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Review

Dairy Processing: The Soft Spreadable Cheese Xygalo Siteias

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Abstract: The aim of cheese manufacturers is to produce high quality and safe products. Along the food chain of "milk to cheese and food products", milk is collected, transferred, and managed in a standardized manner; processing results in safe, ready-to-eat products, of high nutritional quality. Soft, acid cheeses are prepared in various regions of Greece, mainly from ewe milk, goat milk, or their mixtures. They are produced from the rennet and/or acid coagulation of thermally-treated, full-fat milk undergoing acidification/curdling and ripening. Xygalo Siteias is a Greek soft cheese, produced in the area of Siteia, Crete, where it was recognized as PDO in 2011. It is close—more in texture and less in taste—with other cream cheeses PDO of Greece, such as Pichtogalo of Chania, and Katiki Domokou, still it differs in the preparation technique as well as in its physicochemical, biochemical, microbiological, and organoleptic characteristics. In this review, we focus on the processing and characteristics of Xygalo Siteias, mentioning perspectives for the further microbiological characterization of the product, the determination of its shelf-life in combination with new packaging-materials, as well as the attention it deserves as a food important for breeders, the local economy, and consumers, since it is associated with the Cretan-Mediterranean diet type.

Keywords: food chain; dairy processing; soft cheese; PDO; Xygalo Siteias

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1. Introduction

Cheese can be classified into certain categories based on texture, such as very hard, hard, semi-hard, and soft [1]. Soft cheese can be described or defined by its texture, biochemistry, appearance, flavor, and methods of processing; in general, it is considered a type of cheese that is made in a rather short time and has a soft, creamy texture. The texture of the cheese is mainly associated with the moisture content [2]. The types of cheese, according to moisture (%), are: very hard <25, hard 25–36, semi-hard 36–40, and soft >40 [1]. Fresh soft cheese is made from cow's, goat's, or sheep's milk, or a combination of these products; may be of protected designation of origin (PDO) [3]. Concerning processing methods, soft cheeses are made from thermally treated or untreated milk [4], which is fermented by the use of specific bacteria; while rennet is occasionally used in order to produce a firmer texture. Fresh cheeses are ready for use as soon as the production process is complete, but ripened cheeses require maturing at a low temperature for up to one month or more. Consequently, soft cheeses can be categorized into different groups, e.g., ripened, unripened, spreadable, and cream. For example, Xygalo Siteias—a Greek soft cheese, produced in the area of Siteia, Crete—is a soft, ripened, and spreadable cheese [3]. Due to the different cheese-making processes, the nutrient composition of each soft cheese differs. This is because of the characteristics and quality of the milk used in its production and may be affected by the production season, and by the selection and mixing of milks [5].

2. Soft Spreadable Cheeses in Greece

The differences in cheese making processing form a variety of soft products, that when spreadable, have high moisture (60–80%) and fat on a dry basis (40–55%), rather low salt (0.8–1.8%) and pH ~4.5; some of them are under protected denomination of origin (PDO)

cheeses, as, i.e., Anevato, Galotyri, Katiki Domokou, Kopanisti, Pichtogalo Chanion, as well as Xygalo Siteias [6]. Among them, Katiki Domokou is a soft cheese made in the Domokos area, as well as other parts of mountainous-mainland central Greece, derived from goat's and ewe's milk produced from local breeds. In the western Greece Aitoloakarnania-region, this cheese is also commonly known as "tsalafouti". The milk is left at room temperature (at 20 to 22 °C) to sour and curdle with or without rennet addition. It is then mechanically drained in a cheese cloth, salt is added (1%), and then the cheese is kept refrigerated until it is retailed and consumed [7].

Pichtogalo Chanion is a soft and spreadable cheese manufactured from ewe's milk or mixtures of ewe's and goat's milk, which is left to sour for 24 h. The cheese is drained, then salt is added at about 1%, and the product is ready for consumption. Pichtogalo Chanion is salty and sour in taste; it has a milky aftertaste and the aroma of yogurt. The product is made in the area of Chania, in the western part of the island of Crete. In 1996, Pichtogalo Chanion was granted PDO (Protected Designation of Origin) status [7].

Xygalo Siteias is a soft, fresh, and spreadable cheese, traditionally made in Crete, Greece [3,8,9]. It is a product of milk acidification, made in the area of Siteia, at Lasithi, in the eastern part of Crete. The milk mixture is optionally pasteurized, and then cooled to 25 °C. Salt (sodium chloride, NaCl) is added to a maximum of 2% by weight, as may be harmless acidic bacterial cultures, and small amounts of natural rennet from suckling lambs' stomachs (mainly if the milk has been pasteurized), called "tirephtis" in the Cretan-shepherds' idiom. Xygalo Siteias matures for at least 1 month, or even for 2 months, the latter especially if the milk was not pasteurized. It has a slightly sour taste, a characteristic aroma, a very bright-white nuance, and a creamy-full texture [8].

3. Xygalo Siteias Value Chain

3.1. A Traditional Product in Modern Market

This cheese is identified with an ancient name indicating milk acidification 'Οξύγαλα' (Oxygala or acid milk), or simpler 'Ξύγαλο' (Xygalo), whose production method goes back to the Hellenistic and Roman times. It remained an artisanal product for centuries. As an industrial product, it was first marketed at the beginning of the 1990s. Ever since, it has been largely accepted by the broader consumers' population of Crete (especially in eastern Crete) and Greece (especially in Athens and Thessaloniki). Gastronomy initiatives which certify restaurants offering dishes in-line with the Cretan diet, recommend Xygalo as an excellent "hors d'oeuvre", by the name "Xygalo Steiako" [8–11]. In the market of Crete in 2021, one can find at least three brands of xygalo, with the factories of two of them being very near the town of Siteia, one of them, the bigger, in the village of Hamezi. The third one lies in the broader Lasithi area, at Neapolis. Furthermore, numerous (we estimate in a few decades level) artisanal producers exist in the Siteia area, producing for local taverns and restaurants since there is a thriving local hospitality industry, as well as for families living in the area. The overall yield of cheeses produced in the area of Siteia, Lasithi Crete, is approximately 1300 tons per year. Of those, we estimate that Xygalo Siteias comprises roughly 60–100 tons per year; with processing of 150–200 tons of milk per year to supply this demand (Nikolaos Lapidakis MSc, personal communications with local producers and relevant authorities).

3.2. Area of Production

Processing of the milk, and production of Xygalo Siteias, must take place within the Siteia region, which is within the former Municipalities of Siteia, Makry Yialos, Itanos, Lefki, and all their municipal districts [3]. This is essentially a peninsula comprising the whole of the eastern end of Crete. It comprises mostly middle-mountain terrain (altitude of 300–1000 m, with small plateau), with less than 20% of lowland (under 300 m) and few upland areas (1000–1500 m). The Siteia region has lower rainfall, stronger winds, and higher temperatures than elsewhere in Crete at the same altitude. The number of hours of sunshine is particularly high, ranging from 2700 h per annum in the north, to over 3000 h

in the south (highest in Greece). Sheep and goats are reared in many places, mainly in the middle-mountain areas and to a lesser extent in the lowlands [8,9,12].

3.3. Breeds That Produce the Milk for Xygalo Siteias

Studies in the 1960s [13,14] describe varieties of the Greek Zackel on the island of Crete—the Siteia, the Psiloriti (the name Psiloris also used), and the Sfakia. Mature rams of the Psiloriti and the Sfakia variety are estimated to be about 64–66 cm at the withers, compared to about 57 cm for the Sitia; ewes of the three varieties are about the same height, in the range of 52–55 cm. Owners and animal merchants who are knowledgeable of small ruminants on the Crete island, attribute the divergence in the size of the varieties to qualitative differences in the forage available in the respective areas they used to live, with the poorest grazing being in the eastern part of Crete (Lasithi), where the smallest of the three varieties, the Sitia variety, is found. It was noted that the muzzle of Psiloriti (or Psiloris) rams and ewes is straight; Sitia ewes have a straight profile also, but rams have a convex muzzle. Rams of the three varieties have laterally spiraled horns, and most ewes are polled. The fleece measurements of the Cretan Zackel are shown in Table 1 [15]. Since the 1970s, the Sfakia and Psiloriti (or Psiloris) varieties (or breeds) were not considered as threatened and constituted, with crossbreds, the majority of the 385,000 Cretan Zackel (as estimated in 1977) [15]. The Siteia breed, on the other hand, has been endangered ever since the late 70s. It was estimated, at the time of a relevant survey (January 1975), that crossbreeding, with transferred, from other parts of Crete, Sfakia and Psiloriti rams had reduced the number of the Sitia to less than 1000. There is no reason or information to believe that the decline has abated since then [15], so we better refer to "Siteia crossbreeds" with Psiloriti and Sfakia breeds.

Table 1. Fleece measurements of Cretan Zackel adopted/modified, from reference [15].

Breed	Mean Staple Length (mm)	Overall Diameter Range (μ)	Mean of Diameter Modes (μ)	Breed Average Diameter (μ)	Medullation %		% Inactive Follicle		S/P Follicle Ratio
					Fleece	Skin	Primary	Secondary	
Sfakia	138	12–154	23.6	45.3	27.6	9	60	37	3.5
Sitia	150	14–126	23.0	36.8	14.0	0	82	48	2.8
Psiloriti	118	12–180	19.8	38.0	19.0	5	15	19	3.5

The raw material used to prepare Xygalo Siteias is fresh milk from healthy sheep and goats that are reared in the traditional manner within the Siteia region, entirely suited to the particular climate and flora; they stem from goat breeds indigenous to Greece and local sheep breeds (Siteia breeds, Psiloriti and Sfakia breeds, and mainly cross-breeds thereof). The 'Siteia sheep' is a subphylum of the Aegean Islands' small mountain-breed sheep. It is suited to areas with limited vegetation and rainfall, such as the climate in Siteia, and is not reared for milk alone but also for meat and wool. Over the past 30 years, an increasing number of the Psiloriti and Sfakia breeds have also been reared; since they are also adequately suited to middle–high mountain conditions. These Cretan breeds are also cross-bred by shepherds with Siteia sheep to increase the latter's milk yield. An overall population of 28,000–30,000 animals is estimated [8]. Studies suggest that the Siteia-breed sheep yields a relatively smaller quantity of milk per animal, i.e., 106–115 kg per annum per ewe on semi-intensive farms, and 72–80 kg on extensive farms, in Siteia; whereas, in comparison, the average yield for the whole of the island of Crete is 110–150 kg and 78–98 kg per annum per ewe, respectively [8]. The goats in the Siteia region (estimated as 18,000–20,000 animals) are breeds indigenous to Greece adapted to inaccessible areas with limited shrub-like vegetation. The sheep and goats in the Siteia area are reared in the traditional manner on extensive or, at most, semi-intensive farms, less on lowlands and more in middle–mountain areas (altitude of 300–1000 m), on grasslands with a multitude of indigenous and aromatic plants that give the milk particularly tasty characteristics. In the past 30 years, many farmers have built housing/milking installations near villages, moving

towards semi-intensive farming, combining positive elements of extensive and intensive farming methods [8].

3.4. Local Flora, Pastries and Animal Husbandry in Siteia Area

The sheep and goats are reared extensively or, at most, semi-intensively in the traditional manner, in the lowlands and middle–mountain areas not exceeding 1000 m. In October and November (when the newborns are suckled), due to the sparsity of natural vegetation and the animals' increased feeding needs, olive leaves and dried fodder (e.g., clover, hay, maize) are used at a rate of 30–40% depending on the year. From December to around April (higher milk production, after the newborns have been weaned), they feed on the local wild flora (grasses and bushes, mostly aromatic and indigenous), which is more abundant during winter and spring rainfall (sage, *Salvia fruticosa* and *Salvia pomifera*), rock-rose ('aladania'—*Cistus creticus*), heather (*Erica manipuliflora*), Jerusalem sage (*Phlomis lanata*), spiny broom (*Calycotome villosa*), oak (*Quercus coccifera*), and others). Right up to the beginning of March, these are supplemented by branches and leaves leftover from the annual pruning and cleaning-up of olive trees. During the winter period, dried fodder is also supplied in quantities usually not exceeding 30% in total so that the animals' needs are covered during the days of heavy rainfall, snow and frost. From May onwards and throughout the summer (reduced milk production), most flocks feed on various dried cereals originating in the area's fields, sown specifically for this purpose by the farmers, and graze on grasslands covered with local flora. Depending on the year, dried fodder from other areas of Crete and Greece (e.g., hay, clover, and maize) may be given by way of supplement, at a rate of 30–40% [8].

3.5. Xygalo Siteias Production-Procedures

Xygalo Siteias is produced from goat milk or sheep milk, or a mixture of both [8]. Concerning the mixing of goat and sheep milk, in regions where small ruminants are important to the economy, the development of products that include different proportions of sheep and goats milk attracts more consumers and additionally improves the nutritional value of the product, mainly with respect to the variety of fatty acid and mineral contents [16]. Goat milk has a white-matte colour, does not contain β-carotene and has a sweet and pleasant distinctive "freshly milked taste"; however, it can sometimes, at the end of lactation or after a period of storage in a cold environment, acquire a certain flavor one can describe as "animalic"; called "katsikila" in the Cretan idiom. The goat milk has a density ranging between 1.026 and 1.042, with a pH ranging from 6.3 to 6.7; the distinct flavor of goat milk is possibly due to the release of short-chain fatty acids during the handling of milk. Sheep milk exhibits a more marked white opacity and has a characteristic "sheepy" smell [16]. This feature is relatively less-evident in milk that is stored in a good hygienic condition, i.e., put in refrigerated tanks after suction [16]. The milk processed to produce Xygalo should be the product of milking at least ten days after the animal has given birth; either the farmer transports the milk to the cheese production-plant or it is refrigerated in milk chillers and collected frequently (usually under the cheese-plant responsibility), in a suitable vehicle or a refrigerated tank [8].

The cheese Xygalo Siteias is a product of milk acidification. The milk mixture is pasteurized (optionally) and then cooled to 25 °C. Salt (NaCl) is added to a maximum of 2% weight by weight (w/w), as are common (mainly traditional yogurt) acidic bacterial cultures, and small amounts of natural rennet from animals' stomachs (mainly if the milk has been pasteurized) [3,8]. Different cheese varieties need different salt contents, from 0.4% for Emmental cheese, up to 4%, or even 5% for blue cheeses. It is considered that through its influence on the growth of curd microorganisms, and the activity of enzymes such as rennet and microbial enzymes, salt modulates cheese ripening. Starter bacteria are more sensitive to salt than non-starter lactic-acid bacteria (NSLAB). Most Lactococci are inhibited from 4% salt-in-moisture, while *Streptococcus thermophilus* is inhibited at 2.3% [17]. Overall, salt slows-down proteolysis; while in moisture-concentrations of 2–6%, salt increases the

swelling and the solubility of casein, thus promoting the fusion of the cheese curd, especially for cheeses with a low pH. Salt also prevents an unwelcome extensive separation of serum during the ripening process [17].

The production of Xygalo in the "traditional" way does not include the use of lactic acid culture, which is usually similar to that of yogurt (*Streptococcus thermophilus—Lactobacillus bulgaricus*), as well as the use of rennet (preparations of the milk-clotting enzyme chymosin or renin), but is based on the gradual coagulation of milk due to the native milk-flora (lactic-acid bacteria), which lasts a little longer than the industrial method. The process duration depends to a large extent on the ambient temperature, and for this reason, this method is usually carried out in the summer months. Initially, Xygalo was produced only during the summer, when goat and sheep milk was scarcer, and there was not enough milk to make hard cheeses, while the temperatures favored the natural acidification of the curd. Housewives, or traditional cheesemakers, used special clay pots (called "kouroupi" in the Cretan idiom), which when gently put upside down, helped to remove the serum without breaking the cheese gel. In addition, according to this "traditional" method, the raw milk is not pasteurized so that there is a sufficient amount of lactic-acid culture, which will cause its gradual coagulation (Lapidakis N., personal communications with local artisanal-Xygalo producers).

The industrial production process of Xygalo PDO Sitia (permitted by the PDO regulation) is: the milk is pasteurized (71.8 °C for 18 sec or at 65 °C for 30 min, or with any other combination of temperatures/time that will bring the desired result). It is then cooled to 30–35 °C, where the lactic-acid culture, based on local traditional-yogurt, is added. The amount of culture is 2–5% per 100 kg of milk. After 15–20 min, a minimum amount of liquid rennet (3–4 g per ton) is added, and at the end, the product is transferred to containers not tightly closed for a month at temperatures of 18–20 °C where it matures (Lapidakis N., personal communications with Xygalo producers). Authentic Greek yogurt with "tsipa" (the solid top-layer of semi-solid yogurt, in the Cretan idiom), a dairy product where the active bacteria *S. thermophilus* and *L. bulgaricus* are predominant, is usually also produced from sheep and goat milk, by exactly the same factories that produce Xygalo Siteias. Yoghurt may be considered a cheap source of starter cultures that contains adequate types of microorganism of which most are thermophilic and can be utilized in the production of cheese. The yogurt culture/starter can be used at concentrations of 0.5–2.5%. Increasing the culture concentration is considered to be associated with the development of higher acidity, creating unfavorable conditions for the microbes and enzymes to work efficiently and releasing more whey [18].

Following the above, the product is left to ferment naturally in metal or appropriate plastic food-grade containers that are kept stationary and covered, but not hermetically sealed, for seven to ten days at a temperature of 15–20 °C. The excess fat and butter are removed from the surface of the curd. Ripening continues in these containers for approximately one month at a temperature of 10–15 °C, with no stirring of the curds for the entire duration of the acidification-ripening process. Finally, the product is separated from the whey that is concentrated at the bottom of the containers; it is placed in food-grade casks and is refrigerated/kept at a temperature of under 4 °C.

If the milk has not been pasteurized, Xygalo Siteias should remain refrigerated for at least two months before it is released in the market for human consumption so that the physiological flora counteracts pathogens, and further checks can be carried out to ensure that the product is free from any undesirable microorganisms. Xygalo Siteias is white, pasty and/or granular in texture, and is skinless (without "tsipa"). It tastes fresh, sourish, slightly salty and has a pleasant very-characteristic aroma. It is considered to have a maximum moisture content of 75% and a maximum salt content of 1.5%, whilst its fat in dry matter is expected to range from 33% to 46%; the fat content of the sheep's milk adjusted so that the fat content of the final product remains under 46% (in dry matter). It is expected to have a minimum protein content of 31.5% [8].

Concerning the labelling of the end product on its packaging, it must show in clearly visible and legible type: (i) The product name in Greek 'ΞΥΓΑΛΟ ΣΗΤΕΙΑΣ' or 'ΞΙΓΑΛΟ ΣΗΤΕΙΑΣ' (and/or in Latin characters 'XYGALO SITEIAS' or 'XIGALO SITEIAS'), followed by the words 'Protected Designation of Origin', or the equivalent in (an)other language(s) using the Latin or other script; (ii) The name and address of both the production and packaging enterprises. Where raw (non-pasteurized) milk is used in the production process, the packaging should also bear any special marking prescribed or to be prescribed in the relevant national and community legislation [8].

3.6. Composition of Xygalo Siteias and Comparison with Other Soft Greek Cheeses

Xygalo Siteias has a maximum moisture content of 75%, a maximum salt content of 1.5% and a minimum protein content of 31.5%. Its fat in dry matter (FDM) reaches from 33% to 46%. This fat content distinguishes Xygalo from other similar products that have a higher FDM. For example, the minimum fat content from Pichtogalo, another traditional Greek cheese, is 50%, which is much higher. The minimum FDM for other similar cheeses is 40%, 43% or 45%. The low fat content of Xygalo Siteias is obtained by using a high proportion of goat's milk and/or removing fat from the used milk or the actual Xygalo-cheese during the production. The methods to produce the other similar cheeses have no equal skimming stage but undergo stages of homogenization instead [8].

Besides Xygalo there are twenty other traditional Greek cheeses that have received PDO recognition until 2021. Xygalo is compared mainly with two of these cheeses: Katiki Domokou from central Greece (Thessaly area) and Pichtogalo Chanion from Crete. The composition and structure of these two cheeses are more or less similar to the composition and structure of Xygalo. Table 2 show the maximum moisture content, the minimum protein content, the maximum salt content and the fat in dry matter (FDM) of Xygalo, Katiki, and Pichtogalo cheeses. The maximum moisture and salt content are for all cheeses similar, except for the maximum moisture content of Pichtogalo (65%), which is 10% lower than those of Xygalo and Katiki (75%). The main difference is the minimum protein content, which is highest in Xygalo (31.5%) and lowest in Katiki (8.8%). The FDM reaches from 33% in Xygalo to 50% in Pichtogalo, which of course, also depends on the kind of milk that has been used during the production [8,18].

Table 2. Comparison of Xygalo Siteias, Katiki Domokou and Pichtogalo Chanion characteristics.

	Maximum Moisture Content (%)	Minimum Protein Content (%)	Maximum Salt Content (%)	Fat in Dry Matter (%)
Xygalo [8]	75	31.5	1.5	33–46
Katiki [18]	75	8.8	1	minimum 40
Pichtogalo [18]	65	14	1	minimum 50

Recently, Danezis et al. (2020) determined more physicochemical and biochemical values of Xygalo Siteias, and they report as follows: pH 4.08; moisture 78.5%; fat 8.83%; fat in dry matter or FDM 40.6%; NaCl 1.62%; proteins 9.02%. Concerning fatty acids (FA) they were estimated as g of each FA per g of total FA detected: C4 0.107; C6 0.943: C8 1.58; C10 6.55; C11 0.067; C12 3.71; C14 11.0; C14:1 0.433; C15 0.993; C15:1 0.237; C16 29.7; C16:1 1.30; C17 0.723; C17:1 0.227; C18 10.9; trans C18:1 1.20; trans-11 C18:1 2.51; cis-9 C18:1 21.6; C18:2n-6t 0.527; C18:2n-6c 2.45; C18:3n-6 0.027; C18:3n-3 0.773; cis-9, trans-11 C18:2 1.24; trans-10, cis-12 C18:2 0.077; C20:0 0.197 and C20:2 0.053 [6]. Furthermore, Danezis et al. (2020) carried out discriminant analysis for different Greek cheeses, including soft cheeses, using two discriminant functions of the fatty acid profile and physicochemical characteristics. In the study of Danezis et al. (2020), Xygalo Siteias appeared as a distinct entity, clearly different from Galotyri, Anevato, Katiki Domokou, and Pichtogalo Chanion that were clustered near. More far, in this specific study, were clustered Xynomyzithra Kritis, Feta, Manouri, and Kalathaki Limnou [6].

3.7. Microbiological Quality of Xygalo Siteias

The microbiological quality and shelf-life of Xygalo Siteias is still under study in our laboratory. Among our experiments, Xygalo samples were collected by the local market and microbiological quality assessment was carried out by determining the mesophilic aerobic count (MAC) on Standard Plate Count Agar (PCA) agar after incubation at 32 °C for 48 h, and the Coliform bacteria (Total Coliforms or TC) numbers with the Brilliant Green Bile (BGB) broth method, after incubation at 37 °C for 24 h. The MAC range was 2.4×10^6–10^7 CFU/g (colony forming units per gram) on PCA, a count range influenced by the different ripening times of the product. On the other hand, the mean most probable number (MPN) of total coliforms/100 g sample was 9 CFU (MPN accuracy 95%), ranging between 1–36 CFU. To our knowledge, this is one of the first microbiological studies on xygalo, and may contribute, with further studies of course, to monitoring its quality [19].

Gosman and Timpe (2013) [20] worked with us in Siteia and studied two local factories, one with an implemented HACCP system and one without. The study [20] was carried out under the guidance of Dr. R.B. van Ommeren and the laboratory supervision/assistance of Nikolaos Lapidakis MSc in Dairy Science; it concentrated mainly on lactic acid bacteria (LAB), Total Coliforms, *Escherichia coli*, and *Enterococcus faecium*. Over a period of 6 weeks, the bacteria culture in freshly produced Xygalo Siteias has been monitored/studied, and the difference in bacterial growth during these weeks has been recorded. An interesting finding of this study [20], which of course remains to be further verified, was that, as expected, the amount of bacteria varies within the weeks. Still, the presence of *E. coli* peaked in both samples in the third week: mean 210 CFU/100 mL of the HACCP factory samples and 1100 CFU/100 mL of the non-HACCP factory samples. Additionally, *E. coli* was not detected in both categories of samples in the sixth week. Whether this is a sign of non-LAB bacteria suppression, due to the development of the natural LAB-flora and the overall maturation of the product, remains to be verified.

In addition, in the study of Gosman and Timpe (2013) [20], a hygiene check has been performed in the two factories, to determine the differences in hygiene compliance. Results showed that in the under HACCP produced sample, lactobacilli (lactic-acid bacteria, LAB) are present in higher numbers than in the non-HACCP sample. The numbers of LAB were approximately two times higher in the HACCP-applying factory than in the non-HACCP factory, a result that remains to be verified and further interpreted. The values of *Escherichia coli* were generally higher in the non-HACCP produced samples than in the HACCP-produced samples, with the highest value of 1100 CFU/100 mL in comparison with 210 CFU/100 mL in the HACCP samples. The presence of *Enterococcus faecium* was in the non-HACCP sample, distinctively higher than in the HACCP sample. The bacterium *E. faecium* may occur in many foods, especially in animal products and is an indicator for fecal contamination. The hygiene checks carried out showed that 12 out of 108 points were insufficient in the HACCP factory. In the non-HACCP factory, the score was double since 23 points were insufficient, as far as the researchers were able (or occasionally had the permission) to search [20].

3.8. Perspectives for the Further Microbiological Characterization of Xygalo Siteias

Extensive applied research has been carried out on fresh soft cheeses [1,7,18]. The main parameters studied were and are the differences in processing, the use of raw untreated milk versus the addition of starter cultures, the products' risk assessment, the estimated shelf life of the products, etc. Still, the native microbial flora of the milk has a critical role in the development and maturation of each traditional cheese. Without underestimating the management of microbial quality, further studies on the more accurate characterization of this native microbial-flora in traditional cheeses, as well as modern sequencing technologies, may not only allow more in-depth understanding of this microbiota but also provide information and technology for the development of standardized starters, producing and reproducing the main qualities of the traditional products.

4. Discussion

The many breeds of sheep and goat are part of the world's rich animal genetic resources (AGR). Food and Agriculture (FAO) Organizations' interest in small-ruminants breeds, parallels its concerns about the conservation of plant genetic resources (PGR), which culminated in the establishment of the International Board for Plant Genetic Resources (IBPGR) in 1974, and the FAO Commission for PGR in 1984. FAO has been interested in both PGR and AGR since its inception in 1945 and has achieved much to foster documentation of livestock breeds, including small ruminants as sheep and goats. FAO, since the 1980s, suggested it would possibly be more profitable to use adapted local prolific sheep, familiar to difficult local environments, for crossing, instead of productive but demanding imported breeds from very different environments [21,22].

The genetic diversity of local breeds can improve the productivity, adaptability, and resilience of agri-food value chains, as well as of the local food-systems. However, several indigenous sheep breeds of Greece are threatened due to the abandonment of traditional production systems based on local breeds and to the import of foreign high-producing breeds. Linking local breeds to the traditional high-quality products can advance the value of indigenous-sheep genetic resources, contributing to the sustainable and economic development of less favored areas [23]. The mountain villages of Siteia prefecture represent some of the most barren and poor areas of the whole Crete region and can benefit a lot both from the Cretan sheep breeds, as well as the production of Xygalo, a traditional cheese associated with the food and nutrition culture of the area. Especially, the involvement of the local youth in farming and animal husbandry possibly represents one of the keys to sustaining the population and the economy, as well as with higher local living standards, life-long education, youth recreation opportunities etc.

The production of Xygalo is considered low for the moment, although it can be found in all markets in the area of Siteia and most in the Lasithi prefecture of Crete. It is not monitored closely enough by the Greek authorities, so the Greek Organization of Milk (ELOGAK) could not detect any production in the year 2016 [24,25]. Of course, we do not exclude the possibility that these data may concern and represent difficulties of the local industries to copy with the economic cost for the PDO certification. Within the last years (2019–2021), only one plant has been reported by local authorities (Region of Crete, data not shown) to have an active PDO certification. It's not actually a surprise that within the evaluation of the substantial expected benefits coming from the European protection regulations and of other costs related to the PDO/PGI, there may be more factors across the supply chains (i.e., the austerity of certification procedures), that producers have to evaluate in order to continue or not, to comply to a PDO/PGI scheme [26]. Furthermore, we express our opinion that the actual milk quality (http://www.minagric.gr/images/stories/docs/agrotis/POP-PGE/prodiagr_xygalo_siteias.pdf, accessed on 25 November 2021) in the Siteia area has to be monitored in more detail [27] concerning chemical/biochemical and cell count parameters, seasonal fluctuation etc.; beyond the basic microbiological and adulteration tests carried out by the laboratories of the Greek Ministry of Agricultural Development and Food.

Various cheese types evolved through history; practically, almost every area in Greece, and the island of Crete, has its own cheese-making tradition. Some cheese varieties are local, handcrafted foods whose production has been handed down from one generation to another; without interest in their continued production, these cheese varieties will disappear. Other local varieties are made in small factories from pasteurized milk, commercial rennet and starters [7,28]; these may be similar or may be very different from the traditional versions. The series of microbiological changes in soft cheeses during storage and the subsequent shelf-life depends on the production technology; the cheese type characteristics (acidity, NaCl, etc.); package etc. Currently, in the Hellenic Mediterranean University (HMU) we carry out relevant research to determine the microbiological changes in Xygalo Siteias during storage, under the program of the project "Flagship Action for Research in the Agri-Food Sector of Crete: Four Institutions, Four Reference Points "with the acronym

Agro4Crete. The project is coordinated by the Hellenic Mediterranean University, while participates include the University of Crete, the Hellenic Agricultural Organization DIMITRA or "ELGO-Dimitra", as well the Greek Foundation of Research and Technology (FORTH). One of our tasks is the determination and characterization of the actual LAB flora that can be potentially used as a starter for Xygalo Siteias.Furthermore, appropriate packaging solutions [29,30] could minimize quality changes in soft cheeses, resulting in an increased shelf life as well as quality maintenance. In due course, we will also search for new material with antimicrobial action, under the program "Sustainable food packaging based on essential oils in polymeric matrices", with the acronym 'NanoBioPack' with code MIS 5,056,214 and project code: Τ6ΥΒΠ-00307, (project code HMU: 80746), which is implemented within the framework of the National Action "Aquaculture"—"Industrial Materials"—"Open Innovation in Culture" of the Operational Program "Competitiveness, Entrepreneurship and Innovation" (EPANEK) 2014–2020 and is co-financed by the European Regional Development Fund (ERDF). The future of the Greek dairy chain is considered promising, despite the high competition within and outside of the European Union [31]; further research and dissemination of research results may add to the sustainable development of the sector.

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