milk) except for the cheese with the label "product of mountain". The milk is coagulated by the addition of bovine rennet at a temperature of 33-37°C (15-30 minutes). The curd is cut to produce fine granules, the size of a hazelnut or less. The curd is semi-cooked at 47°C. After draining, the curd is put into molds. Before salting, the cheeses are kept for a minimum period of 48 hours at 10/15°C and 80-85% relative humidity (RH). The cheese may be dry salted or brine salted at 20°C, +/- 2°C. The minimum ageing is 20 days for pressed Asiago, 60 days for fostered Asiago and 90 days, from the last day of production of fostered Asiago, and 30 days, from production of pressed Asiago, for the product with the label "product of mountain". Ripening is carried out at 10-15°C and 80-85% relative humidity. For the first 15 days after salting, fostered Asiago may be kept in storage at temperatures between 5 and 8°C. Asiago cheese, with the label "product of mountain" must be ripened in rooms located in mountain areas where temperature and humidity are determined by natural environmental conditions. The pressed Asiago cheese may also be labeled with the indication "fresh". Fostered Asiago may be labeled as "matured" or "aged" cheese if it has been ripened over 10 months while labeled "extra aged" if ripened more than 15 months. The Asiago cheese labeled as "product of mountain" cannot be treated on the surface with colorants and agents, which avoid the developing of molds.



http://www2.regione.veneto.it/videoinf/rurale/precedenti/anno%202006/33/Asiago_formaggi.htm

Figure 1. Asiago.

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Website

<http://www.asiagocheese.it/>

BITTO

Characteristics (PDO June 12, 1996 modified on November 25, 2009)

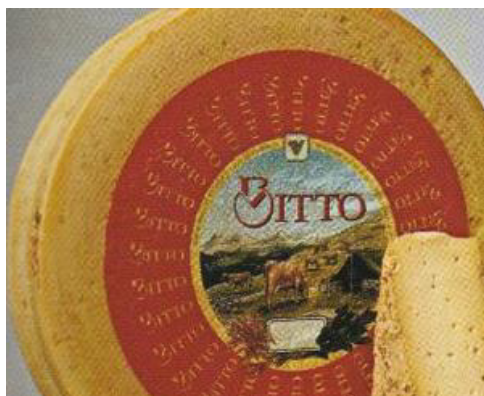
Bitto has a cylindrical shape (diameter 30-50 cm, height 8-12 cm and weight 8-25 kg) with a concave and sharp edge. The rind is solid with a depth of 2-4 mm. The color switches from yellowish to more intense yellow as it ripens. The interior paste is solid with rare eye-holes and its color changes from white to yellow depending on the age. At the beginning of the ripening process, the cheese taste is sweet and delicate. After the first year it develops a sharper and richer flavor, also due to the use of goat's milk. The product can be grated as a condiment after one year of age. According to PDO requirements, fat in dry matter must be not less than 45% and moisture, at 70 days, must be 38%.

Production Area

The geographical area of production is the whole territory of the province of Sondrio, some municipalities in the Alta Val Brembana in the province of Bergamo, and some municipalities in the province of Lecco.

Cheesemaking

Bitto is a traditionally made, semi-cooked and semi-hard cheese produced at an altitude of at least 1,500 m only between June 1 and September 30. It is made with whole raw cow's milk of the Italian Brown breed, to which a supplement of raw goat's milk up to a maximum of 10% is allowable. According to the guidelines on production, besides grazing pastures, the dairy cows' diet may be supplemented by feeds containing maize, barley, wheat, soybean and molasses (up to a maximum of 3 kg of dry matter per day). Milk must be processed within one hour from the end of the milking. Acidification is due to indigenous microflora, but the use of autochthonous starters made up from indigenous Bitto microflora is allowed. Milk is coagulated with bovine rennet. The curd is cooked at a temperature between 48 and 52°C for about 30 min and then is cut to produce granules with the size of a grain of rice. Once the curd is extracted, it is placed in traditional wooden molds, achieving the typical concave shape. Cheese can be dry salted or brine salted. Cheese starts to ripen in the so-called Alpine "casera", a rural small hut near the pasture, and finishes in the factories down in the valley at the natural climatic conditions of the production area. This process lasts for at least 70 days.



<http://www.visitfai.it/dimore/castelgrumello/la-tua-visita-132-Prodotti-tipici>

Figure 2. Bitto.

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Website

<http://www.ctcb.it/>

BRA

Characteristics (PDO 1 July 1996)

Bra can be found in two forms, soft and hard. Both types have a cylindrical form (diameter 30-40 cm, convex edge 7-9 cm, weight 6-8 kg). The color of the interior paste is white/ivory in the soft type and slightly yellow in the hard type, with very rare and small eyes. The structure is fairly solid and elastic in the soft type. The rind, not edible, is light grey, elastic, smooth and regular in the soft type while solid, hard and dark beige in the hard type. The soft type has a very soft and mainly sweet taste. The hard type is much more savory. The soft type is used as table cheese while the hard type is usually grated. For both types of cheeses, the fat in the dry matter must be a minimum of 32%.

Production Area

The geographical area of production is the whole territory of the province of Cuneo for both production and ripening, and the municipality of Villafranca Piemonte, in the province of Torino, for the ripening only. Soft and hard Bra cheese, produced and ripened in the mountain municipalities listed in the PDO, can be labeled “di Alpeggio”.

Cheesemaking

Bra is a pressed, semi-fat cheese, made with cow's milk to which small amounts of sheep and/or goat's milk can be added. According to the procedural guidelines, the cattle must be fed with green forages or hay. Milk (from one or two milkings) is often partially skimmed. Coagulation is obtained by using liquid rennet at a temperature between 27 and 32 °C. The cheese must be produced with a typical technology involving a double curd cutting. The cheese is then appropriately pressed and put into apposite molds. Usually, the cheese is dry salted twice and in some cases brine salting is carried out as well. The ripening period must be at least 45 days for the soft type and 6 months for the hard type.



<http://www.langood.it/public/shop/formaggi/formaggi-vaccini/formaggio-bra-tenero-giobrat.asp>

Figure 3. Bra.

Website

<http://www.assopiemonte.com/>

CACIOCAVALLO SILANO

Characteristics (PDO 1 July 1996 modified on 4 July 2003)

Caciocavallo Silano has an oval or trunk-conical form with creeks. Each cheese can weigh from 1 to 2.5 kg. The rind is thin, smooth and straw yellow colored. The interior paste is white or straw yellow, regular, firm and it very rarely presents eyes. The taste is gentle and sweet in less aged cheeses becoming piquant in those aged. According to PDO requirements, the fat in dry matter must not be less than 38%.

Production Area

The geographical area of production is the whole territory of Calabria, Campania, Molise, Puglia and Basilicata regions.

Cheesemaking

Caciocavallo Silano is a semi-hard, pasta filata (or spun paste) cheese made with cow's milk. Milk is coagulated at 36-38°C by the addition of paste bovine or kid rennet. When the curd has reached the wanted firmness, its cutting is performed to produce granules with the size of a hazelnut. The ripening starts with a vigorous lactic fermentation, which lasts from 4 to 10 hours or more, depending on the acidity of the milk used. Cheese ripening is completed when the cheese is ready to be kneaded (or "spun"). In order to check the maturation time, a small amount of cheese is collected at very close time intervals and put in boiling water to test if it can be extended into elastic, shiny, continuous and strong fibers. Then, the paste is manually modeled until the required form is obtained and each single piece of cheese obtained is closed at the apex and quickly dunked in boiling water. The final form, with head where required, is given manually. The cheeses are individually cooled in cold water and salted using brine solution (resting not less than 6 hours). After the brining, Caciocavallo cheeses are hung in a couple on horizontal poles to be ripened for a minimum of 15 days.

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Website

<http://www.parcosila.it/it/saperi-e-sapori/prodotti-dop/consorzio-caciocavallo-dop>



<http://www.parcosila.it/it/saperi-e-sapori/prodotti-dop/consorzio-caciocavallo-dop>

Figure 4. Caciocavallo Silano.

CANESTRATO PUGLIESE

Characteristics (PDO June 12, 1996)

Canestrato Pugliese has a cylindrical shape (diameter 25-34 cm, edge 10-14 cm, weight 7-14 kg) with a brownish, hard, roughness and a thick rind. The rind is treated with olive oil, possibly mixed with wine vinegar. The interior paste is solid and very friable with a slight or more intense yellow according to the cheese age. The cheese has a characteristic piquant taste. According to PDO requirements fat in dry matter must be at least 38%.

Production Area

The geographical area of production is the whole territory of the province of Foggia and some municipalities in the province of Bari.

Cheesemaking

Canestrato Pugliese is a hard cheese made with sheep's milk. The herd must be fed with green and/or conserved forages or hay (only exceptionally with concentrate supplementation). Milk (from 1 or 2 milkings) is coagulated at 38-45°C with the addition of lamb rennet within 15-25 min. The following steps of cheese-making must be completed within 30-60 days, depending on the size and weight of the form. Cheese is pressed into particular containers, "canestri" or baskets, which give the characteristic roughness to the rind. Two-4 days after the production, cheese is still maintained in the baskets where it can be salted in dry conditions or using brine solution. Ripening lasts from 2 to 10 months and takes place in fresh and ventilated rooms. Cheese, aged for at least six months, can be consumed as table cheese or grated cheese.



http://www.arssa.abruzzo.it/atlanteprodotti/home.php?module=view_prodotto&id=34&idtipo=4

Figure 5. Canestrato Pugliese.

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CASATELLA TREVIGIANA

Characteristics (PDO 2 June 2008)

Casatella Trevigiana has a cylindrical shape (big form: diameter 18-22 cm, edge 5-8 cm, weight 1.8-2.2 kg; small form: diameter 18-12 cm, edge 4-6 cm, weight 0.25-0.70 kg). The interior paste is soft, shiny and a little bit creamy with a color ranging from milky-white to creamy-white. Small eyes can be present. The rind is almost absent. The cheese has fresh milky aroma and a sweet and a slightly acidic taste. According to PDO requirements the chemical characteristics must be as follows: moisture 53-60%, fat 18-25% and protein higher than 12%.

Production Area

The geographical area of production is the whole territory of the province of Treviso.

Cheesemaking

Casatella Trevigiana is a soft cheese made with cow's milk from the Italian Frisone, Pezzata Rossa and Bruna breeds. Cows must be fed with forages and territorial concentrates and the total fat content of the milk must be higher than 3.2%. Production starts within 48 hours from the milking. Milk can be pasteurized (70-75°C, 15-25 sec) and left to cool down at 34-40°C. Acidification is achieved by the addition of indigenous milk starters composed by *Streptococcus thermophilus* and thermophilic lactobacilli with a prevalence of *Lactobacillus delbrueckii* subsp. *lactis*. Milk is coagulated at 34-40°C by addition of liquid or powder bovine rennet within 15-40 min. The curd is cut crosswise and left to stand between 45 and 55 min, in order to obtain a more drained and firm curd. A second cut is carried out to produce

granules with the size of a walnut. Curd is then extracted and put in molds, locally, at 25-40°C for a maximum of 3.5 hours (for bigger forms). During the draining, the forms are turned 2 to 4 times. Cheeses can be salted in brine solution (16-22°C, 4-12°C) for 40-50 min for smaller forms and 80-120 min for bigger forms. Instead of using brine solution, dry salting can also be done. Ripening is carried out in molds at 2-8°C for 4-8 days, by turning the forms every two days. Casatella Trevigiana must be packed in the territory of production before commercialization.



<http://www.veneto.to/veneto-qualita-dettaglio?uuid=144c7976-6ef4-4785-8b89-d8986ecb97e9&lang=it>

Figure 6. Casatella Trevigiana.

Website

<http://www.casatella.it/il-consorzio-di-tutela/>

CASCIOTTA D'URBINO

Characteristics (PDO 12 June 1996)

Casciotta d'Urbino has a cylindrical shape (diameter 12-16 cm, edge 5-7 cm, weight 0.8-1.2 kg). The matured cheeses have a thin rind (1 mm thickness) and a straw yellow color. The interior paste is soft with characteristic small holes. The color is white-straw yellow. The characteristic taste, due to the particular cheesemaking process, is sweet and pleasantly acidic. It is consumed as table cheese. According to PDO requirements, fat in dry matter must be not less than 45%.

Production Area

The geographical area of production is the whole territory of the provinces of Pesaro and Urbino.

Cheesemaking

Casciotta d'Urbino is a semi-cooked cheese made from sheep (70-80%) and cow's milk (20-30%). Milk (from 2 milkings) is coagulated at 35°C with liquid and/or powder rennet. Cheese is manually pressed into special molds, using a typical procedure. Cheese is dry or brine salted. Cheese ripening lasts from 20 to 30 days at 10-14°C and 80-90% relative humidity, depending on the size of the forms.



<http://www.guidaenogastronomia.com/casciotta-d-urbino.html>

Figure 7. Casciotta d'Urbino.

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Website

<http://www.casciottadiurbino.it/consorzio>

CASTELMAGNO

Characteristics (PDO July 1, 1996 modified on December 14, 2012)

Castelmagno has a cylindrical shape (diameter 15–25 cm; edge: 12–20 cm; weight: 2–7 kg). These characteristics are referred to the minimum ripening period (60 days). Fresher forms have a not-edible, thin rind with a reddish yellow color, while the more matured forms

have an aged aspect and a darker color. The structure of the cheese is very crumbly at the beginning of the ripening and becomes firmer as it is aged. The interior paste is white/ivory colored, tending towards ochre-yellow with streaks of greenish-blue color in the more matured forms. The presence of streaks is due to the development of natural molds, belonging to the *Penicillium* species. Its delicate taste gets stronger and sharper as the ripening season goes on. According to PDO requirements, fat in the dry matter must be a minimum of 34%.

Production Area

The geographical area of production is limited to three municipalities (Castelmagno, Pradleves and Monterosso Grana) in the province of Cuneo.

Cheesemaking

Castelmagno PDO cheese is a semi-hard cheese produced with raw cow's milk and a small amount of sheep and/or goat's milk (from 5 to 20%). Cattle must be fed on green forages or hay. Milk, which can be obtained from a maximum of four consecutive milkings and can be skimmed, has to be heated to 30–38°C and coagulated by the addition of liquid calf rennet (with at least 70% of chymosin). Pasteurization, thermisation and use of starter cultures are not allowed. Once the curd reaches an adequate firmness, it is turned and then cut under the whey, traditionally called “la laità”. The following cutting is carried out to gradually reduce the size of granules to that of a hazelnut (10–15 min under continuous stirring). The curd is left to separate from the whey and then is transferred on a dry and clean cloth (called “risola”) where it rests for 18 h. After the draining, the curd is put in suitable food containers, including wood containers, under the whey obtained from previous cheese making and left at 10°C for 2–4 days. The curd is then milled, salted, enveloped in a cloth and put in molds for at least one day, where it is manually or mechanically pressed. The cheese forms can further be dry salted to give color and consistency to the rind. Finally, the cheese is placed in natural caves where ripening takes place for at least 60 days at 5–15°C and 70–98% relative humidity, in order to allow the development of the natural molds.



http://www.castelmagno-oc.com/pres_cast/tesi_form_cast.htm

Figure 8. Castelmagno.

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Website

<http://www.assopiemonte.com/>

FIORE SARDO

Characteristics (PDO July 1, 1996)

Fiore Sardo cheese has a cylindrical shape, 12-18 cm high and 18-20 in diameter, and weight 1.5-4 kg. The rind changes color, from yellow to brown at the end of ripening and the interior has a white-yellow color and a Grana-like texture. During the ripening the cheese becomes piquant due to large lipolysis induced by the rennet enzymes. It could sell as “grated” cheese if it is ripened more than 6 months. According to PDO requirements, fat in dry matter must be higher than 40%.

Production Area

The geographical area of production is the whole territory of Sardegna Region.

Cheesemaking

Fiore Sardo is produced from whole raw ewe’s milk. Sheep must be of Sardinian breed and must pasture in an environment rich in aromatic herbaceous (*Lolium rigidum*, *Trifolium subterraneum* and *Medicago arabica*) and shrubby (*Arbustis unedo*, *Pistacia lentiscus*, *Myrtus communis* and *Thymus*) species. The milk used comes from one (from June to September) or two (from October to May) daily milkings, and it can be thermized and natural starter cultures may be added. Fresh milk must have a pH of 6.6, a fat content of 6.2-7.5% and a protein content of 5.5-6.3%. Coagulation takes place in a copper vat using lamb or kid

rennet paste, traditionally produced at the farm by shepherds themselves, and it is carried out in 12-28 minutes at 34°C during the spring and summer season, or at 36°C during the winter. After coagulation the coagulum is cut into millet-grain size and left to rest under the whey for at least 5 min. The curd is then transferred into stainless steel molds with a cut-down cone shape that confers to the cheese the typical “mule’s back” form. After the molding, the cheese is turned upside down to promote the whey removal. At the end, cheeses are washed with hot water or whey to promote the formation of a smooth and resistant rind. The ripening is divided into three steps: the first step lasts 15 days during which cheeses are smoked 2 hours every day at 18-20°C using local wood or brush. The second step lasts 3 months at a temperature of 10-15°C during which cheeses are turned upside down. The last step takes place in a ripening room at a temperature lower than 15°C with a relative humidity of 80-85%. During this period cheeses are turned upside down and the surface can be rubbed with an olive oil-vinegar and salt emulsion.



http://www.sardissimo.it/public/photogallery/fiore_sardo_dop.jpg

Figure 9. Fiore Sardo.

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FONTINA

Characteristics (PDO June 12, 1996 modified on February 3, 2011)

Fontina cheese has a cylindrical shape, 7-10 cm high and 35-45 in diameter, and weight 7.5-12 kg. The rind has a brown color at the end of ripening and the interior has a color ranging from ivory to pale yellow with an elastic texture. According to PDO requirements, the fat in the dry matter must be higher than 45%.

Production Area

The geographical area of production is the whole territory of Valle d'Aosta Region.

Cheesemaking

Fontina is produced from whole raw cow's milk exclusively obtained from native breeds (red pied, black pied and chestnut), fed with hay and green grass grown in the same Region. The milk used comes from one milking and it can be added with autochthonous starters that are preserved by the Consortium "Produttori e Tutela della DOP Fontina". Coagulation takes place in a copper or steel vat at 34-36°C for 40-60 min using calf rennet. After coagulation the coagulum is cut into maize-grain size and, stirring continuously, the curd is heated up to

46-48°C to promote the whey draining. Once the curd becomes sufficiently cleared it is left to settle under the whey for 10 min. The curd is then transferred into cloth bags that are put inside typical molds with concave-sides on which a small casein plate is applied with the cheese's progressive number and pressed. The pressing stage lasts 12 hours during which the cheese is turned upside down to promote the whey removal. Before the final turning the small number plate is applied with the producer's identification number which, together with the casein plate, guarantees the clear tracing of the product. Cheeses are brine-salted for no longer than 12 hours. Cheeses are ripened in caves dug out the rock or into a ripening room for at least 3 month at 5-12°C with a relative humidity higher than 90%, during which the cheese is periodically brushed and dry-salted on the surface. During the first month of ripening, cheeses are turned daily, salted one day and washed with a brine solution the day after to promote the formation of the typical red rind due to the growth of the microbial ecosystem of the surface.



http://vetrina.fontina-valledaosta.it/uploads/633/800_3.jpg

Figure 10. Fontina.

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Website

www.consorzioproduttorifontina.it

FORMAGGELLA DEL LUINESE

Characteristics (PDO April 11, 2011)

Formaggella del Luinese cheese has a cylindrical shape with fat sides, 4-6 cm high and 13-15 in diameter, and weight 0.7-0.9 kg. Molds can be present on the white rind with different colors. The interior has a white color with many eyes and an elastic texture. The cheese has a medium-mild, delicate, pleasant flavor that becomes stronger during the ripening. According to PDO requirements water content must be less than 55% and fat in dry matter must be higher than 41%.

Production Area

The geographical area of production includes numerous municipalities in the province of Varese.

Cheesemaking

Formaggella del Luinese cheese is made from whole, raw goat's milk coming from the Camosciata delle Alpi, Nera di Verzasca and Saanen breeds (and their crosses), which are typical of the Alpine area. In addition to grazing, the diet of the herds, which remain at pasture for 7/8 months, is based on the use of hay fodder from local mixed meadows supplemented with concentrates. During the grazing season, alongside the use of wild plants such as heather, spring pruning's from hazel, ash and chestnut trees and wild herbs, the diet is supplemented with concentrates and, in some cases, hay fodder. During the period in stalls, hay fodder and concentrates are primarily used. The hay fodder is mainly obtained from areas on the valley floor where mixed meadows with species such as *Dactylis glomerata*, *Poa pratensis*, *Poa trivialis*, *Avenula pubescens*, *Trifolium repens* and *Trifolium pratense* predominate. The use of grass silage is not permitted. The milk used, coming from a maximum of three milkings, is added with autochthonous starters or selected starters made of *Streptococcus* and *Lactobacillus* thermophilic strains and a small percentage of *Lactococcus*

mesophilic strains. Coagulation is made at 32-34°C in 30-40 min using natural calf rennet. After coagulation the coagulum is cut into the size of maize-grains and, stirring continuously, the curd is heated up to 38°C to promote the whey removal. Once the curd becomes sufficiently cleared it is left to rest under the whey for 15 min. The curd is then transferred in 14 cm diameter molds and left on tables for 48 hours to promote the whey removal. During this period it is necessary to turn the cheese upside down at least 2-5 times. Cheeses are dry or brine-salted (solution at 18-20% NaCl at 14-20°C for 7 hours per kg of cheese). Cheeses are ripened in a room for at least 20 days at a temperature under 15°C with a relative humidity of 85-95%.



http://www.crsosina.it/ricette/images/formaggella_del_Luinese.jpg

Figure 11. Formaggella del Luinese.

FORMAGGIO DI FOSSA DI SOGLIANO

Characteristics (PDO November 30, 2009)

Formaggio di Fossa di Sogliano cheese has an irregular shape with typical bumps and depressions due to the pressure inside the pit. The surface is primarily wet and greasy and in some cases may be covered by butterfat and molds, which can be easily scraped off. Small cracks and possible yellow ochre stains of varying intensity on the surface are also typical of the product. There is minimal or no rind, and the cheese weighs 0.5-1.9 kg. The interior has an ivory white to a slightly yellowish color and a semi-hard texture. The flavor changes, depending on the composition of the aged cheese, in accordance with the following characteristics: the ewes' milk cheese has an aromatic aftertaste and a fragrant, full and pleasant flavor, slightly tangy to a greater or lesser extent; the cows' milk cheese is subtle and delicate, with a moderately salty and slightly acidic taste with a hint of bitterness; the mixed cheese has a pleasant flavor between salty and sweet, with a slightly bitter taste. According to

PDO requirements the water content must be less than 55% and the fat in dry matter must be higher than 32%.

Production Area

The geographical area of production is the whole territory of the provinces of Forlì-Cesena, Rimini, Ravenna, Pesaro-Urbino, Ancona, Macerata and Ascoli Piceno and some municipalities in the province of Bologna.

Cheesemaking

Formaggio di Fossa di Sogliano is produced from 100% whole cow's milk or 100% whole ewe's milk or a mix of both milks with a ratio of 80:20 respectively. The bovine species used to produce the milk are Italian Friesian, Alpine Brown, Italian Red Pied and cross-breeds; the ovine species are Sarda, Comisana, Massese, Vissana, Cornella White, Fabrianese of Langhe and Pinzirita and cross-breeds. The animals may be housed or grazed. The basic feed for housed animals consists of fodder comprising grasses and legumes collected from monophyte, oligophyte and polyphite meadows. The milk used, coming from two daily milkings, must have the following properties: cow's milk (fat % by volume > 3.4; protein % by volume > 3.0; bacterial count UF/ml <100000; somatic cell/ml <350000; anaerobic sporigens/litre absent; inhibitors absent and cryoscopic point °C < 0.520); ewe's milk (fat % by volume > 6.0; protein % by volume > 5.4; bacterial count UF/ml < 1400000; somatic cells/ml < 1400000 and inhibitors absent). The milk can be used raw or pasteurized. Coagulation takes place at 30-38°C in 7-20 min using natural rennet. After coagulation the coagulum is cut into maize or kernel size and left to rest under the whey for 15 min. The curd is then transferred into molds (12-20 cm in diameter and 6-10 cm in high) and manually or mechanically pressed. The cheese can be subjected to a stewing process. Cheeses are dry or brine-salted. Cheeses are ripened for a minimum period of 2 months to a maximum period of 8 months. For the ripening, it is possible to use cells at 6-14°C with a relative humidity of 75-92%. Traditionally cheeses are ripened in a pit dug into tuffaceous rock (fossa). Before the cheeses, closed into cloth bags, are placed in the pits, the pits are suitably prepared according to the traditional method: when not in use the pits are kept closed by means of wooden covers with the addition of sand or rocks. When they are to be used, they are opened, aired and then sanitized by fire and smoke by burning small quantities of wheat-straw. When the fire is out, the pits are cleaned to ensure that no ash remains. A raised platform made of untreated wooden planks is placed at the bottom of each pit. This allows the fatty liquid, produced during the fermentation of the cheese as it ages, to drain away. The walls of the pit are lined with a layer of at least 10 cm of wheat-straw supported by vertical reed fencing. The pit is filled to the top with bags of cheese. After a period to allow settling, never more than ten days, more bags can be added to fill the pit. When the pit is full, the top is covered by uncolored cloths suitable for use with foodstuffs, and/or straw, to prevent transpiration. The pit is then closed by means of a wooden cover, which is sealed using plaster or lime sandstone mortar. Further covering using rocks, sandstone powder, sand and/or planks is permitted. This is when the aging starts. The pits may not be opened during the aging process. The cheeses

remain in the pits from at least 80 to at most 100 days. Inside, the temperature remains constant, between 17 and 25°C, throughout the entire 80-100 days of ageing while the relative humidity increases from 80% to 95% in the first 24 hours and then remains stable for the entire ripening period.



<http://www.comune.sogliano.fc.it/ilpaese/produzioni/formaggioidifossa/Img/Formaggio01.jpg>

Figure 12. Formaggio di Fossa di Sogliano.

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Website

www.ilformaggioidifossa.com

FORMAI DE MUT DELL'ALTA VALLE BREMBANA

Characteristics (PDO June 12, 1996)

Formai De Mut Dell'Alta Valle Brembana cheese has a cylindrical shape, 8-10 cm high and 30-40 in diameter, and weighs 8-12 kg \pm 10%. The color of the thin rind ranges from yellow to grey at the end of ripening, and the interior has a white ivory color with partridge eyes and an elastic texture.

Production Area

The geographical area of production includes some municipalities of Alta Val Brembana in the province of Bergamo.

Cheesemaking

Formai De Mut dell'Alta Val Brembana is produced from whole cow's milk obtained from the Alpine Brown breed. The animals are pastured during the summer period, and in winter are housed and fed with hay fodder mainly obtained from areas on the valley floor. The milk used comes from one or two consecutive milkings and it is characterized by a naturally low acidity. Coagulation takes place at 35-37°C in 30 min using rennet. After coagulation the coagulum is cut into rice-grain size and heated up to 45-47°C. When the temperature is reached, the curd is stirred for 30 min, out from the heat source, and left to rest under the whey for 20 min. The curd is then transferred into molds and manually or mechanically pressed for 48 hours to promote the whey removal. Cheeses are dry or brine-salted on alternate days for a period of 8-12 days. Cheeses are ripened for at least 45 days to 6 months at 8-13°C at a constant relative humidity.



http://www.originalitaly.it/blog/wp-content/uploads/2012/04/31100_19.jpg

Figure 13. Formai de Mut dell'Alte Valle Brembana.

Website

www.formaidemut.info

GORGONZOLA

Characteristics (PDO June 12, 1996 modified on February 3, 2009)

Gorgonzola cheese has a cylindrical shape, 13 cm high and 20-32 in diameter. Concerning the weight, it is possible to sell three different types of cheeses: large wheel, mild

type: 10-13 kg, with a mild or slightly tangy taste, minimum maturation period 50 days; medium wheel, tangy type: 9-12 kg, with a pronounced tangy taste, minimum maturation period 80 days; small wheel, tangy type: 6-8 kg, with a pronounced tangy taste, minimum maturation period 60 days. The thin rind is grey due to the microbiota present and it has a white or pale yellow color with molds (marbling) producing characteristic blue-green veins and a creamy to firm texture. According to PDO requirements, the fat in dry matter must be higher than 48%.

Production Area

The geographical area of production is the whole territory of the provinces of Bergamo, Biella, Brescia, Como, Cremona, Cuneo, Lecco, Lodi, Milano, Monza, Novara, Pavia, Varese, Verbano-Cusio-Ossola and Vercelli and some municipalities in the province of Alessandria.

Cheesemaking

Gorgonzola is produced from whole pasteurized cow's milk obtained from the Italian Friesian breed. Milk is inoculated with natural milk cultures constituted by *Streptococcus thermophilus* and *Lactobacillus delbrueckii* spp. *bulgaricus* species and a suspension of *Penicillium* spores and selected yeasts, which characterize Gorgonzola as a blue cheese. Coagulation takes place at 28-36°C in 30 min using calf rennet. After coagulation the coagulum is cut and left to rest under the whey. The curd is then transferred into molds and the origin mark, with the identification number of the dairy farm, is placed on both flat ends and left 12-15 hours to promote the whey removal. Cheeses are dry-salted for several days at a temperature of 18-24°C. Cheeses are ripened for at least 50 days at 2-7°C with a relative humidity of 85-99%. During ripening cheeses are pierced two times: the first time after 15 days of ripening on one side, and after 25 days on the other side, so that the air can enter into the cheese leading to the growth of molds.



<http://cdn.blogosfere.it/saporiericette/images/gorgonzola-dolce.jpg>

Figure 14. Gorgonzola.

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Website

www.gorgonzola.com

GRANA PADANO

Characteristics (PDO June 12, 1996 modified on June 17, 2011)

Grana Padano cheese has a cylindrical shape with slightly convex circumference rind, 18-25 cm high and 35-45 in diameter and weight 24-40 kg. The cheese has a hard and smooth rind with a thickness of 4-8 mm and golden yellow color. The interior has a white or straw-color, a hard but finely grained texture, flaky from the middle out and with barely visible eyes. The cheese can be sold as a “grated” product obtained exclusively from whole cheese that has already been certified. Grated cheese must have moisture not lower than 25% and not higher than 35%; the appearance should not be powdery, but even, particles with a diameter of less than 0.5 mm and not more than 25%.

The Grana Padano cheese produced in the Trento and Bolzano Provinces is named Trentingrana but the production discipline differs because the type of milk used must come from the Alpine Brown cow breed; in the fodder the use of silage is forbidden as well as the use of lysozyme. According to PDO requirements, fat in dry matter must be higher than 32%.

Production Area

The geographical area of production is the territory of the provinces of Alessandria, Asti, Biella, Cuneo, Novara, Torino, Verbania, Vercelli, Bergamo, Brescia, Como, Cremona, Lecco, Lodi, Mantova (only left of the Po River), Milano, Monza, Pavia, Sondrio, Varese, Trento, Padova, Rovigo, Treviso, Venezia, Verona, Vicenza, Bologna (only right of the Reno River), Ferrara, Forlì Cesena, Piacenza, Ravenna and Rimini and in the municipalities of Anterivo, Lauregno, Proves, Senale-S. Felice e Trodena.

Cheesemaking

Grana Padano is produced from raw milk obtained from cows of the Italian Friesian breed, fed primarily with feed produced on the home farm or in the Grana Padano production area. No less than 50% of the dry matter of the daily feed should be made up of feed with a ratio of fodder to feed of no less than 1, with reference to the dry matter, and at least 75% of the dry matter of the fodder in the daily ration should come from feed produced in the production area of the milk. The fodder could be fresh fodder, hay, straw, silage and it can contain cereals and their derivatives, oil seeds and their derivatives, tubers and root vegetables and products derived from them, dehydrated fodder, derivatives of the sugar industry, legume seeds, fats, minerals, additives. The milk, obtained by two daily milkings, is partially skimmed by a natural rising of the cream made in very large tanks for 12 hours at 12-15°C. After the creaming process the milk is put into a copper vat with an inverted cone shape and lysozyme (2.5 g/100 Kg of milk) could be added. After the addition of natural whey starter cultures, coagulation takes place in the vat using calf rennet. After coagulation the coagulum is cut and cooked at a temperature under 56°C. When the coagulum pieces reach an elastic texture they are then left to rest under the whey for a maximum of 70 minutes. The curd is then transferred into molds and left for 48 hours to promote the whey removal. Cheeses are brine-salted for 14-30 days. Cheeses are ripened for at least 9 months at 15-22°C with a relative humidity of 80-85%.



<http://www.langhe.net/wp-content/uploads/2011/04/Grana-Padano.jpg>

Figure 15. Grana Padano.

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Website

www.granapadano.com

MONTASIO

Characteristics (PDO June 12, 1996 modified on April 8, 2011)

Montasio cheese has a cylindrical shape, 8 cm high and 30-35 in diameter, and weighs 6-8 kg. The rind is smooth, regular and elastic with a yellow color and the interior has a slightly straw-yellow color with some eyes. The cheese has a piquant and pleasant taste. According to

PDO requirements, water content must be higher than 36.72% and fat in dry matter must be higher than 40%.

Production Area

The geographical area of production is the whole territory of Friuli-Venezia Giulia Region, the whole territory of the provinces of Belluno and Treviso and the area along the boundary of the province of Padova from where it intersects with that of the province of Treviso to the Serenissima motorway, continuing to the motorway bridge over the Brenta River and then along the river to its mouth.

Cheesemaking

Montasio is produced from raw cow's milk. The cow breeds used are Alpine Brown, Italian Red Pied and Black Pied. The breeds are fed with cereals (particularly maize and barley), green and dried fodder (polyphites and alfalfa) and silage (mainly from maize). These products make up about 80-85% of the total diet and come mainly from the production area. The concentrates and nucleus proteins are supplied by feed manufacturers generally located in the production area who mainly use local cereals, buy protein meal (e.g. soy and alfalfa, also produced on site) and mineral and vitamin supplements. The milk comes from a maximum of four milkings. The milk is then placed in copper vats heated at 32-36°C, with added natural milk starter cultures. Coagulation takes place using calf rennet for 20-25 min. After coagulation the coagulum is cut into rice-grain size and cooked at 42-48°C. When the temperature is reached the curd is stirred for 20-30 min out of the heat source. The curd is then transferred into molds and pressed to promote the whey removal. Cheeses are dry or brine-salted. Cheeses are ripened for at least 60 days at a temperature higher than 8°C.



http://www.winecountry.it/assets/besideWine/cheese/montasio_young.jpg

Figure 16. Montasio.

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Website

www.formaggiomontasio.net

MONTE VERONESE

Characteristics (PDO July 1, 1996)

Denomination of Origin ‘Monte Veronese’ is reserved to the cheeses having specific characteristics and moreover, depending on the type of the milk used. In particular, the cheese is made in the same production area. Using the same cheese making rules, it may be produced starting from whole milk or semi-skimmed milk, and called “Monte Veronese” or “Monte Veronese d'alleva”, respectively.

Production Area

The geographical area of production is located in the North of the province of Verona, beginning at the state highway n.11 (Padana Superiore) to enter the district of San Bonifacio, which is crossed, it passes through Villanova to reach San Martino Buon Albergo e San Michele center and Verona along the bypass, and it continues up to km 297 of the Croce bianca until Caselle and finishing in the district of Peschiera bordering on provinces of Verona and Brescia.

A) "Monte Veronese" PDO

Cheese has the following characteristics:

- a) cylindrical shape
- b) weight between 7 and 10 kg
- c) size: heel height 6-10 cm, diameter 25-35 cm. The variations both of the weight and dimensions of the cheese depend by the manufacturing production as well as the ripening period
- d) Thin and elastic rind, more or less intense straw yellow color
- e) The paste is white lightly straw yellow with small holes equally distributed
- f) The taste is mild and palatable. Ripening is carried out for a minimum of 90 days for the table cheese type and a minimum of six months for the grated cheese
- g) fat in dry matter must be not less than 44%

B) "Monte Veronese "d'allevo" PDO

Cheese has the following characteristics:

- a) cylindrical shape with a flat or slightly bowed sides
- b) weight between 6 to 9 kg
- c) size: heel height 7-11 cm, diameter 25-35 cm. The variations both of the weight and dimensions of the cheese depend by the manufacturing production as well as the ripening period.
- d) thin and elastic rind, more or less intense straw yellow color
- e) The paste is white, lightly straw yellow with small holes equally distributed throughout and usually with a size 2 to 3 mm bigger than the cheese made from whole milk
- f) The cheese has a perfumed taste typical for the ripened cheese which becomes more piquant when the ripening is longer
- g) fat in dry matter must be not less than 30%

Cheesemaking

A) "Monte Veronese" from whole milk is a hard cheese exclusively made from raw whole cow's milk, coming from one or two consecutive milkings, and having a final acidity value ranging from 3.6 to 3.8 SH/50 ml. Milk acidity can be obtained naturally or by adding milk ferments derived from the dairy factory involved in cheese production or from other previous productions made from factories indicated in article 2 of the Regulation.

The milk is coagulated for 15-20 min by the addition of calf rennet and the breaking of the curd is carried out for few seconds to obtain clots with dimensions of a grain of rice.

The curd is heated to reach the final temperature of 43-45°C for 10 min and left to cook for 25-30 min. Salting is carried out in dry conditions or in brine solution after the draining off of the curd, about 24 hours. Ripening finishes within 30 days with a minimum of 25 days.

B) "Monte Veronese d'allevo" is either a table or grated cheese type made from semi-cooked pasta exclusively by using partially skimmed cow's milk obtained from one or two

consecutive milkings. Final acidity value of the milk ranging from 3.8 to 4 SH/50 ml, may be obtained naturally or by adding milk ferments derived from the dairy factory involved in cheese production or from other previous productions made from factories indicated in article 2 of the Regulation.



<http://www.venlat.it/prodotti.html>

Figure 17. Monte Veronese PDO.

The curd is obtained using rennet made from calves' stomachs for 25-30 min and breaking is carried out for few seconds up to obtain the clot with dimensions of rice grains.

The curd is heated to reach the final temperature of 46-48°C and left to cook for 15 minutes.

The curd is then allowed to stand in a warm condition for about 25-30 min.

Salting is carried out in dry conditions or in brine solution after the draining off of the curd of about 24 hours. Ripening finishes at a minimum of 90 days for the cheese used as table cheese type while the grated cheese must ripen for a minimum of six months.

Website

<http://www.monteveronese.it/>

MOZZARELLA DI BUFALA CAMPANA

Characteristics (PDO June 12, 1996, modified on February 4, 2008)

Mozzarella di Bufala Campana is a steamed cheese exclusively produced with buffalo's milk and marketed inside its preserving liquid or "accompanying" liquid. Mozzarella di Bufala Campana must have a characteristic and delicate taste with fat (on dry matter) of a minimum of 52% and maximum moisture content of 65%.

Production Area

The geographical area of production is the whole territory of the provinces of Caserta and Salerno and some municipalities in the provinces of Napoli, Benevento, Frosinone, Latina, Roma, Isernia and Foggia (only some of the area for each municipality).

Cheesemaking

Mozzarella di Bufala Campana is a cheese made from the milk of the Mediterranean Buffalo breed signed on a specific registry. In the past, pasta filata cheeses were obtained from raw milk. Nowadays, to avoid sanitary problems linked to the animal, for example the possible presence of *Brucella* spp., the sanitary regulations require the pasteurization of the milk before its transformation.

Procedural guidelines have been modified to permit the production of Mozzarella di Bufala Campana either with raw milk or thermally treated milk or pasteurized milk (GU n.258 of 6th November 2003).

Milk used must have a fat and protein content not less than 7.2% and 4.2%, respectively. It is exclusively supplied by the production obtained from one or two milkings, and sent for transformation within sixteen hours from the first milking. The milk is coagulated after the addition of natural whey starters because the regulation does not allow the use of commercial starters.

Milk is coagulated at the temperature range of about 33-39°C by using calf rennet (about 30% of pepsin) for 20-30 minutes and left to stand for about five hours. Curd obtained is then cut in slices therefore being grinded and heated by addition of hot water at 95°C. Curd is then carried out to 'filatura' therefore 'mozzata' or shaped into a particular size and form. After the shaping, the Mozzarella is rapidly cooled at the temperature of about 28-25°C and kept in its acidulous, eventually salted, preserving liquid. Mozzarella di Bufala Campana PDO may be smoked using only natural and traditional processes and in this case the designation of origin must be followed by the term "smoked".



<http://www.taccuinistorici.it>

Figure 18. Mozzarella di Bufala Campana.

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Website

<http://www.mozzarelladop.it/>

MURAZZANO

Characteristics (PDO June 12, 1996)

Murazzano is a fresh cheese produced exclusively with milk from ewes of Langhe's breed (or a minimum of 60%) or eventually adding cows' milk but no more than 40%. Animals must be fed with fresh and/or stored pasture coming from the production area. Murazzano PDO cheese has a cylindrical shape with flat sides and diameter of 10-15 cm, heel height of 3-4 cm and a weight of 300-400 g. The ripening time is long, from 4 to 10 days. The cheese has no rind but matured cheese has a yellowish film. The paste is white or ivory-white with few small holes. The texture is soft. The odor is fine and delicate. The taste is mainly sweet and fine but becomes more savory and intense in aged products. Murazzano PDO cheese has a minimum fat content (on dry matter) of 44% but if it is produced with 100% of

ewe's milk (minimum fat content on dry matter of 47%) the label may say "pure ewe". The cheese must have cylindrical shape.

Production Area

The geographical area of production includes all the municipalities in the 'Comunità Montana Alta Langa' in the province of Cuneo and also some municipalities in the province of Cuneo.

Cheesemaking

Murazzano is produced with raw or pasteurized milk. The milk from two daily milkings is coagulated by the addition of bovine liquid rennet at a temperature of 37°C (with a tolerance of +/- 3°C) for 30 minutes. Commercial starter cultures containing thermophilic and mesophilic lactic bacteria may be used. Generally, no starter cultures are used but producers may use a selected starter to characterize their production. The curd is cut twice: the first produces grain of large size, like an orange, while the second produces granules with the size of a hazelnut. The curd is collected and drained in molds during the first 24 hours. The cheese is dry-salted. Ripening may be 4-10 days long or may otherwise reach the maximum of 2 months.

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<http://www.cooperativalapoiana.it>

Figure 19. Murazzano.

Website

<http://formaggiomurazzanodop.com/consorzio-tutela.php>

NOSTRANO DI VALTROMPIA**Characteristics (PDO July 6, 2012)**

Nostrano di Valtrompia is a hard cheese made from partially skimmed raw cow's milk from cows of the Bruna Alpine breed, with the addition of saffron in a quantity between 0.05 and 0.2 g/100 kg of milk. The cheese has a cylindrical shape with flat sides, diameter of 35-45 cm, heel height of 10-15 cm and a weight of 8-18 Kg. The cheese rind ranges in color from yellow-brown to a reddish color. The paste is firm, straw yellow sometimes deep, with small holes equally distributed. Taste is intense, sometimes spicy. The fat content of the cheese ranges from 18 to 28% while the fat content in the dry matter ranges from 27.5 to 42%. Moisture of the cheese is 36%.

Production Area

The geographical area of production is the province of Brescia located in Trompia Valley.

Cheesemaking

The milk from two daily milkings, sometimes four during the periods of low lactation, is coagulated by the addition of bovine liquid rennet (chymosin minimum at 70%) at a range of temperature from 35°C to 40°C for 60 min. No starter or culture additions are used but commercial starter cultures containing thermophilic lactic bacteria may be employed. The curd is cut in a range time of 10-30 min and produces granules with the size of a rice grain. The curd is collected and saffron is added. Hence, the curd is cooked at a temperature of 47-52°C and it is left to stand in the whey for 15-60 min and then carried out for draining off for the first 24 hours. After 24 hours, not subjected to the pressing process, it is turned for 4-5 times at room temperature. Brining is carried out in dry conditions for 5-20 days depending by the cheese size, room temperature, and ability of the cheese to absorb the salt, moisture and pH of the cheese. Ripening finishes for a minimum of 8 months to 24 months at a temperature of 5-18°C and humidity of 60-90%. During the ripening, the cheese rind is frequently oiled to prevent the presence of acarus and mold contamination with the possible result of pitting of the rind.



<http://www.bresciaoggi.it>

Figure 20. Nostrano di Valtrompia.

Website

<http://www.ruralpini.it/Info regioni09.09.11-Nostrano-Valtrompia.htm>

PARMIGIANO REGGIANO

Characteristics (PDO June 12, 1996 modified on September 5, 2003 and August 8, 2011)

Parmigiano Reggiano is a hard semi-fat cheese made from raw cow's milk partially skimmed by natural surface skimming. Cow's milk, exclusively derived from animals fed with forages originated from the area of origin, must be used as raw milk and it is not subjected to any thermal treatments. The use of additives is forbidden.

Cheese has a cylindrical shape with flat sides and the heel is more or less slightly convex with flat sides. The diameter is 35-45 cm, heel height is 20-26 cm and it has a minimum weight of 30 Kg. The color of the rind is natural straw yellow with a thickness of about 6 mm. The paste has a structure with grained and flaky texture. The cheese has a fragrant aroma and delicate taste, flavorsome without being too pungent. Fat in the dry matter must not be less than 32%.

Production Area

The geographical area of production is the whole territory of the provinces of Parma, Reggio Emilia, Modena, Bologna (on the left side of Po river), and Mantova (on the right side of Po River).

Cheesemaking

The milk from two daily milkings, evening and morning, is delivered to the cheese dairy within two hours from each milking. Each milking must be conducted within four daily hours and the milk must be immediately refrigerated and stored at a temperature not less than 18°C.

The milk is partially skimmed by natural surface skimming in steel tanks in open ambient. Milk from the morning milking, immediately after its delivery to the cheese dairy, is added with the partially skim milk of the previous evening milking. It is possible to stock a portion of milk, no more than 15%, for the cheese making of the day after. In this case the milk must be collected in appropriate refrigerated tanks equipped with suitable agitators at a temperature not less than 10°C and collected inside the tanks of natural surface skimming the same evening. Starter inoculum for the milk is constituted by natural starter whey obtained from the spontaneous acidification of the whey left from the cheese making of the day before. Coagulation of the milk is carried out in a copper truncated cone vat and it is obtained using calf rennet. Once the milk is coagulated, the curd is broken and cooked at 55-56°C, left to settle at the bottom of the vat to obtain a compact mass.

Afterwards, the curd is transferred in specific molds for shaping and after some days it is immersed into the salt solution for brining.

Ripening is carried out for at least 12 months and during the summer period the temperature of the ripening room must not be less than 16°C.



<http://www.idealcheese.com>

Figure 21. Parmigiano Reggiano.

REFERENCES

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Website

<http://www.parmigiano-reggiano.it/>

PECORINO DI FILIANO

Characteristics (PDO December 14, 2007)

Pecorino di Filiano is a hard cheese made with whole milk exclusively obtained by sheep of Gentile di Puglia and Lucania, Leccese, Comisana, Sarda and their crossbreed coming from an area indicated by procedural guidelines. Milk used for the cheese making comes from one or two milkings (generally evening milkings and that of the morning after).

The cheese has a cylindrical shape with flat sides, a flat or slightly convex heel, a diameter from 15 to 30 cm and heel height from 8 to 18 cm.

The rind has a typical color left by the cane cheese-sieves called '*fuscella*'. In the most ripened cheeses, the color ranges from yellow golden to dark brown due to the treatment with extra virgin oil and vinegar produced in Basilicata. Cheeses are manually rubbed on the side.

Cheese texture is compact presenting very small holes not equally distributed and a color ranging from white to straw yellow in the aged cheese.

Flavor is initially sweet and mild and it becomes lightly spicy in taste during the maturation.

Fat in dry matter must not be less than 30%.

Production Area

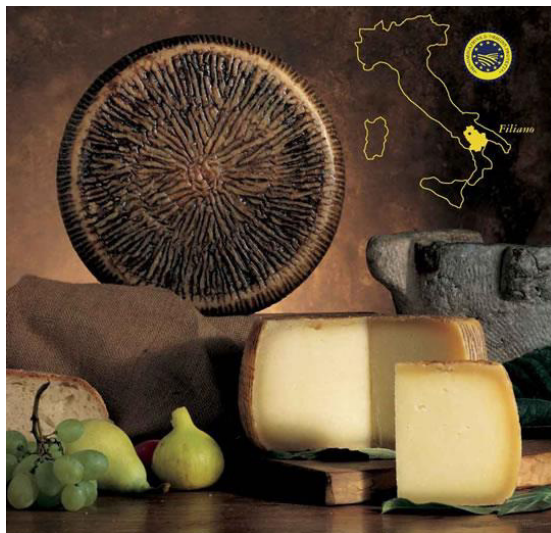
The geographical area of production is the whole territory of the province of Potenza.

Cheesemaking

Pecorino di Filiano is made from milk derived by one or two milkings (evening and morning milkings) within 24 hours. Raw milk opportunely filtered, using sieves, is heated up to the maximum temperature of 40°C with added kid or lamb rennet derived from animals artisanally bred in that production area.

Once the milk is coagulated, the curd is broken by using a wooden spoon called '*scuopolo*' or '*ruotolo*' to obtain the clot with dimension as grain of rice. After the rest of the curd under the whey for few minutes, it is put inside the molds to obtain the typical shape of the cane cheese-sieves *fuscella*. Hence, the curd is pressed by the hands for the draining of the whey and heated at 90°C for a maximum of 15 minutes. Salting is carried out either dry or brined and repeated many times every day depending by the shape of the cheeses or in a saturated brine solution where the cheese is directly immersed and left for 10-12 hours per kg of cheese. Ripening takes place in natural tufa caves or in specific maturing rooms at the temperature of 12-14°C and a relative humidity of 70-85% for at least 180 days. Starting from

the day 20 of ripening, the rind of the cheese may be treated with extra virgin oil produced in Basilicata and vinegar. Pecorino di Filiano cheese is produced all year round.



<http://www.basilicatanet.com>

Figure 22. Pecorino di Filiano.

Website

www.pecorinodifiliano.it

PECORINO ROMANO

Characteristics (PDO June 12, 1996 modified on October 29, 2009)

Pecorino Romano is a hard, cooked cheese produced exclusively from fresh full-fat sheep's milk obtained from sheep bred in the area indicated in the procedural guideline. Cheese has a cylindrical shape with flat side, diameter between 25 to 35 cm and heel high from 25 and 40-cm. Cheese weight ranges from 20 to 35 Kg according to the size of the cheese wheel. The rind is thin, ivory color or natural straw yellow. Cheese texture is compact or presenting little holes; color ranges from white to straw yellow more or less intense. Flavor is aromatic and lightly spicy for the table cheese; or very spicy, intense and pleasant taste. Fat in dry matter must not be less than 36%.

Production Area

The geographical area of production is the whole territory of Sardegna and Lazio region and the whole territory of the province of Grosseto.

Cheesemaking

Pecorino Romano is a hard cheese made with whole milk exclusively obtained by sheep of the Sarda breed coming from area indicated by procedural guidelines. Milk used for the cheesemaking comes from one or two daily milkings.

Milk may be heat-treated and eventually inoculated with autochthonous lactic cultures sometimes integrated with cultures, which come from the area of production. Milk is heated at 38–40°C with added lamb paste rennet coming from the animals bred in that specific area. Cooking of the curd must take place at variable temperatures from 45 to 48°C. Salting is carried out in dry condition or in brine solution and it may be as long as 120 days. Ripening is long, at least five months, for the table cheese, or eight months for the grated cheese. Cheese may be enveloped with neutral or colored plastic bags. Cheese is produced during the period from October to July.



<http://www.cheesemaking.com/Romano.html>

Figure 23. Pecorino Romano.

REFERENCES

Mangia, NP; Murgia, MA; Garau, G; Deiana, P. Microbiological and physiochemical properties of Pecorino Romano cheese produced using a selected starter culture. *Journal of Agricultural Science and Technology*, 2011 13 (4), 585-600

Website

<http://www.pecorinoromano.com/>

PECORINO SARDO

Characteristics (PDO July 1, 1996 modified on May 1, 2011)

Pecorino Sardo is a cooked cheese made exclusively from whole sheep's milk, eventually heat-treated or pasteurized, separated into two different categories:

- 'sweet' of short maturation (20-60 days) and
- 'mature' ripened not less than 2 months. Cheese has a cylindrical shape with flat sides and flat or slightly convex heel.

Pecorino Sardo "sweet" type has a cylindrical shape with flat sides, diameter between 15 to 18 cm and heel height from 8 and 10 cm. Cheese weight ranges from 1 to 2.3 kg. Rind is smooth, thin, white in color or lightly straw yellow. Cheese texture is compact, soft and elastic, firm or presenting little holes. Flavor is sweet and aromatic or lightly acid. Fat in dry matter must not be less than 40%.

Possible variations of the cheese sizes and weight may depend both by the technical conditions of production and by the ripening period.

Pecorino Sardo "mature" type has a cylindrical shape with flat sides, diameter between 15 to 22 cm and heel height from 10 and 13 cm. Cheese weight ranges from 1.7 to 4.0 kg. The rind is smooth, thin, lightly straw yellow in color in its early shape; while hard and fine grained in the more ripened cheese tending to straw yellow during the ripening, firm or with eyes irregularly distributed.

Flavor is lightly spicy. Fat in dry matter must not be less than 35%.

Production Area

The geographical area of production is the whole territory of the Sardegna region.

Cheesemaking

Whole sheep's milk inoculated with lactic starter cultures coming from the origin area and indicated as "*Streptococcus thermophilus*" is coagulated at a temperature between 35-39°C with calf rennet at a quantity to ensure the complete coagulation after 35-40 minutes.

Once the milk is coagulated, the curd is broken up to reach the dimension of hazelnuts for the "sweet" type, while the dimension of a corn grain is for the "mature" type. Curd is then semi-cooked at a temperature not higher than 43°C. Cheese is subjected to steaming and pressing at temperature conditions to guarantee the optimal acidification and draining of the cheese.

Once the draining is completed, brining of the cheese is made in a wet or dry condition for a short time using salt at a concentration of no more than 2% of the cheese.

Ripening is carried out in an appropriate room at a temperature between 6 to 12°C and humidity between 80-95%.



<http://www.italos.it>

Figure 24. Pecorino Sardo.

REFERENCES

Mandrau, MA; Mangia, NP; Murgia, MA; Sanna, MG; Garau, G; Leccis, L; Caredda, M; Deiana, P. Employment of autochthonous microflora in Pecorino Sardo cheese manufacturing and evolution of physiochemical parameters during ripening International Dairy Journal, 2006, 16 (8), 876-885.

Website

<http://www.pecorinosardo.it/>

PECORINO SICILIANO

Characteristics (PDO June 12, 1996)

Pecorino Siciliano is a hard cheese exclusively made from fresh whole raw sheep's milk without the addition of any starter cultures and coagulated using lamb rennet.

Cheese has a cylindrical shape with a flat side, diameter between 14 to 38 cm and heel height from 10 and 18 cm. Cheese weight ranges from 4 to 12 kg. The rind is smooth, thin, white color or lightly straw yellow. The cheese texture is compact, soft and elastic, firm or presenting little holes. Flavor is sweet and aromatic or lightly spicy. Fat in dry matter must not be less than 40%.

Production Area

The geographical area of production is the whole region of Sicilia.

Cheesemaking

Raw whole sheep's milk is coagulated by using rennet at a temperature between 37-40°C for about 40 minutes.

Once the milk is coagulated, the curd is broken up to reach the dimension of a grain of rice. Cheese is subjected to steaming, using hot water at a temperature of 40-45°C and the curd is left to rest for 10-20 minutes. The curd is then transferred in the cane cheese-sieves called "fascedde", which confer to the cheese the typical shape, and lightly pressed to guarantee the optimal draining of the whey. Once the whey is recovered, a part of it is employed for making the Ricotta cheese while other part is heated at 85°C, used for the heating of the curd (blanching). Heating of the curd goes on for 2-4 hours until the temperature drops to 45-50°C. Cheese is then placed on a table for 24-48 hours turning it upside down many times.

Salting of the cheese is carried out in dry conditions and the ripening takes place in an appropriate room with good ventilation for a minimum of 4 months (for the semi-matured cheese) or up to 12 months.



<http://www.consorziopecorinosiciliano.it>

Figure 25: Pecorino Siciliano.

REFERENCES

Vernile, A; Baresford, TP; Spano, G; Massa, S; Fox, PF. Chemical studies of Pecorino Siciliano cheese throughout ripening. *Milchwissenschaft*, 2007, 62 (3), 280-284.

Website

<http://www.consorziopecorinosiciliano.it/>

PECORINO TOSCANO

Characteristics (PDO July 1, 1996 modified on April 14, 2010)

The name Pecorino is a generic term to indicate a cheese produced only from sheep's milk. Pecorino Toscano is a cheese produced in two typologies: soft cheese (fresh) and semi-hard (ripe) cheese, only from whole sheep's milk from the production area.

It has a cylindrical shape with slightly convex outer sides; dimensions: diameter of the faces from 15 to 22 cm, height of the heel from 7 to 11 cm, weight: from 0.75 a 3.50 kg.

Production Area

The geographical area of production is the whole territory of the Toscana region and some municipalities in the Umbria and Lazio regions, and can be produced all year.

Cheesemaking

Whole raw or pasteurized ewe milk, that can be inoculated with cultures of autochthonous or selected starter, must be coagulated at a temperature ranging between 33 and 38 °C with the addition of calf rennet in order to obtain the curd within 20-25 minutes. The cheesemaking and processing between the two cheese typologies of Pecorino Toscano differ, in particular, in the breaking mode of the curd. The curd for the preparation of the soft cheese (fresh typology) is broken into grains of a hazelnut size, while to produce hard and ripened cheese the curd is broken more finely until it is the size of grain to immediately dry off the whey. In this last cheesemaking, it is possible to semi-cook the curd until it reaches 40-42 °C for 10-15 min. After breaking and possibly cooking, the curd is put into suitable forms to drain the whey. The syneresis is carried out by manual pressing or stewing in steel containers heated by an injection of steam until 50 °C. Duration of this stewing is variable and longer (up to 10 hours) for hard cheeses. The obtained product is commonly dry salted for an average of 32 hours or in a brine solution at 12-15 °C for 10-36 hours.



<http://www.pecorinotoscanodop.it/>

Figure 26. Pecorino Toscano.

Ripening of soft cheese typology is at least 20 days at low temperatures ($> 5^{\circ}\text{C}$) while semi-hard cheese should be left for at least four months of ripening at $<12^{\circ}\text{C}$, both with a humidity between 75-90%. This last type is frequently used for grating.

According to the Disciplinary of Production, Pecorino Toscano cheese must have at least a fat content (on dry matter) of 45% for soft cheese and 40% for semi-hard cheese.

REFERENCES

- Buccioni, A.; Minieri, S.; Conte, G.; Benvenuti, D.; Pezzati, A.; Antongiovanni, M.; Rapaccini, S.; Mele, M. Changes in conjugated linoleic acid and C18:1 isomers profile during the ripening of Pecorino Toscano cheese produced with raw milk. *Italian Journal of Animal Science*, 2012, 11 (4), 426-430.
- Buccioni, A.; Rapaccini, S.; Antongiovanni, M.; Minieri, S.; Conte, G.; Mele, M. Conjugated linoleic acid and C18:1 isomers content in milk fat of sheep and their transfer to Pecorino Toscano cheese. *International Dairy Journal*, 2010, 20 (3), 190-194.
- Buccioni, A.; Rapaccini, S.; Minieri, S.; Antongiovanni, M. Quality of lipid fraction in Tuscan sheep cheese (Pecorino Toscano PDO). *Italian Journal of Animal Science*, 2007, 6 (1), 539-541.

Website

<http://www.pecorinotoscanodop.it/>

PIACENTINU ENNESE

Characteristics (PDO February 15, 2011)

Piacentinu Ennese is a particular semi-cooked, hard, pressed cheese produced from whole raw ewe's milk. It has a natural acidity of fermentation at pH 6.5-6.8 of autochthonous Sicilian breed of sheeps (Comisana, Pinzirita, Valle del Belice) characterized by the addition of saffron (*Crocus sativus*) produced only in the same area and whole black peppercorns (*Piper nigrum*). It has a cylindrical shape, with slightly convex or almost straight outer sides.

Dimensions, obtainable by the use of a rattan basket, are: outer sides minimum 14 cm up to 15 cm, with a diameter of the pot minimum 20 cm, maximum 21 cm. Weight is between 3.5 and 4.5 kg.

The cheese smell is delicate with a slight aroma of saffron, salt is barely perceptible, and is slightly spicy in the first phases of ripening, which could increase.

Production Area

The geographical area of production is the whole territory of the province of Enna.

Cheesemaking

In the discipline of production of this particular cheese, much attention is focused on the animal feed. In fact, whole raw ewe's milk is used in the cheesemaking and produced from ewes bred at natural pastures, located at an altitude between 400 and 800 m above sea level, and/or fodder, hay and straw obtained in the production area. Wheat stubble and vegetative byproducts from, for example, cladodes of prickly pear, non-OGM cereal grains and concentrates are also allowed as animal feed.

Whole raw ewe milk must come from two manufacturing area milkings within 24 hours. After heating the milk to a maximum temperature of 38 °C, it is filtered, saffron (maximum 5 g/100 l of milk) is added and solubilized and then coagulated, after the addition of lamb or kidskin rennet, into a wooden vat within 45 minutes. The curd is cut into particles the size of rice grains, then summarily separated from the serum and collected in rush baskets ("fascedde"), which leaves a particular modeling on the surface of the rind. During this phase, whole black peppercorns are added into the curd. At each pepper addition, the curd is strongly pressed, and burned for 3-4 hours. Then the curd is set on a wooden board to dry at room temperature. The curd is then dry salted with coarse salt, repeating the operation twice in ten days. The minimum time for Piacentino Ennese ripening is 60 days in ventilated rooms, or locally, at a temperature of 8-10 °C and humidity between 70-80%.

From a point of view of the chemical characteristics of Piacentinu Ennese PDO cheese, the discipline describes that the fresh forages from area of production, eaten by the sheep, have characteristic terpenic fingerprints, which can be found in the milk and cheeses produced during the summer pasture. These terpenoidic molecules, such as the α -terpineol, are thus considered chemical biomarkers, found in the cheese.

According to the Disciplinary of Production, Piacentino Ennese PDO must have at least a fat content (on dry matter) of 40%, protein content (dry matter) of 35%, salt content (dry matter) of 5%, and a pH between a 4.8-5.7.



<http://www.blogsicilia.eu/>

Figura 27. Piacentinu Ennese.

REFERENCES

- Fallico, V; Tuminello, L; Pediliggieri, C; Horne, J; Carpino, S; Licitra, G. Proteolysis and microstructure of Piacentinu Ennese cheese made using different farm technologies. *Journal of Dairy Science*, 2006, 89 (1), 37-48.
- Horne, J; Carpino, S; Tuminello, L; Rapisarda, T; Corallo, L; Licitra, G. Differences in volatiles, and chemical, microbial and sensory characteristics between artisanal and industrial Piacentinu Ennese cheeses. *International Dairy Journal*, 2005, 15 (6-9), 605-617.

PIAVE

Characteristics (PDO May 21, 2010)

Piave is a cooked, hard and ripened cheese. It is produced using 80% of Italian Bruna, Pezzata Rossa and Frisona cow's milk, and comes from the mountains of the production area. Cheese is made inoculating autochthonous starters and it is produced in dairies located within the same territory. Piave is made from milk of cows fed with a minimum of 70% of local forages and industry feed, vegetables, fruit and urea. Biuret as feed must be excluded.

Piave cheese is produced in five different aged typologies:

- 1) Fresh with a ripening between 20 and 60 days; diameter of 320 mm \pm 20 mm; heel height of 80 mm \pm 20 mm; weight of 6.8 kg \pm 1 kg.
- 2) Medium ('*Mezzano*'): ripening between 60 and 180 days; diameter of 310 mm \pm 20 mm; heel height of 80 mm \pm 20 mm; weight of 6.6 kg \pm 1 kg.
- 3) Old with a ripening aged more than six months; diameter of 290 mm \pm 20 mm; heel height of 80 mm \pm 20 mm; weight of 6.0 kg \pm 1 kg.
- 4) Old gold selection with a ripening aged more than 12 months; diameter of 280 mm \pm 20 mm; heel height of 75 mm \pm 20 mm; weight of 5.8 kg \pm 1 kg.
- 5) Old reserve with a ripening aged more than 18 months; diameter of 275 mm \pm 20 mm; heel height of 70 mm \pm 20 mm; weight of 5.5 kg \pm 1 kg.

Piave presents these sensorial characteristics:

- Flavor: sweet for Fresh and Medium typology cheese that, with the ripening, becomes more intense until it is slightly spicy in aged typologies.
- Rind: clear and tender in the Fresh typology, during the ripening it becomes darker and thicker tending towards an ocher color.
- Paste: blank in Fresh typology without holes while, in aged cheese, the paste is more granular and crumbly with a slight yellowish color.

Production Area

The geographical area of production is the whole territory of the province of Belluno.

Cheesemaking

Whole raw cow's milk, coming from two or four milkings within 72 hours, is titrated by centrifugation to have a final fat content of $3.5 \pm 0.3\%$ w/w. Milk is then pasteurized at $72\text{ }^{\circ}\text{C}$ for 16 seconds, lysozyme and starter are added to reach a final acidity of $10^{\circ}\text{SH}/50 \pm 3$. Afterwards milk is inoculated with whey starter (acidity of $27^{\circ}\text{SH}/50 \pm 3$), heated at $34\text{--}36\text{ }^{\circ}\text{C}$ and coagulated after the addition of rennet (at least 50% chymosin). The curd is cut into particles the size of rice grains, cooked at $44\text{--}47\text{ }^{\circ}\text{C}$ and subjected to agitation for 1.5-2 hours. The curd is pressed inside the mold, marked with the name 'Piave' and then salted in a brine solution at for at least 48 hours. Ripening of the cheese is carried out locally with a temperature of $8\text{--}14\text{ }^{\circ}\text{C}$ and a humidity of 70-90%.

The disciplinary code of Piave ensures the traceability of the product by means of a control plan on breeders, cheese-makers and packers, and compliance monitoring is carried out by a Control Organization.



<http://www.agraria.org>

Figure 28. Piave.

Website

<http://www.formaggiopiave.it/>

PROVOLONE DEL MONACO

Characteristics (PDO February 9, 2010)

Provolone del Monaco is a semi-hard 'pasta *filata*' (stretched-curd) seasoned cheese, produced only with raw cow's milk from autochthonous cows fed in the production area of the Napoli province. Disciplinary pays particular attention to the production of the raw materials such as milk, as well as to the welfare of the animals. Animal feed can be represented by at least 40% (on dry matter) of forages and/or brushwood produced, for example, by pruning of citrus and olive trees. A list of not permitted animal feed is indicated, such as genetically modified crops or animal origin feed.

The cheese has a slightly elongated shape, a weight between 2.5 and 8 kg, a thin rind of slightly yellowish color with slight longitudinal bays, like raffia strings, which divides the cheese into at least in six sections and are used as support for a pair of cheeses. The interior paste is cream-colored, elastic and compact, with typical holes of diameters up to 5 mm. It has a sweet and buttery flavor and a light and pleasant spicy taste that will become spicier after seven-eight months of ripening.

Production Area

The geographical areas of production are some municipalities in the province of Napoli.

Cheesemaking

Whole raw cow's milk, coming from one milking, after heating at a temperature of 34-42 °C, is coagulated with the addition of kid or calf rennet. The curd is cut into particles the size of maize' grains, and then allowed to stand for 20 minutes. The curd is then heated at a temperature between 48-52 °C and left to stand for 30 minutes allowing the whey to be extracted. After spinning trials of the curd to have a positive elasticity and resistance, the curd is cut into ribbons in hot water (85-95 °C) and then refrigerated in cold water for firming. The product is then salted in brine at for 8-12 hours/kg of product.

Provolone del Monaco has to be ripened for the first 20 days at room temperature for lactic-proteolytic maturation and then at 8-15 °C for at least for six months.

According to the disciplinary code, traceability is guaranteed documenting incoming and outgoing products.

Cheese needs to have a fat content (dry matter) of at least 40.5%.

REFERENCES

Romano, R; Borriello, I; Magaldi, C; Giordano, A; Musso, S S. Ripening grade influence on fatty acids, ω -3 and CLA of Provolone del Monaco cheese. Progress in Nutrition, 2008, 10 (3), 165-173.



http://www.agricoltura.regione.campania.it/tipici/provolone_monaco-new.html

Figure 29. Provolone del Monaco.

PROVOLONE VALPADANA

Characteristics (PDO June 12, 1999 modified on November 7, 2012)

Provolone Valpadana is a semi-hard cooked ‘*pasta filata*’ cheese produced exclusively by whole cow’s milk coming from the production area. Cheese can be distinguished in two typologies, one sweet and one spicy, if they are made using pasteurized or thermized milk respectively.

Spicy cheese, after eight months of ripening, can be marked as P.V.S. (Provolone Valpadana Stagionato i. e. Provolone Valpadana Ripenend) exclusively after a technical verification about the external appearance of the form, the texture of the paste, the color, the flavor and the taste.

Provolone Valpadana is made from milk of cows fed with at least 70% of local forages, which are guaranteed according to the disciplinary code, with incoming and outgoing documents.

Different shapes are produced such as salami, melon or pear forms with a smooth and thin rind that can be absent for the sweet typology. The paste is generally compact, but not dry, and may have sparse holes. Flavor is delicate up to to three months of maturation, then it becomes spicier with more advanced ripening.

Production Area

The geographical area of production is the whole territory of the provinces of Cremona, Brescia, Verona, Vicenza, Padova, Rovigo, Piacenza and some municipalities in the provinces of Bergamo, Mantova, Lodi and Trento.

Cheesemaking

In cheesemaking rules, the disciplinary code describes only the requirement for using natural whey starters, obtained by incubation of the residual whey of the previous cheesemaking until an acidification of a maximum of 26°SH/50 mL. This choice in the disciplinary code could result in a reduction of the microbial diversity of natural whey starter but at the same time, the advantage of less variability of the lactic fermentation. Whole raw cow's milk, coming from one milking, after heating to a temperature of 36-39°C, is coagulated with the addition of calf rennet for sweet cheese typology, and lamb and/or kid rennet for the spicy typology without lipases addition.

The practice of cooking is not described in the disciplinary code, however the spinning of the paste ('filatura della pasta') is reported. It must be carried out manually, after the natural lactic fermentation, on a clot of the curd with spinning pH of between 4.70 and 5.20. Cheese is then allowed to stand in cold water, and the forms of cheese are salted in a brine solution for a period from a few hours to 30 days, depending on the weight of the forms. Before the ripening, performed in suitable local areas suspended from a support, forms are subjected to the drying. During the maturation, the cheese could be coated with additives such as E202 (potassium sorbate), E203 (calcium sorbate), E235 (pyramicin) or paraffin.

The period of ripening depends on the weight of the forms:

- up to 6 kg, a minimum ripening of ten days
- over 6 kg, minimum ripening of 30 days
- over 15 kg and for spicy typology, a minimum ripening of 90 days
- over 30 kg and spicy typology, ripening over 8 months.

The cheese can be smoked.

Cheese needs to have a fat content (dry matter) between 44-54% and a water content over 46% in sweet and spicy typology up to 6 kg, and a water content over 43% in spicy typology over 6 kg of weight.



<http://www.consorziotutelaprovone.it/>

Figure 30. Provolone Valpadana.

Website

<http://www.consorziotutelaprovolone.it/>

QUARTIROLO LOMBARDO

Characteristics (PDO 12 June 1996)

Quartirolo Lombardo is a soft table cheese produced by whole or semi-skimmed cow's milk, coming from two milkings obtained from production area.

Quartirolo Lombardo cheese has a quadrangular parallelepiped shape with flat sides, 4-8 cm high, 18-22 in diameter and weight 1.5-3.5 kg. The rind is thin and soft, pinkish white in cheeses during the initial stage of ripening, becoming reddish gray-green in the mature product. The texture of the paste is crumbly and becomes more compact and soft during the maturation of white color. The taste is slightly sour in fresh cheese and more aromatic in ripened cheese.

Production Area

The geographical area of production is the whole territory of the provinces of Brescia, Bergamo, Como, Cremona, Milano, Pavia and Varese.



www.quartirololombardo.com/

Figure 31. Quartirolo Lombardo.

Cheesemaking

Coagulation is performed by adding calf rennet during the heating at 35-40°C within 25 minutes with the possibility of adding natural starter cultures. The curd is cut twice to reach a

grain size of a hazelnut and then mixed with the whey in special forms. After the stewing at 26-28°C for a minimum of four hours to a maximum of 24 hours, the cheese is shaped. It is salted in dry conditions or in brine solutions in the local area at 10-14°C. The ripening is carried out locally at 2-8°C and humidity of 85-90% for a time between five to 30 days for soft cheese. After 30 days of aging, it is marked 'Quartirolo Lombardo maturo' (i.e. Quartirolo Lombardo ripened).

No treatments of the rind are allowed.

The disciplinary code allows a fat content (dry matter) at least 30% for the cheese produced by semi-skimmed milk.

Website

<http://www.quartirololombardo.com/>

RAGUSANO

Characteristics (PDO July 1, 1996)

Ragusano is a traditional pasta filata cheese, produced from cow's whole raw milk, fed with wild plants, herbs and hay, from the mountain plateau of the production area.

The cheese has a quadrangular parallelepiped shape, dimensions: sides of the square cross-section from 15 to 18 cm, length of the parallelepiped from 43 to 53 cm, weight from 10 to 16 kg. Cheeses have thin, smooth, yellow-brown rind and a compact and yellow body with small holes.

Milky, sweet and delicate notes characterize young cheese while the aged cheese presents a spicy, butyric and floral aroma.

Production Area

The geographical area of production is the whole territory of the province of Ragusa and some municipalities of Siracusa.

Cheesemaking

Milk, coming from one or more milkings, is coagulated with natural lamb or kid rennet paste likely to entail a time of setting and hardening from 60 to 80 minutes. Cut of the curd is made, following the addition of water at $80 \pm 5^\circ\text{C}$, to obtain a rice-grain size. Then the curd is drained by sedimentation and pressed to facilitate the purging of the whey, and a mass of solid curd is obtained. The curd is then reheated under the whey or water at 80°C for at least 85 minutes which allows the fusion. A drying stage is conducted leaving the paste for approximately 20 hours and then it is cut into slices, that are covered again with water about

80°C for 8 minutes. Paste then is stretched to obtain a spherical mass in shape with a smooth outer surface and then in order to assume a parallelepiped shape. The technology of this 'pasta filata' cheese differs drastically from other cheese varieties in using hot water (around 85°C) to stretch the curd. Typically, these forms are immersed in saturated salt brine in order to obtain a cheese with interior content (dry matter) of 6% sodium chloride. Then it is ripened in two blocks of cheese tied together with a rope and hung over the rafters to facilitate moisture loss in ventilated rooms at 14-16°C. A cover of olive oil is allowed for smoked aged cheeses, which are marked as smoked cheese.

A minimum period of ripening is not mentioned in the disciplinary code, even if two levels of minimum fat content (dry matter) are dependent on time ripening: at least 40% for table cheeses and a minimum of 38% for cheeses ripened over six months. The maximum humidity content is 40%, without differentiating the cheeses.



<http://en.wikipedia.org/wiki/>

Figure 32. Ragusano.

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RASCHERA

Characteristics (PDO 1 July 1996)

Raschera is a semi-hard, pressed, medium fat or fat cheese, produced from raw or pasteurized cow milk, sometimes supplemented with small additions of sheep and/or goat milk. Raschera is a cylindrical or quadrangular cheese with flat surfaces. The cylindrical shape has a diameter of 30-40 cm, a convex edge of 7-9 cm and a weight of 7-9 kg. The square shape has a side of 40 cm, an irregular edge of 12-15 cm and a weight of 8-10 kg. The rind is thin, elastic and regular, reddish-grey with yellow highlights and red patches. The paste is white or ivory-white with few small and sparse holes. The texture is consistent and elastic.

From a sensorial point of view, the odor must be fine, delicate, and typically fragrant in fresher cheeses and the taste is slightly spicy and savory when seasoned. The ripening lasts at least 30 days.

Production Area

The geographical areas of production are some municipalities in the Monregalese Valley (Italian Maritime Alps, NorthWest Italy) in the province of Cuneo. This cheese can be named “*d’Alpeggio*” when it is produced in summer in mountain pastures from the Italian Alps at an altitude of over 900 meters above sea level.

Cheesemaking

In the traditional Raschera PDO cheesemaking, raw cow milk, or partly skimmed milk, coming from two manufacturing area milkings, is warmed to 27–30°C and left resting for 20–30 min after the addition of liquid bovine rennet. Clotting time is established visually by the cheesemaker. When pasteurized milk is used, a commercial starter, generally made with thermophilic and mesophilic lactic bacteria, is used. The curd is cut into particles, then separated from the serum and collected in a hemp cloth, which is left for approximately 10 minutes of drainage. Finally, the curd is wrapped in the cloth is put into cylindrical or quadrangular forms and pressed to allow the remaining whey to drain away for at least 12 h. At the end, the product is ready to be dry salted for three days for sides and ripened in natural cells dug underground at 12–15°C for at least 30 days. Here the constant temperature and humidity create the optimal conditions for the 1–6 months of ripening and consequently for the formation of the reddish rind characteristic of this cheese.

According to the Disciplinary of Production, Raschera PDO cheese must have at least fat (dry matter) of 32%.



<http://www.raschera.com/>

Figura 33. Raschera.

Website

<http://www.raschera.com/>

ROBIOLA DI ROCCAVERANO

Characteristics (PDO July 1, 1996)

The Robiola di Roccaverano is a fresh cheese produced from ewe's or goat's milk or a mixture of ewe, goat and cow's milk. The quantity of cow's milk must be less than 85%. The Robiola di Roccaverano cheese is cylindrical with flat surfaces. The cylindrical shape has a diameter of 10–15 cm, an edge of 4–5 cm and a weight of 250–300 g. There is no rind and the paste is white or ivory-white without holes. The texture is soft and slightly consistent. The odor is fine, delicate, and rarely pungent. The taste is mainly acid and fine.

Production Area

The geographical areas of production are some municipalities in the provinces of Asti and Alessandria.

Cheesemaking

The Robiola di Roccaverano is produced with raw or pasteurized milk. The milk is curdled by the addition of bovine liquid rennet at a temperature of 30-35°C. A commercial starter is also used, generally made with mesophilic lactic bacteria. Generally each producer uses a different starter to characterize his production. The curd is cut to produce granules with the size of a hazelnut. The curd is collected and drained inside specific molds. The cheese is dry salted. Natural aromas such as truffle, hot pepper, herbs or rosemary may be added.

According to the Disciplinary of Production, Robiola di Roccaverano must have at least a 50% fat content (in dry matter), a protein content (in dry matter) of 34% and ash (in dry matter) of 3%.



(<http://www.robioladiroccaverano.com>)

Figure 34. Robiola di Roccaverano.

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Website

<http://www.roboladiroccaverano.com/>

<http://www.assopiemonte.com/>

SALVA CREMASCO

Characteristics (PDO December 20, 2011)

The Salva Cremasco is a quadrangular cheese with flat surfaces. The square shape has a side of 11-13 cm or 17-19 cm, an edge of 9-15 cm and a weight of 1.3-1.9 or 3-5 kg. The ripening is carried out for at least 75 days. The rind is soft and regular with typical surface bacteria and a yellow-brown color. The paste is white or pale-yellow, with small, irregular and sparse holes. The texture is consistent and springy, very weak above the rind. The taste is aromatic, intense and piquant in the more ripened cheese.

Production Area

The geographical area of production is the whole territory of the province of Bergamo, Brescia, Cremona, Lecco, Lodi, and Milan.



(<http://www.mondodelgusto.it>)

Figure 35. Salva Cremasco.

Cheesemaking

The Salva Cremasco is produced with whole raw or pasteurized cow's milk. The milk is curdled by the addition of bovine liquid rennet at a temperature of 32-40°C. Autochthonous starters could be used. Generally each producer uses a different starter to characterize his

production. After 10-20 min the curd is cut two times to produce granules the size of a hazelnut and then put in typical square molds. After a period at 21-29°C for 8-16 hours, the cheese is salted in dry condition or in brine solution. The ripening is performed at 2-8°C with 80-90% humidity. During the ripening, the rind is washed with brine to obtain a thin and colored rind and a strong proteolysis of the paste.

According to the Disciplinary of Production, Salva Cremasco must have at least 48% fat in dry matter and water content lower than 47%.

Website

<http://www.salvacremasco.com/>

SPRESSA DELLE GIUDICARIE

Characteristics (PDO December 22, 2003)

The Spressa delle Giudicarie is a cylindrical cheese with a diameter of 30-35 cm, an edge of 8-11 cm. and a weight of 7-10 kg. The ripening lasts at least 90 days for the “fresh” cheese and at least 180 days for the “ripened” cheese. The rind is soft and regular with a grey or yellow-brown color. The paste is white or pale-yellow, with small, irregular and sparse holes. The texture is consistent and springy with aromatic odor. The taste is sweet in the “fresh” cheese and salty and piquant in the “ripened” cheese. The Spressa delle Giudicarie can be produced between September 10 and July 30.

Production Area

The geographical areas are the municipalities in the Giudicarie, Chiese, Rendena and the Ledro Valley.

Cheesemaking

The Spressa delle Giudicarie is produced with partially skimmed cow's milk obtained with natural surfacing. The milk is curdled by the addition of bovine liquid rennet at a temperature of 33-37°C. Starters could be used. Generally each producer uses a different starter to characterize his production. After 20-50 min the curd is cut to produce granules with the size of rice and then cooked at 40-44°C for at least 20-30 min. The curd is mixed for a further 35-65 min then removed and put into cylindrical molds. The curd is then left to stand for 24 hours then salted in brine for 4-6 days or dry for 8-12 days. Ripening is performed at 10-20°C with 80-90% of humidity. According to the Disciplinary of Production, Spressa delle Giudicarie must have at least 33% fat content in dry matter and a water content ranging from 32 and 40% for the fresh cheese, and 28 and 38% for ripened cheese.



(<http://www.agraria.com>)

Figure 36. Spresella delle Giudicarie.

REFERENCES

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SQUAQUERONE DI ROMAGNA

Characteristics (PDO July 24, 2012)

The Squaquerone di Romagna is a spreadable cheese with a weight of 0.1-1 kg. The ripening is carried out for 1-4 days. There is no rind and the paste is white, without holes and a defined shape. The texture is soft, creamy, and spreadable. The odor is soft and milk flavored. The taste is sweet.

Production Area

The geographical area of production is the whole territory of the province of Ravenna, Forlì-Cesena, Rimini, Bologna and Ferrara (only the area between the SS24 and the Po River).

Cheesemaking

The Squaquerone di Romagna is produced with whole pasteurized cow's milk. The cheesemaking must be done within 48 hours from milking. The milk is curdled by the addition of bovine liquid rennet at a temperature of 35-40°C. Starters could be used. Generally each producer uses different starters to characterize his production. After 10-30 min the curd is cut to produce granules the size of a nut and left to stand to obtain a pH of 5.9-6.2. The curd is put into typical cylindrical molds and left to stand for 24 hours at 15°C. The

curd is then salted in brine for 10-40 min for each kilogram of cheese. Ripening is performed at 3-6°C for 1-4 days. According to the Disciplinary of Production, Squacquerone di Romagna must have a fat content in dry matter ranging from 46 and 55% and a water content ranging from 58 and 65%.



(<http://www.ravennaintorno.it>)

Figure 37. Squacquerone di Romagna.

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STELVIO O STILFSER

Characteristics (PDO February 15, 2007)

The Stelvio o Stilfser is a cylindrical cheese with a diameter of 36-38 cm, an edge of 8-10 cm and a weight of 8-10 kg. The ripening is carried out for at least 60 days. The rind is soft and regular with a yellow-orange color for fresh cheese or yellow-brown color for ripened cheese. The paste is pale-yellow with irregular and sparse holes. The texture is consistent and springy with an aromatic odor.

Production Area

The geographical area of production is the whole territory of the province of Bolzano.

Cheesemaking

The Stelvio is produced with whole pasteurised cow's milk. The cheesemaking must be done within 48 hours from milking. The milk is curdled by the addition of bovine liquid rennet at a temperature of 32-33°C. Starters and lysozyme could be used. Generally each producer uses a different starter to characterize his production. After 20-30 min the curd is cut to produce granules the size of maize, and then about 25% of the whey is removed and water at 50-70°C is added to obtain a final temperature of 36-40°C. The curd is mixed for some minutes then removed and put into cylindrical molds. The curd is then pressed from 30 min to 2 hours. After a period in a hot room, the cheese is salted in brine solution for 36-48 hours. Ripening is performed locally at 10-14°C and 85-95% of humidity. During the ripening the rind is washed with brine containing a mix of chromogenic bacteria to obtain a colored rind. According to the Disciplinary of Production, Stelvio o Stilfser must have a fat content in dry matter higher than 50% and a water content lower than 44%.



<http://www.turismo-trentino-alto-adige.com>

Figure 38. Stelvio o Stilfser.

Website

<http://www.stilfser.it>

TALEGGIO

Characteristics (PDO June 12, 1996)

The Taleggio is a quadrangular cheese with flat surfaces. The square shape has a side of 18-20 cm, an edge of 4-7 cm and a weight of 1.7-2.2 kg. The ripening is carried out for at least 40 days. The rind is thin and soft, and regular with a light yellow-red color. The paste is white or ivory-white with small and sparse holes. The texture is moderately consistent and elastic. The odor is soft with milk and cream characteristics. The taste is very soft and mainly sweet.

Production Area

The geographical area of production is the whole territory of the province of Bergamo, Brescia, Como, Cremona, Lecco, Lodi, Milano, Pavia, Novara, and Treviso.

Cheesemaking

The Taleggio is produced from whole pasteurized cow's milk. The milk is curdled by the addition of bovine liquid rennet at a temperature of 36-38°C. Starters are used. Generally each producer uses a different starter to characterize his production. After 15 min the curd is cut to produce granules the size of a hazelnut and put in typical square molds. After a period at 22-28°C for at least 10 hours, the cheese is salted in a dry condition or in a brine solution. During the ripening the rind is washed with brine to obtain a thin and colored rind and a strong proteolysis of the internal paste. According to the Disciplinary of Production, Taleggio must have a fat content (in dry matter) ranging from 48 and 53%, a protein content ranging from 36 and 44%, an ash content ranging from 3 and 4%, and a water content ranging from 45 and 50%.



(<http://www.italos.it>)

Figure 39. Taleggio.

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Website

<http://www.taleggio.org>

TOMA PIEMONTESE

Characteristics (PDO July 1, 1996)

The Toma Piemontese is a cylindrical cheese produced in two sizes: large (6-8 kg) with a diameter of 24-34 cm and small (1.8-5.9 kg) with a diameter of 15-25 cm. The ripening lasts at least 15 days for the small size and 60 days for the large size. There are two types of Toma Piemontese:

- Toma Piemontese: the rind is smooth, elastic and regular. The color ranges from light straw yellow to reddish brown depending on its ageing. The paste is white or ivory-white with small and sparse holes. The texture is moderately consistent and elastic. The odor is soft with milk and cream characteristics. The taste is also very soft and mainly sweet. It is produced in small and large size.
- Toma Piemontese semigrassa (semi-skimmed): the rind is smooth and regular but not elastic. The color is a wrinkled, hard, reddish-grey with yellow and white highlights depending on its ageing. The paste is yellowish with small and sparse holes. The texture is consistent and not elastic. The odor is strong and persistent. The taste is very savory and mainly salty in ripened products. It is produced only in large size.

Production Area

The geographical area of production is the whole territory of the province of Cuneo, Biella, Novara, Torino, Verbania and Vercelli and some municipalities in the provinces of Alessandria and Asti.

Cheesemaking

The Toma Piemontese is produced with whole raw or pasteurized cow's milk. The milk is curdled by the addition of bovine liquid rennet at a temperature of 32-35°C. A commercial starter generally made with thermophilic lactic bacteria is added to pasteurized milk. Generally each producer uses a different starter to characterize his production. The curd is cut twice to produce granules the size of maize. After draining, the curd is put in molds and pressed for at least 5-6 hours. The cheese is then salted in brine for about 36 hours. Dry salting is also used. The Toma Piemontese semigrassa (semi-skimmed) is produced with skimmed raw or pasteurized cow's milk. The cheesemaking is similar to that used for Toma Piemontese. According to the Disciplinary of Production, the chemical composition of Toma Piemontese is correlated to the size. For Toma Piemontese large size the water content is 43-51%, protein content (in dry matter) is 37-4% and fat content (in dry matter) is 44-54%. For Toma Piemontese small size the water content is 42-48%, protein content (in dry matter) is 40-46% and fat content (in dry matter) is 50-54%. For semi-skimmed type, the water content is 46-54%, protein content (in dry matter) is 50-60% and fat content (in dry matter) is 30-38%.



<http://www.langhe.net>

Figure 40. Toma Piemontese.

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Website

<http://www.assopiemonte.com/>

VALLE D'AOSTA FROMADZO

Characteristics (PDO July 1, 1996)

Valle d'Aosta Fromadzo is a cylindrical cheese with a diameter of 15-30 cm, an edge of 5-20 cm and a weight of 1-7 kg. The ripening lasts at least 60 days. The rind is soft and regular with a yellow-grey or yellow-brown-grey color. The paste is pale-yellow, with irregular, small and sparse holes. The texture is consistent and springy with aromatic odor. The taste is sweet if fresh and salty-piquant if ripened. In 2011 the production was about 6 tons.

Production Area

The geographical area of production is the whole territory of Valle d'Aosta region.

Cheesemaking

The Valle d'Aosta Fromadzo is produced with whole or partially skimmed raw cow's milk. The milk is curdled by the addition of bovine liquid rennet at a temperature of 34-36°C. Autochthonous starters could be used. The curd is cut, cooked to 45°C, mixed for some minutes then removed and put into cylindrical molds. The curd is pressed and salted in brine or in dry conditions. Ripening is performed at 8-14°C with a humidity higher than 60%. According to the Disciplinary of Production, valle d'Aosta Fromadzo must have a fat content (in dry matter) lower than 20% for skimmed cheese and ranging from 20 and 35% for whole cheese.



(<http://www.originalitaly.it>)

Figure 41. Valle D'Aosta Fromadzo.

Website

<http://www.fromadzo.com/>

VALTELLINA CASERA

Characteristics (PDO July 1, 1996)

The Valtellina Casera is a cylindrical cheese with a diameter of 30-45 cm, an edge of 8-10 cm and a weight of 7-12 kg. The ripening lasts at least 70 days. The rind is soft and regular with a yellow-pale color. The paste is pale-yellow, with irregular, small and sparse holes. The texture is consistent and springy with an aromatic odor. The taste is sweet and piquant for the long ripened cheeses. In 2011 the production was about 1,200 tons.

Production Area

The geographical area of production is the whole territory of the province of Sondrio.

Cheesemaking

The Valtellina Casera is produced with partially skimmed raw cow's milk. The milk is curdled by the addition of bovine liquid rennet, then the curd is cut to produce granules the size of maize and cooked between 40 and 45°C for about 30 min. The curd is put into cylindrical molds and pressed for 8-12 hours. The cheese is salted in brine or in dry conditions. Ripening is performed at 6-10°C with a humidity higher than 80%. According to the Disciplinary of Production, Valtellina Casera must have a fat content (on dry matter) higher than 34%.



(<http://www.valsana.it>)

Figure 42. Valtellina Casera.

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Website

<http://www.ctcb.it/>

VASTEDDA DELLA VALLE DEL BELICE

Characteristics (PDO October 28, 2010)

The Vastedda della Valle del Belice is a cheese with a typical round loaf shape with a diameter of 15-17 cm, high 3-4 cm and a weight of 0.5-0.7 kg. The ripening is carried out for 1-2 days. The rind is absent and the paste is white, smooth, and without holes. The texture is soft and soluble. The taste is sweet and sour.

Production Area

The geographical areas of production are some municipalities in the province of Agrigento, Trapani and Palermo.

Cheesemaking

The Vastedda della Valle del Belice is produced with whole raw ewe's milk. The ewe must be of Valle del Belice race. Cheesemaking must be done within 48 hours from milking. The milk is curdled in a copper boiler by the addition of lamb rennet at a temperature of 36-40°C. After 40-50 min the curd is cut to produce granules the size of rice and washed with hot water. The curd is then removed and put into typical rush molds. After 24-48 hours the curd is cut, put in a typical basin on wood and mixed with hot water (80-90°C). The curd is hand worked to obtain a sphere. This sphere is put in a pottery plate where the curd obtains the typical shape. After 6-12 hours the cheese is salted in brine from 30 min to 2 hours. According to the Disciplinary of Production, Vastedda della Valle del Belice must have a fat content (in dry matter) higher than 35%.



(<http://www.gentedelfud.it>)

Figure 43. Vastedda della Valle del Belice.

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