Arch Lebensmittelhyg 66,
99–106 (2015)
DOI 10.2376/0003-925X-66-99

ISSN 0003-925X

Korrespondenzadresse:
Nils.Grabowski@tiho-hannover.de

4th Hanover Milk Symposium

[1]Institut für Lebensmittelqualität und -sicherheit (LMQS), Stiftung Tierärztliche Hochschule Hannover, Hanover, Germany; [2]Departamente de Salud Pública, Centro Universitario de Ciencias Biológicas y Agropecuarias (CUCBA), Universidad de Guadalajara, Guadalajara, Mexico

Total fat content and microbiological food safety parameters of cheeses introduced illegally by airline passengers into the European Union

Gesamtfettgehalt und mikrobielle Lebensmittelsicherheitsparameter von illegal von Flugpassagieren in die Europäische Union eingeführten Käsen

Nils Th. Grabowski[1], Wiebke Jansen[1], Diego Francisco Gómez Miranda[2], Diego Andrés Ortiz Cárdenas[2], Delia González Aguilar[2], Carlos Pacheco Gallardo[2], Günter Klein[1]

Summary

Although travellers are not allowed to introduce products of animal origin from third countries into the European Union (EU), customs confiscate, in considerable amounts, dairy products regularly. The present survey analysed n = 65 non-EU cheese samples that were confiscated from passengers at two international German airports during one year. The cheeses were identified and analysed chemically (total fat content, activity of alkaline phosphatase) and microbiologically (presence of salmonellae, *Listeria [L.] monocytogenes,* and total aerobic bacteria [TAB], *Enterobacteriaceae, Escherichia [E.] coli,* coagulase-positive staphylococci, and yeasts and moulds). Total fat content was compared to the literature (if existent), microbiological results evaluated to current EU (regulation [EC] 2073/2005) and German (veterinary public health recommendations) standards. Fat content basically ranged within reported values, but these values show a high degree of variation due to the lack of standardisation of the original product. Several homemade and industrially-manufactured cheeses exceeded the European resp. German thresholds for *Enterobacteriaceae,* yeasts/moulds, and TAB counts. However, no sample yielded *Salmonella* spp. nor *L. monocytogenes* requirements, all *E. coli* values ranged within permitted limits, and all staphylococci were coagulase-negative. The need to freeze the samples before analysing them may have contributed to these results. Still, many of the products are known to pose a public health risk for classical food-borne diseases and may contain emerging, opportunistic pathogens in their countries of origin, which is why surveillance is necessary.

Keywords: traditional cheeses, food safety, customs, regulation (EU) 206/2009, illegal imports

Zusammenfassung

Nach der EU-Verordnung 206/2009 ist es Reisenden nicht gestattet, Lebensmittel tierischen Ursprungs aus Drittländern in die Europäische Union einzuführen. Dennoch werden vor allem Milchprodukte regelmäßig beim Zoll konfisziert. Die vorliegende Untersuchung befasste sich mit n = 65, an zwei deutschen internationalen Flughäfen von Passagieren beschlagnahmten Käseproben. Diese Proben wurden identifiziert und -chemisch (Gesamtfett, Alkalische-Phosphatase-Aktivität) sowie mikrobiologisch (Salmonellen, *Listeria [L.] monocytogenes,* Gesamtkeimzahl [GKZ] sowie Gehalt an *Enterobacteriaceae, Escherichia [E.] coli,* Koagulase-positiven Staphylokokken, Hefen und Schimmelpilzen) untersucht. Der Fettgehalt wurde mit Literaturangaben (soweit vorhanden) verglichen, während mikrobiologische Ergebnisse an EU- (Verordnung [EU] 2073/2005) und deutschen (Empfehlungen aus dem Amtsveterinärwesen) Anforderungen gemessen wurden. Der Fettgehalt entsprach größtenteils den Literaturangaben, doch diese Angaben schwanken sehr aufgrund fehlender Standardisierung bei der Herstellung des Milchproduktes. Einige hausgemachte und industriell hergestellte Käse überschritten europäische bzw. deutsche Grenzwerte für Enterobaktieriazeen, Hefen/Schimmelpilze und GKZ. Allerdings enthielt keine Probe Salmonellen oder *L. monocytogenes.* Alle Gehalte an *E. coli* lagen innerhalb der Norm, und alle Staphylokokken waren koagulase-negativ. Dennoch sind viele Produkte dafür bekannt, ein Gesundheitsrisiko darzustellen, indem sie in ihren Ursprungsländern lebensmittelbedingte Erkrankungen hervorrufen oder aufkommende, opportunistische Keime enthalten können.

Schlüsselwörter: traditionelle Käse, Lebensmittelsicherheit, Zoll, EU-Verordnung 206/2009, illegale Importe

Journal of Food Safety and Food Quality 66, Heft 4 (2015), Seiten 85–124

Introduction

Regarding ways of processing, milk is one of the most variable foodstuffs of animal origin. Of those products, some have obtained a world-wide significance, e. g. yoghourt, *mozzarella* cheese or ghee. Others claim regional, national or even only local importance. String cheeses are very popular in the Circumcircassian region, i. e. the Caucasus and surrounding areas of Russia, Turkey, and Levantine countries, but are relatively unknown beyond these regions. Called *İel panir* in Armenian, *tel, çeçil* or *civil peyniri* in Turkish or *stroka* resp. *spagetti syr* in Russian, the curd for this basic kind of cheese is treated with hot water (making it a pasta filata-type) and pulled into strings of varying diameter, which are afterwards woven into a more compact structure like e. g. a braid. These string cheeses may be further processed by adding colorants or spices, stored in brine or smoked (Hayaloğu et al., 2008b).

The routine procedure regarding foodstuffs confiscated at EU borders includes seizure, recording, and destruction. Participating in a national research project that deals with legally and illegally-introduced foodstuffs (meat) of animal origin in Germany, the authors got the opportunity to obtain samples of non-EU cheeses confiscated at two international German airports. Since data on many traditional products is scarce, the aim of this survey was to determine the total fat content and to perform a microbiological analysis based on EU and German standards for cheese, and to evaluate them according to these standards.

As many foodstuffs can contain zoonotic pathogens, good manufacturing resp. hygienic practice are necessary to ensure food safety. This is done by creating awareness for this issue, establishing national standards and verifying them constantly (WHO, 2012), which may be difficult in some parts of the world. This is why many countries perform severe controls at their borders, seizing and destroying risk materials, e. g. dairy products. The legal framework for this procedure in the EU is regulation (EC) 206/2009 that was mainly established to prevent the introduction of animal diseases (Jansen et al., 2015), but also serves as safeguard against food-borne diseases. Although flight passengers are informed about this regulation before starting their trip, many still carry dairy products with them for several reasons (Grabowski et al., 2015).

Material and methods

The procedure of obtaining, recording and identifying the cheese samples is described in detail in Grabowski et al. (2015). In fact, the cheese samples described in the present paper are a subset of the dairy products obtained in that paper. In brief, cheese samples (n = 65) were obtained, during one year (2014), from two international airports in Germany and handled as category 2 material as stated by regulation (EC) 1069/2009. A stress was laid upon those cheeses that are considered uncommon in Germany, e. g. Turkish *tulum peyniri* (a rennet cheese that ripens in a goat skin resp. perforated plastic bag with a crumbly texture), Russian *stroka syr* or Egyptian *miş* (a fermented cheese, usually spiced) and *qarīş* (a cottage cheese-like product). It is important to stress that only the last provenance before entering the EU could be recorded, unless the label stated otherwise. Thus, if a passenger bought an unlabelled cheese in Kazakhstan (from where she starts her trip), but enters the EU via a connecting flight from Moscow, the product would be recorded as 'Russian', unless the label said otherwise. Then, country of origin and country of provenance were recorded separately.

Two basic types of products were confiscated: on one hand, industrial ones with labels, and on the other, artisanal ones with no labels. Product names of the industrial ones were also recorded in the original language, including, a transliteration and a translation when necessary. For the transliteration, official systems were used whenever possible, i. e. DIN 9 (Cyrillic scripts), 3602 (Japanese), 9985 (Armenian), 31635 (Arabic), and 31636 (Hebrew). For a more detailed discussion of the need for this linguistic precision, see Grabowski et al. (2015).

Products without labels were identified by internet research or questioning persons familiar with these products, e.g. persons coming from these countries and their families, and embassy staff. In some cases, a definite identification was not possible since products could not be tasted. Instead, they were declared as a "type of" a given product.

Chemical analysis

The first step was to test these products for the activity of alkaline phosphatase (Lactognost®, Heyl, Berlin) in order to detect raw milk products. This test, being an official German analysis method (L 01.00-45) according to § 64 of the German Code for Foodstuffs and Feedstuffs (LFGB), uses disodium phenyl phosphate as a substrate for this enzyme, an alkalinizing buffer, and dibromoquinone chlorimide as an indicator for an eventual phenol production.

The total fat content was determined using the butyrometry method modified by van Gulik (DIN 10 479-2). This method basically works like traditional Gerber's butyrometry, i. e. the dairy sample is mixed with concentrated sulphuric acid to destroy the fat globules and free that fat, and centrifuged after amyl alcohol was added. Van Gulik's adaption refers to weighing techniques of cheese samples, operates with other reaction times and uses a modified reaction vessel. The methods used for enzyme activity and fat content are described in detail in Sienkiewicz and Kirst (2006).

Microbiological analysis

Cheese samples were submitted to a series of microbiological parameters as recommended by Klein and Schütze (2011) summarized in Tab. 1 with their corresponding threshold values. The authors summarized the requirements per cheese type, based on the food safety criteria of regulation (EC) 2073/2005 and the "experts' recommendations of the task force 'food microbiology' of Saxony's State reference laboratory"[1], i. e. parameters valid for samples on consumer level. The table however does not include salmonellae (threshold: zero tolerance in 25 g) and *Listeria (L.) monocytogenes* (threshold: ≤2.0 log cfu/g) which are mandatory for all types of cheese. All parameters but staphylococcal enterotoxins were analysed. Standard methods were used according to § 64 LFGB, i. e. DIN EN ISO 6579 (salmonellae), DIN EN ISO 11290-1 *(L. monocytogenes),* DIN ISO 21528-2 *(Enterobacteriaceae),* DIN EN ISO 16654 *(E. coli),* DIN EN ISO 6888-1 (coagulase-positive staphylococci), DIN EN ISO 21527-1, -2 (yeasts and moulds), DIN EN ISO 4833 (total aerobic bacterial count).

[1] Original: „Empfehlungen der Sachverständigen der AG Lebensmittelmikrobiologie der LUA Sachsen".

After analysis, samples were destroyed according to regulation (EC) 1069/2009.

Results

Types of cheeses

The n = 65 cheese samples were grouped into n = 40 cheese types, i. e. this survey detected a great variety of products and, consequentially, very small sample sizes. Apart from *tulum* and its varieties, *qarīş, stroka syr* (fig. 1), *İel panir/tel peyniri, miş, şanklīş,* which have already been described briefly before, the following products resp. product types were identified:

- White brine cheeses, i. e. *beyaz peynir* ("white cheese") a Turkish salted white raw milk cheese (Hayaloğlu et al. 2008b), sold also in Egypt by the name *Istanbolly cheese.* Some cheeses were also termed *feta* on their labels without originating from Greece. This term is maintained in this paper as a reference to the label, stating however that this cheese type is not necessarily congruent with the Greek feta. *Dumiaṭī* is the most commonly-consumed Egyptian cheese. It is a raw white cheese in which salt is added before renneting (Abd-El Salam and Benkerroun, 2006). A variety is *ğibnah baiḍā' birāmīlī,* also known as „Pramela". *Ğibnah ᶜAkāwī,* is a Levantine variety made from pasteurized milk (Alichanidis and Polychroniadou, 2008; Hilali et al., 2011; Osaili and Al-Nabulsi, 2012).
- *Labne,* Turkish strained sheep milk yoghourt (Hilali et al., 2011; Nsabimana et al., 2005)
- *Lor peyniri,* Turkish fresh whey cheese (Çiftçioğlu et al., 2008; Kavaz et al., 2012)
- *Slivočnyj,* a Russian white cheese product
- *Füme çerkez peyniri* (fig. 1), Turkish Circassian cheese (made with milk heated to 95 °C and shaped in traditional baskets), smoked to improve shelf life (Aydınol and Özcan, 2013)
- *Yumuşak peynir* („soft cheese"), a Turkish soft white cheese (Hassanien et al., 2014; Hayaloğlu et al., 2008a)
- Halloumi-style cheeses which curd is scalded and remain in brine, i. e. the Turkish *hellim peyniri* and the Levantine *ğaban nābūlsī* (Erbay et al., 2010; Hilali et al., 2011).
- String-cheeses of the pasta filata type with both acid and rennet curd which are pulled to strings, giving them the appearance of cooked spaghetti (Turkish *sünme peyniri,* Armenian *İelak panir*), coarser strings (Russian *stroka syr*) or even chunks (Turkish [*Gazı*]*antep* (fig. 1) and *ip peyniri*). Eventually, strings may be pulled from bigger chunks (Turkish *çeçil peyniri,* Japanese *sen ichi kama*). The strings may be braided (Turkish *burgu peyniri,* Levantine *ğibnah mağdūlah*) and spiced [Hayaloğlu et al., 2008b; Yıldız et al., 2010]).
- *Kaşar peyniri* is a typical Turkish raw milk cheese of the pasta filata type obtained by adding starter cultures, renneting, curd acidification and scalding. The cheese is stored in dry (Alichanidis and Polychroniadou, 2008). *Kolot peyniri* is a low-fat cow milk cheese similar to *Kaşar*.
- *Köy peyniri,* a Turkish semi-hard salty fresh cheese (Kesenkaş et al., 2012)
- *Rūmī* ("Roman"; fig. 1), a popular Egyptian yellow cheese made without starter cultures, and similar to *pecorino* or *Manchego* (Alichanidis and Polychroniadou, 2008)
- *Lavaş peyniri* ("cheese for thin bread"), a Turkish salty ewe milk cheese (Hayaloğlu and Fox, 2008)

TABLE 1: *Microbiological parameters including the thresholds [log cfu/g] as compiled by Klein and Schütze (2011); grey areas indicate that a given parameter does not apply to a given product.*

Type of cheese	*Enterobacteriaceae*	*E. coli*	Coagulase-positive Staphylococci	yeasts	moulds	Total aerobic bacterial count
raw milk	5.0	4.0	3.0			
fresh	3.0		2.0	4.0	3.0	
soft	4.0	2.0	2.0			
yellow		3.0	3.0			
hard		1.0	2.0		3.0	
preparations	3.0		2.0	4.0	3.0	
processed			2.0		2.0	4.0

* = coagulase-positive staphylococci

FIGURE 1: *Examples of confiscated cheeses; upper left: Russian* stroka syr, *upper right: Turkish* Antep peyniri, *lower left: Egyptian Rūmī*, *lower right: Turkish* füme çerkez peyniri. Pictures: W. Jansen, S. Ortaeri

Journal of Food Safety and Food Quality 66, Heft 4 (2015), Seiten 85–124

- The Turkish *Van otlu peyniri* is a raw ewe milk rennet cheese without starter. Up to 25 spices and herbs are added to the curd, blocks are ripened in brine or dry-salted (Hayaloğlu and Fox, 2008).
- Within processed cheeses, some were plain (i. e. with no further additives). This group also also included the Turkish *dilimli* ("sliced") and *yağlı* ("fatty") *peyniri,* but these terms do not refer specifically to established cheese types. Finally, syr *kolbasa Luhskij* is a Russian product that is packaged like a large sausage, but is a processed cheese.

Fat content

The total fat content along with the sample sizes and the reference values as found in the literature are detailed in tab. 2 and 3. Results also corresponded to the data provided on labels. Within cheese types, some measured values displayed a high degree of variation. Reference values also varied markedly, e. g. from 5.03 to 25.85 % in *Antep peyniri* (Kahyaoğlu and Kaya, 2003; Tekinşen, 2005). In the majority of cases (n = 15) in which a reference was known (n = 25), measured values corresponded to the data in the literature. However, data did not fit in ten cases in which measured values were higher (n = 8) or lower (n = 2).

Enzyme activity

Seven samples (i. e. Turkish *yumuşak peynir,* two *Kaşar peyniri* types, and one *stroka syr, hellim, Köy peyniri,* and one *Rūmī*) resulted positive for the alkaline phosphatase test, i. e. they were raw milk cheeses.

Microbiological analysis

None of the samples contained salmonellae nor *Listeria monocytogenes.* All cultured staphylococci resulted coagulase-negative, occurred in counts between <1.7 and 4.5 log cfu/g, and will not be considered further.

Bacterial counts are presented in tables 4 and 5. There was no major difference between raw and heat-treated cheeses, so data was merged. Except for TAB, most samples ranged below the parameter-individual detection limits. No growth was observed in the *Istanbolly cheese* and *syr kolbasa Luhskij* samples, while positive results for all parameters occurred in the *tulum* and *Kaşar peyniri* types samples.

Evaluation of microbiological criteria

For the evaluation based on the standards set in tab. 1, brine and pasta filata cheeses were treated as 'fresh cheeses'.

Regarding raw milk cheeses, only one *Kaşar peyniri* type sample exceeded the threshold for *Enterobacteriaceae* (5.0 log cfu/g).

Most heat-treated cheeses also ranged below recommended thresholds. The exceptions are detailed in Tab. 6. It shows that elevated counts of *Enterobacteriaceae* (>3.0 and >4.0 log cfu/g; see tab. 1) were the most common complaint. High counts of yeasts and moulds (>4.0 log cfu/g) were typically found in fresh cheeses, and also many processed cheeses displayed elevated total aerobic bacterial counts.

TABLE 2: *Mean total fat [%] of selected Non-EU cheeses (n = 65), part 1: fresh, brine, soft, and pasta filata cheeses. Values in brackets refer to fat in dry matter values.*

	Survey		Literature	References
	x ± sd*	n*		
fresh cheeses				
Berendi tulum peyniri	29.69	1	.	.
Istanbolly cheese	24.00	1	17.9	Abd-El Salam and Benkerroun, 2006
labne	13.13 ± 7.25	2	6.42 – 9.03	Nsabimana et al., 2005
labne type	2.46	1	0.1 – 10.9	Abou Jaoude et al., 2010
lor peyniri	25.32	1	1.13 – 28.32	Çiftçioğlu et al., 2008; Kavaz et al., 2012; Sömer and Kılıç, 2012
tulum type	16.72 ± 4.47	5	5.1 – 32.0	Hayaloğlu et al., 2008a; Morul and İşleyici, 2012
brine cheeses				
beyaz peyniri	20.86	1	(<45.0)	Hayaloğlu et al., 2008b
Dumiaṭī	22.73	1	.	.
feta cheese	26.00	1	17.55 – 24.60	Hassanien et al., 2014; Todaro et al., 2013
ğaban nābülsī type	23.43	2	16.3 – 23.50	Ayyash and Shah, 2011; Todaro et al., 2013
ğibnah ʿAkāwī type	19.59 ± 5.53	1	3.4 – 22.3	Abou Jaoude et al., 2010
ğibnah baiḍāʿ birāmīlī	6.27	1		
qarīš	21.13	1	0.28 – 0.50	Hussein and Shalaby, 2014
slivočnyj	17.53	1	3.9 ± 1.0	Todaro et al., 2013
soft cheeses				
füme çerkez peyniri	16.72	1	25.00 - 27.56	Guneser and Yüceer, 2011; Aydınol and Özcan, 2013
yumuşak peynir	22.41 ± 11.66	4	.	.
pasta filata				
Antep peyniri	23.00	1	5.03 – 25.85	Kahyaoğlu and Kaya, 2003; Tekinşen, 2005
çeçil peyniri	25.00	1	0.50 – 18.43	Elmalı and Uylaşer, 2012; Gülmez and Güven, 2001a; Kamber, 2005; Yıldız et al., 2010
ğibnah mağdūlah	26.27 ± 14.90	2	5.9 – 20.4	Abou Jaoude et al., 2010 ; Toufeli and Özer, 2006
hellim peyniri	18.87	1	22.3 – 28.22	Erbay et al., 2010; Ergonül et al., 2011; Hayaloğlu et al., 2008b
ip peyniri	10.03	1	.	.
Kaşar peyniri	24.55 ± 0.51	2	15.98 – 28.00	Kamber, 2005; Öksüztepe et al., 2009; Sert et al., 2007; Yaşar and Güzeler, 2011
Kaşar peyniri type	17.58 ± 5.07	6	24.75 ± 1.31	Sert et al., 2007
kolot peyniri	35.59	1	.	.
Köy peyniri	21.94	1	16.38 – 21.25	Kesenkaş et al., 2012
sen ichi kama	26.35	1	.	.
stroka syr	25.64 ± 3.14	3	.	.
sünme peyniri	13.40	1	17.16 ± 0.75 – 23.75 ± 0.98	Mutluer and Güven, 2010
tel panir	15.83 ± 11.43	3	.	
tel peyniri type	4.04	1	.	
telak panir	23.00	1	.	

*x = arithmetic mean, sd = standard deviation, n = sample size

Discussion

Fat content

A high degree of variation dominated the fat content results in the present survey and in the literature alike. The reasons for this are multiple.

First, prime matter for (traditional) cheese production can vary markedly, depending on the region and even on the manufacturer. One reason for this is that milk compo-

sition (e. g. fatty acids pattern) varies with the feedstuffs and which may have an impact on the quality and taste of the cheese. By means of an example, *tulum* and *Dumiaṭī* can be made from goat, sheep, buffalo or cow milk, and the milk may be raw, heated below or at pasteurization temperatures (El-Baradei et al., 2007; Hayaloğlu et al., 2008a; 2008b). Second, processing steps may vary from one region to the other, and while in some cases, this product receives a new name (as is seen typically in Turkey), in other cases this is not the case, e. g. in Egypt (El-Baradei et al., 2007; Hayaloğlu et al., 2008a; 2008b). *Şanklīş* is known throughout the Levantine and in Egypt. While in the Levantine it is crafted from cow's or sheep's milk white cheeses, the Egyptian version is made from *qarīş* and is fermented. Sudanese *miš* manufacture also varies greatly, even from family to family, depending on the availability of spices and the taste of the consumers; in some areas, it also may contain maggots which are consumed as part of the foodstuff (El Zubeir et al., 2004).

Third, cheeses are dynamic foodstuffs that change their composition during processing and ripening. Fat content increases as the cheeses loses water during ripening (Al-Dabbas et al., 2014; Hayaloğlu et al., 2008a). Fourth, there should be differences in the degree of standardisation between industrial and artisanally-made cheeses. Industrial cheeses are made with a high degree of standardisation, beginning from the type of milk (as skim milk or yoghourt have a different initial fat content as e. g. entire milk) and starter cultures (and their lipolytic activity) to heating protocols and a HACCP system to guarantee a stable level of product properties. This however is not always true in the case of the industrial versions of traditional cheeses that are part of this survey. While maintaining a certain standard of composition and microbiology in artisanally-crafted cheeses is often neither pursued nor wanted, the lack of standardisation is one of the important challenges for the future of the Turkish cheese industry (Hayaloğlu et al., 2008a; 2008b; Kan et al., 2010). The step from traditional to industrial production including hygienic improvements is also undertaken in Egypt, e. g. with *qarīş*, where the effect of different processing methods (changing starter cultures with or without adding rennet) showed significant changes in composition and rheological properties (Hussein and Shalaby, 2014).

Fifth, some products vary intendedly in their composition, e. g. *Dumiaṭī*. In the first stages of production, the cream layer of the milk is removed, and only a part is added again in order to create different fat levels. The Egyptian standard recognizes low (≤10 % fat in dry matter), half (≤25), three quarters (≤35), and full fat level (≥45) *Dumiaṭī*, with moisture contents of ≥10, 20, 30, and 40 %, resp. (Abd-El Salam and Benkerroun, 2006). Many cheeses contained relatively high amounts of fat (tab. 2 and 3) which is rather typical, since e. g. in Northern Africa cheeses are in high esteem because

TABLE 3: *Mean total fat [%] of selected Non-EU cheeses (n = 65), part 2: yellow cheeses, cheese preparations, and processed cheeses.*

	Survey		Literature	References
	x ± sd*	n*		
yellow cheeses				
Rūmī	28.57 ± 7.59	3	.	.
cheese peparations				
lavaş peyniri type	21.93 ± 2.93	2	17.42 ± 2.95	Çelik et al., 2001
miš	14.84 ± 15.51	2	0.50 – 7.13	Abd-El Salam and Benkerroun, 2006; El Zubeir et al., 2004; Sulieman et al., 2011
šanklīš	4.93	1	4.4 – 12.7	Addas et al., 2012
Van otlu peyniri type	16.72	1	14.50 – 31.50	Hayaloğlu and Fox, 2008
processed cheeses				
dilimli peyniri	27.00	1	.	.
plain	25.31 ± 9.37	2	11.00 - >25.00	Bundesministeriums der Justiz und für Verbraucherschutz, 2013
syr kolbasa Luhskij	27.27	1	.	.
yağlı peyniri	30.50	1	.	.

*x = arithmetic mean, sd = standard deviation, n = sample size

TABLE 4: *Microbiological counts [log cfu/g] of selected non-EU cheeses (n = 65) part 1: fresh, brine, soft, and pasta filata cheeses. For sample sizes see Tab. 2.*

	Enterobacteriaceae	*E. coli*	Yeasts and moulds	Total aerobic bacterial counts
fresh cheeses				
Berendi tulum peyniri	<dl*	<dl	<dl	5.2
Istanbolly cheese	<dl	<dl	<dl	<dl
labne	<dl	<dl	<dl	<dl
labne type	<dl	<dl	3.9	>7.5
lor peyniri	2.4	<dl	>4.5	6.7
tulum type	4.0 ± 0.2	2.2	2.5 ± 0.6	5.7 ± 1.6
brine cheeses				
beyaz peyniri	<dl	<dl	2.8	7.3
Dumiaṭī	<dl	<dl	<3.7	5.1
feta cheese	2.7	<dl	<dl	3.6
ğaban nābūlsī type	<dl	<dl	1.7	6.2 ± 0.3
ğibnah ʿAkāwī type	<dl	<dl	<3.7	3.7
ğibnah baiḍā' birāmīlī	<dl	<dl	<dl	<3.7
qarīš	<dl	<dl	<dl	<3.7
slivočnyj	2.2	<dl	<dl	6.1
soft cheeses				
füme çerkez peyniri	<dl	<dl	<dl	5.2
yumuşak peynir	<dl	<dl	1.7*	5.5 ± 1.6
pasta filata				
Antep peyniri	2.8	<dl	<dl	6.9
çeçil peyniri	<dl	<dl	4.4	7.0
ğibnah mağdūlah	5.3	<dl	<dl	4.2 ± 1.1
hellim peyniri	<dl	<dl	<dl	3.5
ip peyniri	<dl	<dl	1.7	5.7
Kaşar peyniri	<dl	<dl	<dl	5.5 ± 2.7
Kaşar peyniri type	4.0 ± 1.6	3.1 ± 0.3	3.6 ± 1.4	6.2 ± 1.2
kolot peyniri	<dl	<dl	<dl	7.4
Köy peyniri	<dl	2.0	4.4	7.5
sen ichi kama	<dl	<dl	<dl	3.5
stroka syr	<dl	<dl	<dl	6.2 ± 0.5
sünme peyniri	<dl	<dl	<dl	4.1
tel panir	4.2	<dl	2.6	5.9 ± 1.3
tel peyniri type	<dl	<dl	3.1	6.9
telak panir	5.1	<dl	2.4	4.9

*<dl = below detection limit (i.e. 2.7 log cfu/g in *Enterobacteriaceae*, 1.7 log cfu/g for *E. coli*, yeasts and moulds, and 3.5 log cfu/g total aerobic bacterial counts)

Journal of Food Safety and Food Quality 66, Heft 4 (2015), Seiten 85–124

of their ability to provide energy to hard workers via fat. Recently, low-fat versions of traditional products have been developed (contributing to the high degree of variation among values) and their consumption promoted (WHO, 2012).

Then, the literature was very heterogeneous, and while some products like *tulum* and *Dumiaṭī* are relatively well-documented (El-Baradei et al., 2007; Hayaloğlu et al., 2008a), others lacked published data completely. Besides, the literature usually reflects a given status quo by describing products from a certain area (Ergonül et al., 2001) rather than presenting standards.

Finally, differences between reference values and measured ones may also be explained by misclassification of the cheeses. It must be remembered that because the samples were category 2 material, no sensory analysis could be made which would have improved the recognition of a given product.

Microbiology

As with the fat content, sample sizes for the microbiological analysis were very small. A direct comparison with literature values (as cited in Grabowski et al., 2015) is therefore problematic. Instead, the results were evaluated applying the food safety criteria established at EU and German level (Klein and Schütze, 2011).

Only ten of the 40 different cheese types did not comply with these requirements, with elevated counts *Enterobacteriaceae,* yeasts and mould being most frequent. These are typical conditions, but contrarily to the literature (summarized in Grabowski et al., 2015), no salmonellae, listeriae nor elevated counts of *E. coli* nor CPS were encountered. Many traditional cheeses contain zoonotic and opportunistic pathogens that are a serious challenge to public health, and in fact many case reports made in the countries of origin state that the obtained values ranged above national (e. g. Turkish or Egyptian) standards (Arab Republic of Egypt, 2005; El Zubeir et al., 2004; Sert et al., 2007). Besides, passengers travelling long distances and carrying dairy products in their luggage are unlikely to be able to maintain the cold chain. Insofar, elevated bacterial counts could have been expected.

On one hand, many of the sampled products were industrially-crafted, and the usage of heat-treated milk together with an air-tight packaging (if existent) may have eliminated major health risks. Still, this is no absolute guarantee for food safety as was seen in a study in which heat-treated dairy products confiscated at Brazilian airports did contain a series of pathogens including *Brucella* spp. and *Mycobacterium* spp. (Barros de Melo et al., 2014).

On the other hand, the literature also mentions cases in which the products were actively analysed for a given parameter in its country of origin, but was not detected. In this way, the following cheeses types were negative for

TABLE 5: *Microbiological counts [log cfu/g] of selected non-EU cheeses (n = 65) part 2: yellow cheeses, cheese preparations, and processed cheeses. For sample sizes see Tab. 4.*

	Enterobacteriaceae	*E. coli*	Yeasts and moulds	Total aerobic bacterial counts
yellow cheeses				
Rūmī	5.0 ± 0.289	<dl	<dl	6.3 ± 1.2
cheese peparations				
lavaş peyniri type	<dl	<dl	2.2	6.9 ± 0.2
miš	<dl	<dl	<dl	4.4 ± 1.1
šanklīš	5.2	<dl	<dl	4.6
Van otlu peyniri type	<dl	<dl	<dl	6.8
processed cheeses				
dilimli peyniri	<dl	<dl	<dl	3.6
plain	<dl	<dl	<dl	5.9 ± 1.2
syr kolbasa Luhskij	<dl	<dl	<dl	<dl
yağlı peyniri	<dl	<dl	<dl	4.4

*<dl = below detection limit (i.e. 2.7 log cfu/g in *Enterobacteriaceae*, 1.7 log cfu/g for *E. coli*, yeasts and moulds, and 3.5 log cfu/g total aerobic bacterial counts)

TABLE 6: *Illegally-imported cheeses exceeding recommended EU and German microbiological thresholds as compiled by Klein and Schütze (2011). Areas marked in grey indicate parameters that are not applicable to a given cheese group (cf. tab. 1), and "." means "no data", while "total of samples" refers to all samples analysed of a given cheese type.*

Cheese group / Cheese type	Samples [n] above recommended threshold (see tab. 1) *Enterobacteriaceae*	Yeasts and moulds	Total aerobic bacterial count	Total of samples [n]
fresh cheeses				
labne type	.	1		1
lor peyniri	.	1		1
tulum type	3	2		5
pasta filata				
ğibnah mağdūlah type	1			2
Kaşar peyniri type	2			4
İel panir	1			3
İelak panir	1			1
cheese preparations		.		
šanklīš	1	.		1
processed cheeses				
plain			2	2
yağlı peyniri			1	1
total	**9**	**4**	**3**	

- Salmonellae: *labne, beyaz peyniri, ğaban nābūlsī, panir Lori, Rūmī,*
- *Listeria monocytogenes: labne, Kaşar peyniri,*
- *E. coli: labne, füme çerkez peynir,* and
- Coagulase-negative staphylococci: *labne* (Al-Dabbas et al., 2014; Fadel and Ismail, 2009; Semaan et al., 2011; Truzyan, 2003).

Finally, since the material had to be frozen, this might have had an impact on the outcome of recovery rate and the cultivability in the microbiological analysis. Although freezing may not affect viability of many pathogens as such, accompanying conditions (e. g. duration, low pH of the medium resp. matrix, reproductive phase of the bacteria) and cycles of freezing and thawing can lead to marked reductions in bacterial growth afterwards (Archer, 2003).

Conclusion

The present survey overviewed the fat content and microbiological properties of some non-EU cheeses confiscated at German borders. The heterogeneity of results is reflected in the literature showing that these products are characterized by a high degree of idiosyncrasy. While risks because of food-borne diseases are known from many of these cheese types, the reasons for relatively favourable microbiological results in the present survey may be due to hygienic manufacturing in the first place (including growth control via traditional methods) or biases because of prescribed risk material handling procedures. In any case, the scarcity and variability of data stresses the need to enhance research and surveillance in this area, even more so as the manufacture of many products is shifting from artisanal to industrial level in order to ensure public health in the countries of origin.

Acknowledgements

The authors express their gratitude towards Mrs. Silke Ortaeri for her excellent technical assistance in the analyses.

Conflict of interest

The authors certify that they have no affiliation with nor involvement in any organization/entity with any financial or non-financial interest in the subject's matter nor materials included in this manuscript.

References

Abd-El Salam M, Benkerroun H (2006): North African brined cheeses. In: Tamime AY (Ed.): Brined cheeses. Blackwell Publishing, Oxford, Great Britain.

Abou Jaoude D, Olabi A, El Ouyoun Najm N, Malek A, Saadeh C, Baydoun E, Toufeli I (2010): Chemical composition, mineral content and cholesterol levels of some regular and reduced-fat white brined cheeses and strained yoghurt (labneh). Dairy Sci Technol 90: 699–706.

Addas M, Hilali MED, Rischkowsky B, Kefalas P (2012): The quality of Syrian shanklish a traditional dairy product. Tropentag "Resilience of agricultural systems against crises", Göttingen, Germany 2012, http://www.tropentag.de/2012/abstracts/links/Rischkowsky_RqFhshxZ.pdf. Accessed last on June 17th 2015

Al-Dabbas MM, Saleh M, Abu-Ghoush MH, Al-Ismail K, Osaili T (2014): Influence of storage, brine concentration and in-container heat treatment on the stability of white brined Nabulsi cheese. Int J Dairy Technol 67: 427–436.

Alichanidis E, Polychroniadou A (2008): Characteristics of major traditional cheese varieties of East-Mediterranean countries: a review. Dairy Sci Technol 88: 495–510.

Arab Republic of Egypt (Ed., 2005): الجبن الطرى الجزء الرابع: جبن القريش. https://law.resource.org/pub/eg/ibr/es.1008.4.2005.pdf, Accessed last on June 17th 2015

Archer DL (2004): Freezing: an underutilized food safety technology? Int J Food Microbiol 90: 127–138.

Aydınol P, Özcan T (2013): The effect of natural and liquid smokes on the benzo[a] pyrene content and quality parameters of Circassian smoked cheese. Int J Dairy Technol 66: 498–504.

Ayyash MM, Shah NP (2011): The effect of substituting NaCl with KCl on Nabulsi cheese: chemical composition, total viable count, and texture profile. J Dairy Sci 94: 2741–2751.

Barros de Melo C, Pinheiro da Sá ME, dos Reis Souza A, Macedo de Oliveira A, Coelho Mota PMP, Campani PR (20014b): Bacteria in dairy products in baggage of incoming travelers, Brazil. Emerg Infec Dis 20: 1933–1934.

Bintsis T, Papademas P (2002): Microbiological quality of white brined cheeses: a review. Int J Dairy Technol 55: 113–120.

Bundesministerium der Justiz und für Verbraucherschutz (Ed., 2013): Käseverordnung in der Fassung der Bekanntmachung vom 14. April 1986 (BGBl. I S. 412), die zuletzt durch Artikel 19 des Gesetzes vom 25. Juli 2013 (BGBl. I S. 2722) geändert worden ist. http://www.gesetze-im-internet.de/bundesrecht/k_sev/gesamt.pdf. Accessed last on June 17th 2015

Çelik Ş, Özdemir C, Özdemir S (2001): Production techniques and some properties of traditional lavas cheese. Online J Biol Sci 1: 603–605.

Çiftçioğlu G, Erkan ME, Vural A, Aksu H (2008): Assessment of some microbiological and chemical properties of lor whey cheese. Journal of Food, Agriculture & Environment 6: 109–113.

El-Baradei G, Delacrtoix-Buchet A, Ogier JC (2007): Biodiversity of bacterial ecosystems in traditional Egyptian Domiati cheese. Appl Environ Microbiol 73: 1248–1255.

Elmalı G, Uylaşer V (2012): Geleneksel gıdalardan çeçil peynirin üretmi ve özellikleri. Ziraat Fakültesi Dergisi 26: 83–92.

El Zubeir IEM, Abdalla WM, El Owni OAO (2004): Chemical composition of fermented milk (roub and mish) in Sudan. Food Control 16: 633–637.

Erbay Z, Koca N, Üçüncü (2010): Hellim peynirinin bileşimi ile renk ve dokusal özellikleri arasındaki ilişkiler. GIDA – Journal of Food 35: 347–353.

Ergonül B, Ergonül PG, Seçkin AK (2001): Chemical and textural attributes of hellim (halloumi) cheese marketed in Turkey. Mljekarstvo 61: 168–174.

Fadel HM, Ismail J (2009): Prevalence and significance of *Staphylococcus aureus* and *Enterobacteriaceae* species in selected dairy products and handlers. International Journal of Dairy Science 4: 100–108.

Grabowski NT, Jansen W, Ortiz Cárdenas DA, Gómez Miranda DF, González Aguilar D, Pacheco Gallardo C, Klein G (2015): Dairy products introduced illegally by airline passengers into Germany and their zoonotic potential. Arch Lebensmittelhyg, 66: 88–98.

Gülmez M, Güven A (2001a): Kars ilinde satışa sunulan çeçil (civil) peynirlerin bazı mikrobiyolojik ve kimyasal özellikleri. Kafkas Üniv Vet Fak Derg 7: 63–70.

Gülmez M, Güven A (2001b): Beyaz ve çeçil peynirlerinde *Campylobacter, Salmonella* ve *Listeria* türlerinin araştırılması. Kafkas Üniv Vet Fak Derg 7: 155–161.

Guneser O, Yüceer YK (2011): Characterisation of aroma-active compounds, chemical and sensory properties of acid-coagulated cheese: Circassian cheese. Int J Dairy Technol 64: 517–525.

Hassanien MFR, Maghoub SA, El-Zahar KM (2014): Soft cheese supplemented with black cumin oil: impact on food borne [sic] pathogens and quality during storage. Saudi J Biol Sci21: 280–288.

Hayaloğlu AA, Fox PF, Güven M, Çakmakçı S (2008a): Cheeses of Turkey: 1. Varieties ripened in goat-skin bags. Lait 87: 79–95.

Hayaloğlu AA, Özer BH, Fox PF (2008b): Cheeses of Turkey: 2. Varieties ripened under brine. Dairy Sci Technol 88: 225–244.

Hayaloğlu AA, Fox PF (2008): Cheeses of Turkey: 3. Varieties containing herbs and spices. Dairy Sci Technol 88: 244–256.

Hilani M, El-Mayda E, Rischkowsky B (2011): Characteristics and utilization of sheep and goat milk in the Middle East. Small Rum Res 101: 92–101.

Hussein GAM, Shalaby SM (2014): Microstructure and textural properties of Kareish cheese manufactured by various ways. Ann Agric Sci 59: 25–31.

Jansen W, Grabowski N, Klein G (2015): Legal regulations for the introduction of products of animal origin in personal consignments into the European Union and their implementation in Germany. Journal of Food Safety and Food Quality, Arch Lebensmittelhyg 66, 41–45

Kahyaoğlu T, Kaya S (2003): Effects of heat treatment and fat reduction on the rheological and functional properties of Gaziantep cheese. Int Dairy J 13: 867–875.

Kamber U (2005): Kars'ta satışa sunulan Kaşar ve çeçil (civil) peynirlerinin bazı mikrobiyolojik ve kimyasal kalite nitelikleri. Kafkas Üniv Vet Fak Derg 11: 33–38.

Kan M, Gülçubuk B, Kan A, Küçükçongar M (2010): Coğrafi işaret olarak Karaman Divle tulum peyniri. KMÜ Sosyal ve Ekonomik Araştırmalar Dergisi 12: 15-23.

Kavaz A, Arslaner A, Bakırcı (2012): Comparison of quality characteristics of Çökelek and lor cheeses. Afr J Biotechnol 11: 6871–6877.

Kesenkaş H, Dinkçi N, Kınık Ö (2012): Farklı işletmelerde üretilen Köy peynirlerinin özellikleri. Ege Üniversitesi Ziraat Fakültesi Dergisi 49: 167–173.

Klein G, Schütze B (2011): Handbuch der mikrobiologischen Beurteilung von Lebensmitteln. Behr's Verlag, Hamburg, Germany.

Morul F, İşleyici (2012): Divle tulum peynirinin kimyasal ve mikrobiyolojik özellikleri. YYU Veteriner Fakültesi Dergisi 23: 71–76.

Mutluer U, Güven M (2010): Uygulanan bazı farklı işlemlerin sünme peynirinin özellikleri üzerine etkisi. Çukorova Üniversitesi Fen Bilimleri Ensitüsü 22: 19–28.

Nsabimana CV, Hang B, Kossah R (2005): Manufacturing, properties and shelf life of labneh: a review. Int J Dairy Technol 58: 129–138.

Öksüztepe G, Patır B, Dikici A, İlhak Oİ (2009): Elazığ'da tüketime sunulan vakum paketli taze Kaşar peynirlerinin mikrobiyolojik ve kimyasal kalitesi. Fırat Üniversitesi Sağlık Bilimleri Veteriner Dergisi 23: 89–94.

Osaili TM, Al-Nabulsi AA, Taha MH, Al-Holy MA, Alaboudi AR, Al-Rousan WM, Shaker RR (2012): Occurrence and antimicrobial susceptibility of *Listeria monocytogenes* isolated from brined white cheese in Jordan. J Food Sci 77: M528–M532.

Semaan EH, Dib H, Abi Ramia R, Chedid M (2011): Caractérisation chimique et qualité bactériologique de produits laitiers caprins traditionnels libanais. Lebanese Science Journal 12: 21–29.

Sert D, Ayar A, Akın N (2007): The effects of starter culture and chemical composition, microbiological and sensory characteristics of Turkish Kaşar cheese during ripening. Int J Dairy Technol 60: 245–252.

Sienkiewicz T, Kirst E (2006): Analytik von Milch und Milcherzeugnissen. Behr's Verlag, Hamburg, Germany.

Sömer VF, Kılıç GB (2012): Microbiological, physicochemical properties and biogenic amine contents of the strained yoghurts from Turkish local markets. Afr J Biotechnol 11: 14336–14343.

Sulieman AMEH (2007): Effect of pretreatment of milk quality characteristics of jibna-beida (white cheese). International Journal of Food Engineering 3: DOI 10.2202/1556-3758.1123

Tekinşen KK (2005): K. Maraş ve çevresinde üretilen Maraş peynirlerinin mikrobiyolojik ve kimyasal kalitesi. Avrasya Veteriner Bilimlerli Dergisi 21: 57–63.

Todaro A, Adly FA, Omar OAH (2013): History, processing and quality enhancement of traditional Egyptian kariesh cheese: a review. Food Science and Technology 1: 1–6.

Toufeli I, Özer B (2006): Brined cheeses from the Middle East and Turkey. In: Tamime AY (ed.): Brined cheeses. Blackwell Publishing, Oxford, GB, 188–210.

Truzyan N (2003): Baseline assessment of the microbiological contamination of Lori cheese sold in Yerevan markets. Yerevan, Armenia, American University of Armenia, diss.

WHO (ed.; 2012): Promoting a healthy diet for the WHO Eastern Mediterranean Region: user-friendly guide. WHO, Cairo, Egypt.

Yaşar Z (2009): Bögesel kalkınmada yöresel ürunlerin kullanımı: Divle Tulum peyniri örneği. Adana, Turkey, Çukurova Üniversitesi, diss.

Yıldız F, Yetisemiyen A, Senel E, Özkaya D, Öztekin S, Sanlı E (2010): Some properties of Civil cheese: a type of traditional Turkish cheese. Int J Dairy Technol 63: 575–580.

Address of corresponding author:
Dr. Nils Th. Grabowski
Institut für Lebensmittelqualität und -sicherheit (LMQS),
Stiftung Tierärztliche Hochschule Hannover,
Hannover
Germany
Nils.Grabowski@tiho-hannover.de