# Application of innovative production protocols and selected lactic acid bacteria for the enhancement of dairy products

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Dairy productions are particularly important in Sicily and represent a basic component of the regional agri-food economy. Regarding animal productions, although cattle and pig breeding present high levels of specialization, sheep and goat farming is almost completely traditional in Sicily, with extensive breeding mainly located in hilly areas and in the inner and almost isolated mountain zones. Sheep and goat farms, generally of small and medium size, produce various types of cheese that are still made with the milk of autochthonous species applying traditional transformation methods and historical equipment often made of wood. All these factors consolidated a strong dairy tradition; but these cheeses are produced at small scale level and often do not cross the regional boards.

## Objectives

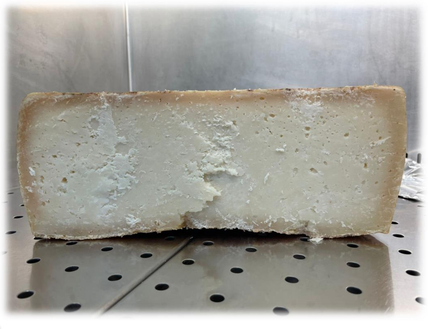
**(I) to provide production protocols to develop new ewe's milk cheeses in order to support rural development; (II) to generate a renewed interest for high-quality and safe ewe's milk dairy products.**

## Experimental plan

Pasteurized bulk ewe's milk will be used for the production of soft spreadable cheeses ("Crescenza" typology) or soft elastic cheeses ("Italico" typology). Raw milk will be processed to obtain hard cooked cheeses belonging to "Grana" and "Swiss" typologies.

**Crescenza-type** cheese is characterized by its soft and deliquescent structure. To this purpose, pasteurized bulk milk will be subjected to a presamic coagulation and a delayed acidification in order to give a sweet taste with lactic aroma to the cheese. No maturation will occur and the cheese will be ready in a few days. The acidification will take place thanks to the use of lactic acid bacteria belonging to *Lactococcus lactis* species which will be *ad hoc* selected for their limited acidifying capacity in order to avoid a too pronounced acidic taste in the finished product and a low proteolytic and aromatic capacity.

**Italico-type** cheese is a fat cheese with a uniform elastic soft texture, a slightly acidic lactic taste and a very thin rind. Maturation will be very short (about 30 days). Also in this case *Lactococcus lactis* strains with medium acidifying capacity and reduced proteolytic capacity will be selected and used as starter cultures.



**Grana-type** cheese is a cooked cheese. In this project it will be produced by modifying the typical technology applied to cow's milk with regards to temperature and time of curd exposure and stewing of the cheeses. Raw ewe's milk of the evening milking will be skimmed and the whole raw milk of the morning milking will be added the day after in order to develop an alternative to the typical Sicilian cheeses. The serum starter, necessary to lower the pH of the milk mass and to trigger the lactic fermentation, will be produced from lactic acid bacteria, mainly *Streptococcus thermophilus* isolated and selected from ewe's cheeses.

**Swiss-type** cheese will be made by applying the traditional technology necessary for the formation of eyes. In this case, propionic acid bacteria responsible for propionic fermentation will be co-inoculated with lactic bacteria. Therefore, in addition to lactic acid bacteria isolated from the production of sheep's milk cheese, propionic bacteria will be also added. In order to favor eye formation, the ripening of this cheese will take place first at high temperatures for acidification (production of lactic acid by streptococci) and then at lower temperatures (about 12-14°C) for the development of propionic bacteria and again at higher temperatures for the settlement of the eyes.

## Analysis

In order to determine the organoleptic properties conferred by the selected strains, all novel cheese typologies will be also produced with commercial starter bacteria for comparison. The final cheeses will be subjected to classical plate counts and isolation of lactic acid bacteria for the genotyping recognition of the dominant and persistent strains, and to next generation sequencing to analyze the entire microbial communities. All cheese will be characterized for their chemical profiles and sensory traits.

## References

Gaglio et al. 2014a. Identification, typing, and investigation of the dairy characteristics of lactic acid bacteria isolated from "Vastedda della valle del Belìce" cheese. Dairy Sci. Technol. 94, 157-180.
Gaglio et al. 2014b. In vivo application and dynamics of lactic acid bacteria for the four-season production of Vastedda-like cheese. Int. J. Food Microbiol. 177, 37-48
Gaglio et al. 2016. Microbial activation of wooden vats used for traditional cheese production and evolution of the neo-formed biofilms. Appl. Environ. Microbiol. 82, 585-595
Gaglio et al. 2019a. Influence of the early bacterial biofilms developed on vats made with seven wood types on PDO Vastedda della valle del Belìce cheese characteristics. Int. J. Food Microbiol. 291, 91-103.
Gaglio et al. 2019b. Effect of saffron addition on the microbiological, physicochemical, antioxidant and sensory characteristics of yoghurt. Int. J. Dairy Technol., 72(2), 208-217.
Gaglio et al. 2020. Addition of selected starter/non-starter lactic acid bacterial inoculums to stabilise PDO Pecorino Siciliano cheese production. Food Res. Int. 109335.
Mora, et al. 2003. Autolytic activity and pediocin-induced lysis in Pediococcus acidilactici and Pediococcus pentosaceus strains. J. Appl. Microbiol., 94, 561-570.
Niro. 2011. Innovazione di processo e di prodotto in formaggi a pasta filata. PhD thesis Università degli Studi del Molise, Italy.
Ombarak, Elbagory. 2017. Bacteriological quality and occurence of some microbial pathogens in goat's and ewe's milk in Egypt. Int. Food Res. J. 24, 847-851.
Settanni. 2012. Persistence of wild Streptococcus thermofilus strains on wooden vat and during the manufacture of a traditional Caciocavallo type cheese. Int. J. Food Microbiol.155, 73-81.
Settanni. 2013. Selected lactic acid bacteria as a hurdle to the microbial spoilage of cheese: application on a traditional raw ewes' millk cheese. Int. Dairy J. 32, 126-132.
Settanni, Moschetti. 2014. New trends in technology and identity of traditional dairy and fermented meat production processes: preservation of typicality and hygiene. Trend Food Sci. Technol. 37, 51-58.
Tarrah. 2020. Whole genome sequence and comparative genome analysis of Lactobacillus paracasei DTA93, a promising probiotic lactic acid bacterium. Arch. Microbiol.