dairy

MDPI

Editorial

Innovation Meets Tradition in the Sheep and Goat Dairy Industry

Paola Scano * and Pierluigi Caboni

Department of Life and Environmental Science, University of Cagliari, 09124 Cagliari, Italy; caboni@unica.it
* Correspondence: scano@unica.it

Small ruminants, such as sheep and goats, are mostly raised in smallholder farming systems widely distributed throughout the world. For some geographical areas, they cover an important economic, environmental and sociological role. Sheep and goats present some advantages over other large ruminants: their grazing preferences enable them to feed on weeds and shrubs; for their small size they require less space and are less likely to damage and compact soils; they are easier to work with and are cheaper to buy and maintain. The range of products produced by small ruminants is easy to market because demand is high, yet largely unfulfilled [1]. The ability to respond to the increasing market demands, in terms of the type of products or quality standards required, is crucial for the survival of the existing farming systems. Not only farmers, but the whole traditional ovine and caprine dairy product chain should be encouraged to adapt to meet consumer needs. In the last few decades, consumer demands have challenged toward higher productivity, sustainability, and safety, protecting at the same time the product's uniqueness. Innovation (implementing novel strategies in all the steps of the production chain) cannot prescind from the scientific research to test, control and validate novel strategies. Aimed at this goal, modern analytical platforms are blooming, often supported by sophisticated statistical data analysis. In this special issue, as a scientific contribution toward the innovation of the small ruminants dairy system, we addressed, by different approaches, issues such as effects of diet on milk quality, breeding systems, seasonality of milk production, uniformity of products, exportability, and shelf life.

Worldwide, sheep and goats are raised within a wide spectrum of feeding systems that lie within the two extremes: extensive vs. intensive. Extensive grazing refers to the use of large areas of unimproved natural land—rangeland—for free-roaming grazing livestock; on the contrary, in the intensive grazing, the animal feed comes mainly from artificial, seeded pastures. Today, in many areas, the traditional grazing on natural pastures of native flora systems has been ameliorated by pasture with selected plants, diet supplements, and other strategies for the animals' well-being, for environmental and economical sustainability and to overcome the seasonality of dairy supply. Given that the small ruminant husbandry is based mainly on smallholder farming, diet and hours spent outdoors by animals vary greatly without stringent protocols, making it difficult to assess and validate the best procedures. One of the studies of this Special Issue has tackled this issue, comparing the milk metabolite profiles of Sarda sheep bred in Sardinia (Italy) by two relatively small farmers under two grazing systems, that differed by the access to selected pasture, time of grazing and quantity of cereal grain (g/day/head) in the diet [2]. Multivariate statistical analysis of the GC-MS metabolite profile integrated with parameters obtained by the MIR calibration procedures, such as milk urea, allowed to highlight metabolites linked to the type of feeding system. Effects of the diet on milk from Sarda sheep bred in Sardinia were also addressed by the work of Manis et al. [3], where changes in milk components upon integration of diet with cocoa husks, an agricultural by-product of tropical countries, were evaluated. Agricultural by-products are fed to animals by over 80 percent of owners, the type and amount of which varies seasonally and depends on

Citation: Scano, P.; Caboni, P. Innovation Meets Tradition in the Sheep and Goat Dairy Industry. *Dairy* **2021**, *2*, 422–424. https://doi.org/10.3390/dairy2030033

Received: 15 July 2021
Accepted: 3 August 2021
Published: 5 August 2021

the region. In the Mediterranean basin, the effects of local agricultural by-products (grape, olive, tomato, citrus pulp and myrtle residues) in the diet of small ruminants is amply studied; however, today, the great availability of agro-industrial by-products produced worldwide opens the door to novel products to be tested. Manis et al. [3] assessed that diet integration with cocoa husks induced level changes in milk metabolites, as detected by UHPLC-QTOF-MS, implicated in the thyroid hormone metabolism and ubiquinol-10 biosynthesis. However, Manis et al. (2021) also observed that the major driver of metabolite changes was the sampling time; in fact, the design of experiment involved the collection of milk samples from treated and control groups along 4 weeks, thus spanning from the late spring to summer. Seasonality of milk composition is characterized by periods of "peak" milk production, after which milk yield declines in summer, as animals go from the mid to late stages of their lactation, and this is more marked in extensive breeding systems, due to changes in the quality and availability of natural pasture. Seasonality of milk fatty acid (FA) composition was studied by Nudda et al. [4], which turned their attention from the amply studied health beneficial omega-3 FA and conjugated linoleic acid (CLA) to the odd and branched chain classes of FA. The latter, long neglected, have recently sparked interest in the scientific community due to an inverse relationship with the development of human diseases. Besides the seasonality of the content of these FA in goat and sheep milk, their "transferability" to the derived cheese has been assessed. The detailed FA profile of cheese confirmed the higher nutritional quality of sheep cheese for beneficial FA, including odd and branched chain FA, compared to goat cheese, and the importance of the period of sampling in the definition of the FA profile.

In order to protect typicity of agricultural/food products, the European Commission has appointed different foods originating from a specific geographical area with the PDO (Protected Designation of Origin) label, which describes the product and reports a disciplinary to be followed. Heat treatment of milk is one of the specifics of cheese disciplinary; milk for cheese manufacturing can be raw or pasteurized/heat-treated. If not, specified manufacturers are free to apply their more convenient milk treatment. Fiore Sardo (PDO) cheese is the oldest ovine cheese of Sardinia (Italy), being historically produced by shepherds in very small artisanal cheese factories. It must be obtained exclusively using raw whole milk from the Sarda Sheep breed. However, the use of heat-treated milk for Fiore Sardo production has been associated with common industrial processing practices in spite of the specifications indicated in the PDO disciplinary. Among the analytical techniques able to discriminate cheese made from raw or heat-treated milk, Anedda et al. [5] have successfully tested the nuclear magnetic resonance (NMR) relaxometry. Water molecules in cheese could be described, at a first approximation, as either free or bound (hydration water molecules), and NMR can give an estimate of the two populations. Fiore Sardo from raw or heat-treated milk showed different percentages of the two water pools, with the latter cheese exhibiting more bounded water. One explanation is a shift of the calcium phosphate from soluble to colloidal state due to the thermal treatment. Micellar calcium phosphate is a highly hydrated colloid, and Ca and P association to casein and micelle hydration are strictly related phenomena that have a marked effect on NMR relaxometry. Going further, Anedda et al. [5] defined a new parameter that takes into consideration both the water population in the two states (free and bound) and the time it takes to relax (T2). This new parameter better discriminated raw from heated milk cheese and highlighted the low variability in industrial cheese samples. Among cheese, PDO Pecorino Romano, obtained from raw sheep milk, is one of the most popular and exported Italian ovine cheeses. The United States, the leading export destination, where this cheese is mainly used as an ingredient in the food industry, have doubts about the safety of Pecorino Romano produced from unpasteurized milk and the Food and Drug Administration (FDA) is frequently evaluating whether to propose more restrictive requirements on the sale of unpasteurized Pecorino Romano. Indeed, cheese made from unpasteurized milk can represent a risk for consumers due to the possible presence of some pathogenic bacteria. Lai et al. [6] monitored the survival of the pathogenic bacteria *Listeria monocytogenes*, *Salmonella* spp.,

Staphylococcus aureus, and *Escherichia coli* O157:H7 during ripening of Pecorino Romano cheese. Whole sheep milk was inoculated with bacteria and divided into two aliquots and only one underwent thermization, then Pecorino Romano was produced from the two batches of milk and the analyzed samples of cheese, collected after 1, 90, and 150 days of ripening, only samples differed for the milk heat treatment. After 24 h, a reduction in bacterial loads was observed for all pathogens in cheese produced from raw milk, while in cheese produced with thermized milk, the bacterial load was below detection. After 90 days of production, all the cheeses were microbiologically safe. Authors concluded that when Pecorino Romano cheese is produced under PDO specifications, either from raw or thermized milk, a combination of factors, including the speed and extent of curd acidification in the first phase of the production, together with an intense salting and a long ripening time, preclude the possibility of growth and survival of a number of pathogenic bacteria [6]. In the Mediterranean area, to revive the ovine dairy industry, the development of new fresh dairy products is increasing. In order to prolong their shelf life, contaminations from mold and yeast must be avoided. In the work of Scano et al. [7], the use of natural alternatives, such as autochthonous Lactobacillus strains, to synthetic preservatives has been tested on different species of mold. The strains were considered potential good candidates to be used in cheese manufacturing as bioprotective cultures. By a GC-MS metabolomics approach, authors highlighted those metabolites mostly involved in the antifungal activity in vitro. This research can be considered a further step towards the use of biopreservatives in the dairy industry.

For this valuable collection of research, editors would like to thank all the authors who submitted their papers to this special issue, the reviewers with their constructive comments, and the editorial staff of Dairy.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Pollott, G.; Wilson, R.T. Sheep and goats for diverse products and profits. *FAO Diversif. Bookl.* **2009**, *9*, 42.
2. Scano, P.; Carta, P.; Ibba, I.; Manis, C.; Caboni, P. An untargeted metabolomic comparison of milk composition from sheep kept under different grazing systems. *Dairy* **2020**, *1*, 30–41. [CrossRef]
3. Manis, C.; Scano, P.; Nudda, A.; Carta, S.; Pulina, G.; Caboni, P. LC-QTOF/MS Untargeted Metabolomics of Sheep Milk under Cocoa Husks Enriched Diet. *Dairy* **2021**, *2*, 112–121. [CrossRef]
4. Nudda, A.; Correddu, F.; Cesarani, A.; Pulina, G.; Battacone, G. Functional Odd-and Branched-Chain Fatty Acid in Sheep and Goat Milk and Cheeses. *Dairy* **2021**, *2*, 79–89. [CrossRef]
5. Anedda, R.; Melis, R.; Curti, E. Quality Control in Fiore Sardo PDO Cheese: Detection of Heat Treatment Application and Production Chain by MRI Relaxometry and Image Analysis. *Dairy* **2021**, *2*, 270–287. [CrossRef]
6. Lai, G.; Melillo, R.; Pes, M.; Addis, M.; Fadda, A.; Pirisi, A. Survival of Selected Pathogenic Bacteria during PDO Pecorino Romano Cheese Ripening. *Dairy* **2020**, *1*, 297–312. [CrossRef]
7. Scano, P.; Pisano, M.B.; Murgia, A.; Cosentino, S.; Caboni, P. GC-MS Metabolomics and Antifungal Characteristics of Autochthonous Lactobacillus Strains. *Dairy* **2021**, *2*, 326–335. [CrossRef]