

STATE OF THE NATIONAL REPORT

LARISSA ON THESSALY REGION – GREECE





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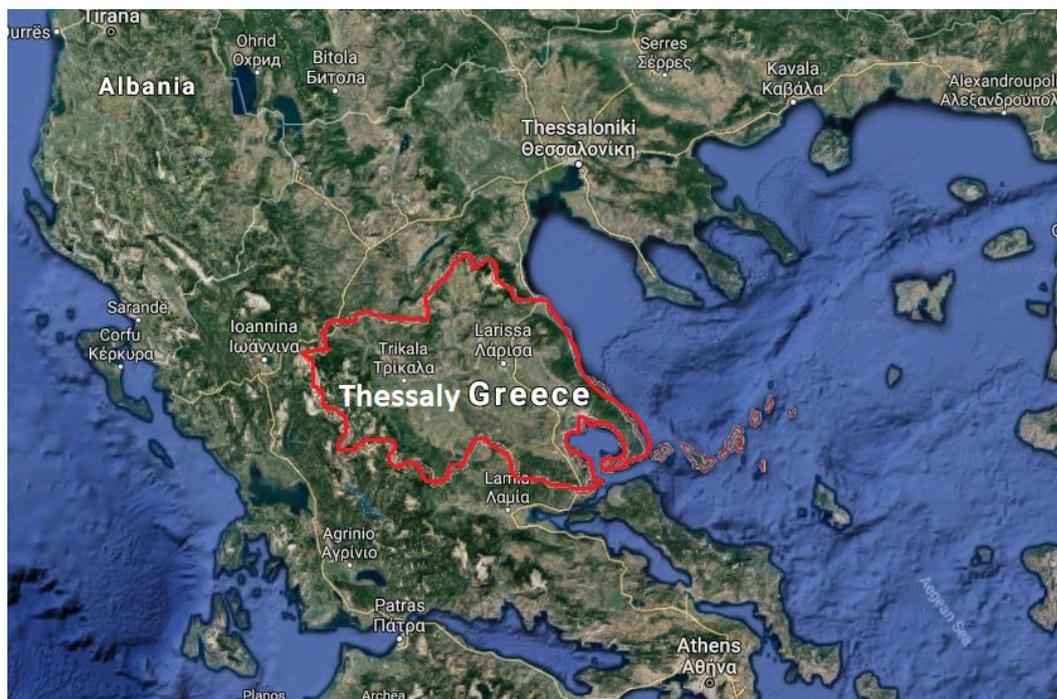


1 Introduction

Greece is located in Southern Europe, bordering the Ionian Sea and the Mediterranean Sea, between Albania and Turkey. It is a peninsular country, with an archipelago of about 3,000 islands.

It has a total area of 131,957 km² (50,949 sq mi), of which land area is 130,647 km² and internal waters (lakes and rivers) account for 1,310 km². Land boundaries with Albania (212 km), Republic of Macedonia (234 km), Bulgaria (472 km) and Turkey (192 km) measure approximately 1,110 km in total. Of the country's total territory, 83.33% or 110,496 km² (42,663 sq mi) is mainland territory and the rest 16.67% or 21,461 km² (8,286 sq mi) is island territory.

Central and western Greece contains high and steep peaks intersected by canyons. Mount Olympus is the highest point in Greece, rising to 2,919 m above sea level. Plains are found in eastern Thessaly, in central Macedonia and in Thrace.



Thessaly is crossed by river Pinios, the third largest of Greece, 205 km long. The headwaters are found in Pindos mountains, while it flows through Kalampaka area, the valley of Tempi and flows into Thermaikos Gulf creating an estuary in the area of



Stomio Villages. Pinios has five tributaries, Enippeas, Klinovitikos, Portaitikos, Pamisos and Karditsiotiko.

The highest mountain peak in Greece, Mytikas, can be found in Thessaly, known as the Throne of the Gods in greek mythology, with an altitude of 2,917 meters. Mytikas heights of Mount Olympus which is shared between the Pieria and Larissa prefectures. Well known thessalian mountais are: Kakarditsa (2.429m.) Voutsikaki (2.154m.), Ossa (1.978m.) Koziakas (1.901m.) and Pelion as well.

Regarding the flora in the Region of Thessaly, a vast variety has been observed. More specifically, in the area around of Olympus Mountain, scientists have identified more than 1000 plant species, 45 of which are protected by international agreements. The areas that display rich biodiversity are Pelion, the western and southern parts of Olympus, Meteora and Koziakas. The plain of Thessaly hosts many interesting plant species such as *Viola rausli* and *Dianthus haematocalyx spp. pruinusus*. According to Law 3937/2011, the following environmental protected areas are mentioned:

- Nature Protection Areas: 2 areas with great ecological and biological value.
- Natural Parks: 4 regions with mixed areas of particular value and interest due to the quality and the variety of their natural and cultural features.
- Habitats and species protection areas: 100 regions
- Natura regions: 38 regions
- Wildlife Shelters: 62 regions of important species of flora and fauna
- Protected landscapes and natural formations: 32 regions (Κονταξή, 2016).

2 Pastures and aromatic plants in Thessaly region

2.1 Main pastures in Thessaly region

Mountain Pelion is situated between the Aegean Sea, to the northeast, and the Pegasitic Gulf, to the southwest, in Magnesia. The geographical coordinates of the

certain region are 23, 0753 longitude and 39, 4456 latitude, according to the European list of sites of Community importance for the Mediterranean biogeographical region, and it includes 31477.9600 hectares of land.

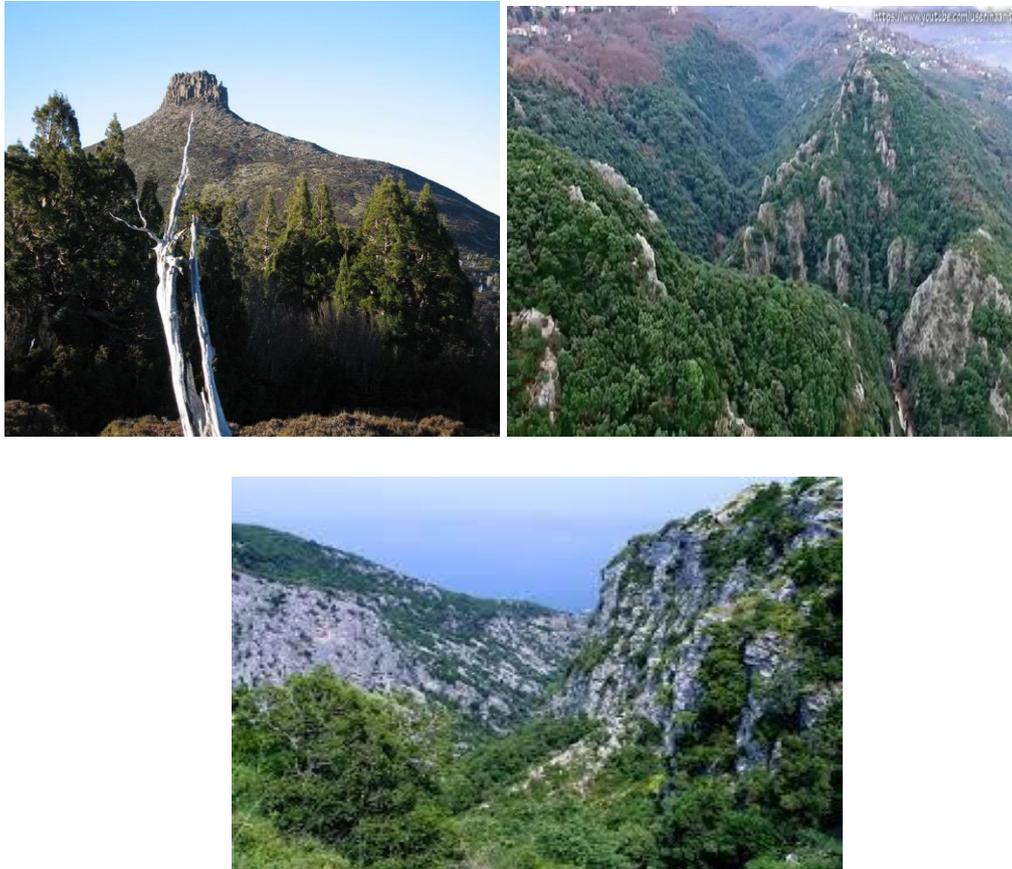


Image 1. *Mountain Pelion*

The region of Pelion is included in the Nature Network (Natura 2000), according to the (EU) 2018/37, under the code GR1430001, with the name “OROS PILIO KAI PARAKTIA THALASSIA ZONI” (European Commission, 2018). The mountain system is 44 kilometers long and 10 to 25 kilometers wide. The altitude of mountain Pelion is about 1.640 meters and it caps the highest point of a sickle-shaped peninsula that juts into the Aegean Sea (Brussell, 2004). Other famous high points of mountain Pelion are Kotroni (1550 m), Aidonaki (1537 m), Plyssidi (1547 m) , Agriolexes (1471 m), Dramala (1455 m), Khitzouraili (1450 m), Golgothas (1415 m) and Lagonika (1300 m) (Bouras, 2009). It borders the Plain of Thessaly, on the west side, and with Mt. Ossa on the north side. Due to its elevation and geographical location, Mt. Pelion receives enough rainfall to support abundant vegetation with a diverse array of plant species. The mountain of Pelion was famous in Ancient Greece for its



richful variety in medicinal herbs. According to the mythology, Jason, who was the king of Volos, was trained in medicinal herbology by Centaur Chiron. The initial name of Jason was Diomedes, but he became such a good healer, that he was given the name “Iason”, by the ancient Greek word “iasis” that means cure (Brussell, 2004). The Mountain Pelion was also the place, where the Gods held their beauty contests, and Centaurs used to live in (Brussell, 2004).

There are three vegetation zones in Pelion; the Mediterranean, the trans-Mediterranean and the beech zone. The first zone occupies the lower area that is covered mostly by maquis, such as *Quercetea ilicis* and by *Platanus orientalis*. Moreover, in this certain zone, many pharmaceutical taxes can be found such as *Salvia fruticosa*, *Thymus spp*, *Sideritis spp*, etc. The second zone, which occupies the medium altitudes, is covered by *Quercus frainetto* and *Castanea sativa* forests. Furthermore, *Melittis melissophyllum* can be found in great abundance in forests of *Platanus orientalis* and *Fagus sylvatica*. About 14 habitats have been recorded in Natura 2000 in the region of Pelion. The characteristic of the third zone is the vast amount of beech trees (*Fagus sylvatica*), that is followed by trees, such as *Populus tremula* and *Salix caprea* (Bouras, 2009).

As was mentioned above, Pelion was known for its rich range of pharmaceutical herbs. More than 620 taxes have been studied systematically, and according to Fotiadis, the flora in this region must include more than 1000 taxes. Some species that can be found in the mountain of Pelion are *Acinos alpines*, *Ajuga reptans*, *Ballota acetabulosa*, *Calamintha acinos*, *Calamintha nepeta*, *Melissa officinalis*, *Mentha longifolia*, *Mentha piperita*, *Mentha spicata*, , *Origanum majorana*, *Salvia officinalis*, *Salvia triloba*, *Salvia verbenaca*, *Salvia verticillata*, *Teucrium chamaedrys*, *Thymus serphyllum*, *Laurus nobilis*, *Allium ampeloprasum*, *Allium sphaerocephalum*, *Aloe vera*, *Asphodeline lutea*, *Malva sylvestris*, *Ficus carica*, *Morus nigra*, *Eucalyptus amygdalina*, *Fraxinus ornus*, *Olea europaea*, (Brussell, 2004).





Image 2. *Mountain Olympus*

Mountain Olympus is a Special Area of Conservation and a Special Protection Area for Birds. It is included in the Natura 2000 Network under the code GR1250001 with the name “Mount Olympus. According to the programme "*Surveillance and evaluation of the conservation status of habitat types of European community interest in the area of jurisdiction of Olympus National Park Management Agency*", about 19 habitat types were recorded under the European Directive 92/43/EEC. Among these 19 habitats, four of them are characterized as high priority areas with the codes 9530, 6230, 9180, 9580, along with the alpine zone, since the majority of endemic species of Olympus are found there (Hellenic Ministry of Environment and Energy, 2014).

More than 1700 plant species have been recorded on Olympus representing 25% of all Greek floras. About 160 plant taxa either belong to a protected status, are rare or endemics. Olympus is characterized by particularly high levels of endemism, as many endemic taxa are found there. Specifically, 26 local endemic species have been recorded on Mount Olympus to date. **These are essentially plants that are found only on Olympus and nowhere else in the world.** Furthermore, the area is home to



species protected under Annexes II and IV of the European Directive 92/43/EEC "*On the conservation of natural habitats and of wild fauna and flora*".

Endemic plants of Olympus and species protected under EU Directive 92/43/EEC

A/A	SPECIES	PROTECTION STATUS
1	<i>Achillea ambrosiaca</i>	Endemic of Olympus
2	<i>Alyssum handelii</i>	Endemic of Olympus
3	<i>Artemisia umbelliformis</i> subsp. <i>eriantha</i>	Annex V
10	<i>Brassica nivalis</i> subsp. <i>nivalis</i>	Endemic of Olympus
25	<i>Taraxacum deorum</i>	Endemic of Olympus
26	<i>Taraxacum thessalicum</i>	Endemic of Olympus

(Olympus National Park Management Agency Information Center, 2018)

Olympus is characterized by a wide variety of vegetation types due to its intense topographic relief, and the existence of many micro-environments. Generally, there are four vegetation zones that can be distinguished on Mount Olympus.

The first zone of broad-leaved evergreens (*Quercetalia ilicis*) is found at an altitude of 300 to 500 meters. The area is mostly covered by shrubs, short trees such as the *Quercus ilex*, *Arbutus adrachnae*, *Quercus coccifera*, *Arbutus unedo*, *Juniperus oxycedrus*, and deciduous species such as *Fraxinus ornus*, *Acer monspessulanu*), *Cercis siliquastrum*, *Cotinus coggygria*, etc.

Forest of beech-fir and mountain conifers (*Fagetalia*) stretch from 600 to 1400 meters, wherein black pines (*Pinus nigra*) dominate the area. In smaller numbers there are *Abies borissi-regis*, *Fagus sylvatica*, *Ulmus glabra*, *Taxus baccata*, *Coryllus avellana*, *Cornus mas*, *Prunus cerasifera* and a variety of herbs.

The zone of cold-hardy conifers (*Vaccinio-Picetalia*) can be found at elevations between 1400 and 2500 meters. The predominant species of pine are the rare *Pinus*

heldreichii, and *Pinus nigra*. Forests of *Pinus heldreichii* are mostly found on dry, rocky slopes. The vegetation, in this region, is adapted to the local conditions and it consists of shrubs, grasses, chasmophytes, while the flora includes many endemic species of the Balkans.

Above 2500 meters, there are mountain meadows and grasslands that display a great diversity, since their floral composition includes many rare wildflowers, most of which are endemic to Greece (Olympus National Park Management Agency Information Center, 2018).



Image 1: *Oregano vulgare* spp. *hirtum*

Oregano vulgare spp. *hirtum* is a widespread Mediterranean taxon, which can be found in the most parts of Greece, under the name of “Greek Oregano”. Famous for its high quality, “Greek Oregano” is mostly used as a spice, raw or dry. *Oregano vulgare* subspecies have stems with small hair, compact inflorescences, granular leaves with density and calyces, bracts with green color, that have the same length with calyces and white flowers (VOKOU, KOKKINI, & BESSIERE, 1993).

The genus *Origanus* includes small annual, biennial or perennial shrubs that can be found in warm, mountainous places. It can be found in different altitudes, from 0m to 1500m. *Origanum vulgare* spp. *hirtum*, that is also called *Origanum heracleoticum*, is a perennial xyloid shrub, with 60 cm height and multistage hairy shoots. The leaves’ dimensions are 15-22x6-15mm and they have elongated shape. They are also mottled

and petiolate and they have small hair sporadically. The size of the corolla is about 4-5 mm and the petals of the flower are mostly white and in some rare cases can be pink. There is also an actinomorphic calyx with five straight jags. The amount of essential oil that “Greek Oregano” varies from 1,1-8.2% w/v and it can be characterized by the presence of timol or carvacrol or both of them. In any case, two certain monoterpenes can be found; ρ -cymen and γ -monoterpine and phenols in smaller amounts. Greek Oregano has a high demand in the European market due to the good quality of the essential oil that is produced, since it is characterized by the high amount of carvacrol that contains. It has been proved that Oregano has the strongest antimicrobial, antioxidant, antifungal, bacteriostatic effect (Sotiropoulou, 2008)



Photo 2. *Mentha spicata*

Mentha spicata common name is spearmint, also known in Greece with the name “diosmos”. In the Greek region, it is a quite common native plant, characterized by spike-like inflorescence. The most common mint species occur at an altitude between 0 meters high and up to 2000 meters and they usually form large diverse populations, with a good adaptation to drought conditions. The plants flower from July to September and the female plants are recognized by the abortion of their anthers that appear within the population. Due to its origin, spearmint has a high variation and many times resembles features of *Mentha longifolia*. However, the main leaf characters of spearmint sessile or petiolate; oblong to ovate-lanceolate, widest near

the middle, with acute or rounded apex and almost cordate base glabrous to densely hairy with simple and branched hairs on the lower surface; and lamina smooth or rugose with crenate-serrate, flat or undulate margins. Spearmint has large pollen grains (37- 42 μm) and seeds (0.62-0.90 mm) than those of its diploid progenitors. Sexual criteria can differentiate hybrid populations from hermaphrodite but it is complicated when hybrids should be distinguished from female *Mentha spicata* plants. In this case, they can be identified only by using seed formation criteria (Kokkini & Vokou, 1989). Spearmint has antibacterial, antifungal, anticancer, antiviral, antidiabetic, antimutagenic, antiprotozoal, anti-inflammatory, antioxidant properties (Raut & Karuppayil, 2014).



Photo 3. *Rosmarinus officinalis*

Rosmarinus officinalis is an evergreen branched bushy shrub, attaining a height of about 0,5 to 1metre with upright stems, whitish-blue flowers and small dark green leaves.*Rosmarinus officinalis* produces yellowish oil with characteristic camphoraceous taste. It is used in the perfume industry, as a flavour agent and it has also been reported to be inhibitory to micro-organisms (Mangena & Muyima, 1999). Rosemary has heating properties and it also works as a blood circulation stimulant. It has also antiproliferative, antioxidant, antibacterial and antispasmodic properties (Al-Sereiti, Abu-Amer, & Sen, 1999). It has also analgesic, antirheumatic, carminative, cholagogue, diuretic, expectorant, antiepileptic properties and it can also be used as a

general tonic and in cases of in case of heart diseases. Externally, is used to stimulate the growth of hair and against scalp eczema and wounds (Mpasourakos, 2016).



Photo 4. *Allium sativum*

Allium sativum is about 30 to 80 cm high and features 6 to 12 flat bifacial leaves that enclose the lower part of the stalk. The circular hollow stalk is undivided and it is surrounded by leaf sheaths. The bulb is divided into cloves. Cloves are formed by the axillary bud and the collateral buds. At the upper end of the stalk, *Allium sativum* grows a spherical pseudo umbel that is featuring a small number of greenish white to white reddish blossoms (Sendl, 1995). Aging garlic cloves in a room with 70oC and 75% humidity for up to 40 days will result to the change of the cloves' colour from grayish to black. The outcome of this procedure is the well known black garlic with fruitful taste and sweet odor (Sasaki, Lu, Machiya, Tanahashi, & Hamada, 2007).

3 Animal biodiversity

Sheep breeding, which has been a traditional dynamic sector in the region of Thessaly, shows no significant changes since 2010. More specifically the number of sheep is about 1,171,688 and 449,759 of goats. About 104,132 tonnes of sheep's milk and 40,011 tonnes of goat's milk and about 30,300 tonnes of Feta cheese are produced in total. The cattle industry, in Thessaly region, mainly produces meat and milk. The

cattles that are bred for dairy production are about 168,000 from 684,100 that are bred in total in Greece (Greek Republic, Thessaly Region , 2011).

4 Mountain herbal flavored cheeses

4.1 Feta cheese



Image 1. Feta cheese

The first reference, regarding the cheese production, is detected in the scripts of Odyssey. At the age of 8 B.C., Homer describes the scene that Odysseus and his companions entered the cave of Polyphemus. Polyphemus was carrying the milk that he collected from his sheep in lambskins, and one day the milk had curled and had taken a solid form. This was considered to be the first report regarding dairy production.

Feta is a protected designation of origin (PDO) soft white cheese ripened in brine, and can be manufactured from ewes' milk or a mixture of ewes' and goats' milk (up to 30%). The milk coagulation has to occur within 2 days from its collection.

Traditionally feta used to be made with unpasteurized milk, but nowadays industrial dairies pasteurize the milk and they use commercial lactic acid cultures. Starters, such as *Lactococcus lactis* and *Lactobacillus bulgaricus* are used in a ratio of 1:3, in order to produce Feta cheese. The milk is pasteurized at a minimum of 72 C for 15 seconds or any equivalent time-temperature combination. After pasteurization, lactic acid starter cultures and calcium chloride are added, as the milk is being held at 34-36 C. during the next step the milk is renneted at 32 C and coagulation takes place in about 40-45 min. The resulting curd is cut in small cubes, and it is transferred into molds, in

order to drain and shape the small pieces. The filled molds are stored at 16-18 °C for 18 up to 24 hours and turned every 8 hours to ensure even drainage. The next day, the produced cheese is taken from the molds and placed temporarily either in wooden barrels or metal containers, where salt is added in layers. The final concentration of salt in the mass of cheese is roughly 3%. The next stage is to mature the salted cheese for 14 - 20 days in brine, at 16-18 °C in order to obtain humidity less than 56% and pH 4.4 - 4.6. The second phase of maturation takes place when feta cheese is kept refrigerated in its brine, at 1-4 °C, for two months (Panagou, Nychas, & Sofos, 2012).

After the second maturation is completed the cheese can be cut in small cubes. The cubes are transferred in sterilized jars and sprinkled with air-dried oregano (*Oregano vulgare spp. hirtum*). The jars are filled with olive oil, sealed and stored in a cool place (>4°C) for 10 days.

4.2 Anthotiro



Image 2. Athotiro

Other popular traditional cheeses of economic and nutritional importance are whey cheeses (Mizithra, Anthotyros, Manouri), that are manufactured from the whey of Feta or hard cheeses. Mizithra and manouri are protected designation of origin (PDO) cheeses, with a maximum permitted moisture content of 60-70%, and a minimum fat content in dry matter of 50-70%, depending on cheese type. Their production is based on denaturation and coagulation of the whey proteins, following heating at high temperatures (>85 °C), where the curd is typically collected from the surface of the coagulating mass. A common practice, in order to enhance the content of protein and

fat, is to supplement the whey with different concentrations of milk and milk fat prior to heating.

The initial acidity of whey milk must be around pH 6.3-6.4 and the volumetric acidity must be around 9-11°D. The cheese whey that is collected from cheeses that are manufactured from ewe or goat milk, is filtered in order to make sure it is clean. The protein denaturation starts at 62°C degrees but the globules are visible at 80-83°C degrees. The warming procedure includes heating the whey cheese up to 70°C approximately for 10 minutes. After this, about 25% of raw ewe or goat milk is added to the whey cheese. The next stage that follows is the heating of the mix until it reaches the temperature of 90°C degrees for 20-25 minutes. At this point coagulation starts taking place and the globules that rise to the surface are transferred to cylindrical moulds. During the transferring to the moulds, air dried “diosmos” (*Mentha spicatta*) is added in every few layer of cheese. The filled moulds are let drain for 3-5 hours at 18-20 °C degrees (Tsiraki & Savvaïdis, 2011). Due to thermal treatment of the whey, the indigenous microbiota is not activated and since starter cultures are not added during the process. “Anthotyros” is practically free of microorganisms and subsequent handling of the curd results in postprocessing contamination with a variety of bacteria rendering (Zerfiridis, 2014). That makes “Anthotyros” susceptible to rapid bacterial deterioration. For this reason, “Anthotyros” is packaged in vacuum in small portions and stored at 4°C (Tsiraki & Savvaïdis, 2011).

4.3 Galotyri



Image 3. Galotyri

Galotyri is a Greek PDO, spread acid-curd soft white cheese with a maximum permitted moisture content of 75% and minimum fat content in dry matter of 40%. Galotyri is considered as one of the oldest traditional cheeses in Greece and is popular in Epirus and Thessaly. The cheese has a pH value of ca. 4.0 and it is characterized by acid taste and a mild aroma. It is produced from pasteurized ewes' or goats' milk or their mixture at various proportions with the supplement of starter cultures and rennet. The raw milk is heated until it reaches the temperature of 85oC for 10 minutes. Afterwards, the milk is cooled to 30oC degrees and starter culture and rennet are added. The mix is let incubate at 30oC and the curd is transferred into cloth bags. The curd is drained at 15oC for about 6 hours. After draining, the curd is taken out on a clean board, mixed well with dry salt (1.5%, w/w) and sealed tightly in containers which are then placed in a cold storage room (<4 _C) for up to two months for ripening (Katsiari, Kondyli, & Voutsinas, 2008).

4.4 Kasseri



Image 4. Greek kasseri

Kasseri cheese is a Greek PDO semi-hard cheese that can be produced from ewes' milk or a mixture of ewes' and goats' milk that can be up to 20%. After pasteurization the starter culture from heat-tolerant strains of *Streptococcus* and *Lactobacillus* is added (1%) at 32°C. After 30 min, rennet is added and coagulation takes place within 40 minutes. The coagulum is cut into 1 cm cubes and scalded at 38 to 42°C for 12 to 15 min. After 15 min the whey is removed and the curd is ripened for 24 hours in order to develop the desired level of pH that must be $\hat{5.1\pm 5.2}$. The curd is cut into

thin slices which are dipped into water (75°C) and kneaded to produce a smooth, elastic mass. Portions are transferred into moulds, while the dried black garlic is added too. After a few hours dry-salting is applied. Dry-salting continues for about 15 days until the number of applications reaches 10 to 14 at 15°C. After this stage, the cheese can be packaged in bags. The ripening continues at 4°C. The cheeses are available for consumption after 3 months of total ripening (Arvanitoyannis & Mavropoulos, 2000).

5 Concluding remarks and recommendations

Greek traditional dairy products have been evolved over centuries in the country according to local culture and artisanal practices in small scale family-owned dairies, that mostly use milk that comes from their own herds or from small regional farms. Nowadays, the combination of healthy and palatable aspects is very attractive for the consumers and for the dairy industry. More and more consumers look for products that they come from small scale producers, who produce their cheese in a traditional way. Moreover, the same consumers look for products with herb enriched flavor. However, the combination of traditional cheese production practices and the potential of poor hygienic conditions in small-scale dairy installations may result in the contamination of the final product. Foodborn pathogens might be present throughout the cheese making procedure and manage to survive until the time of consumption. This kind of contamination can originate from various sources; raw milk, brine, floor, packaging material, cheese cloth, knives, storage room and production room air.

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