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# How safe is European Internet cheese? A purchase and microbiological investigation

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ABSTRACT

The suitability for consumers of a variety of raw milk cheeses purchased over the Internet was investigated in terms of packaging, labelling, physicochemical parameters and microbiological safety. 108 purchases from seven European countries were examined. The prevalences of *Salmonella* spp., *Listeria monocytogenes*, *Escherichia coli* and coagulase positive staphylococci (SA) were determined. All 108 samples were described on websites as raw milk cheeses and thereby qualified for this study. However, after delivery it was noted that 4.6% (5/108) of cheeses were labelled to be manufactured from heat-treated or pasteurized milk. Delivery duration ranged from 24 h to six days. Immediately upon receipt cheese temperatures were observed to range between 5 and 23 °C, whereas in 61.5% of all cases the temperature was higher than 15 °C. Cheese labelling was examined in respect of EC Guideline 2000/13 and Regulation No. 853/2004. Only 17.6% (19/108) of cheeses were properly labelled and fulfilled all European guideline requirements. In 50.9%, 38.8%, 46.3% and 39.8% of all cases (i) specific storage requirements, (ii) name and address of the manufacturer/packer or seller, (iii) net weight and (iv) shelf life (use by date), were missing. Even the labelling information "made from raw milk" was not apparent on 36% of all cheese items delivered. The major foodborne pathogen *L. monocytogenes* was detected in 1.9% of all samples, one of which had counts of $9.5 \times 10^3$ CFU/g. None of the 108 investigated cheeses showed a pH $\leq$ 5.0 and $a_w$ value $\leq$0.94 which are the limiting values for growth of *L. monocytogenes*. For two samples (0.9%) and 11 samples (10.2%) the pH and the $a_w$ value was $\leq$4.4 or $\leq$0.92, respectively at least at one of three stipulated time points (receipt, mid-shelf-life and at expiry). *Salmonella* spp. could not be detected in any of the samples. *E. coli* and SA could be detected in a total of 29.6% ($\geq$10 CFU/g; 32/108) and 8.3% ($\geq$100 CFU/g; 9/108) of samples, respectively, indicating poor conditions of hygiene. Results reveal that labelling and hygiene concerns about the safety of Internet purchased cheeses in Europe are justified.



## 1. Introduction

Microbial contamination of raw milk and its edible products have long been recognized as causal agents of human illness (Oliver, Boor, Murphy, & Murinda, 2009; Oliver, Jayarao, & Almeida, 2005; Robinson, Scheftel, & Smith, 2014). Cheese is no exception, as its manufacture involves several steps where contamination may occur and once produced it is left for prolonged periods to mature at various temperatures. The physicochemical consistency of some cheese types is readily suited to microbial growth of zoonotic and commensal bacteria. Some of these bacteria, such as *Listeria* (*L.*) *monocytogenes* and *Salmonella* spp., are important pathogens that when consumed can result in severe disease and even death (Dominguez et al., 2009; Goulet, Jacquet, Vaillant, Rebiére, & Mouret, 1995). Cheeses with high water content, such as the soft varieties, and those that undergo a slow rise in pH with maturation, are especially vulnerable to growth (Schoder, Rossmanith, Glaser, & Wagner, 2012).

Retailers of cheese traditionally respect that spoilage of their products can be retarded by refrigeration. This has worked well for

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decades of cross-border commerce where cheeses can be transported in refrigerated vehicles. However, today more and more retailers in general are using the Internet to channel sales. For retailers this permits a virtual platform to target particular segments of the market. For consumers, conveniences include the ability to shop whenever they like without having to leave home. Nevertheless, a growing tendency to market cheese via the Internet has elicited serious concerns as to how safe it is to deliver cheese by post. In comparison with electronic commerce in non-foods, higher logistic requirements are necessary for foodstuffs, such as appropriate handling within a refrigeration chain, appropriate labelling and hygienic packaging. On the other hand, the readiness of Internet customers to bear the additional expenses for these precautions in comparison with non-food items is limited (Morath & Doluschitz, 2002).

Safety of these Internet sourced cheese products and the conformity with regulatory norms and all necessary hygiene precautions are a matter of concern. The current novelty of buying food online seriously raises concerns that all these issues must be questionable in the absence of reactionary regulatory oversight. The problems are exacerbated by long transportation times of packaged portions taken from a whole product. Consequently, the aim of this study was to investigate and compare the parameters that pertain to the hygiene status of a variety of Internet-purchased cheeses. These included physicochemical and microbiological characteristics of a variety of cheeses purchased in respect of their suitability for human consumption. In addition, labelling and packaging were evaluated in the context of EU guidelines and regulations. The study was confined to Europe and simulated the procedure used by an Austrian consumer selecting a product from their home computer to be delivered to their home address. In this way cheeses purchased within the EU, but out-with Austrian borders, could be compared and contrasted.

## 2. Materials and methods

### 2.1. Internet search, order and delivery

Cheese retailers offering online purchases to Austrian consumers were identified by Google searches. Choice of cheese purchased was based on the following: online sales, type of milk used, country of production and cheese type (preferably soft cheese with a focus on raw milk cheese) as this is suspected to be of higher microbiological risk (Oliver et al., 2009).

Orders for cheese products were placed using the online forms provided. Deliveries were requested to a private home address in Austria. Immediately after delivery the cheese temperature was measured (details below) and the item stored at 4 °C for max. 3 days.

### 2.2. Packaging, labelling and physical examination

Package labelling was evaluated in accordance with EC Guideline 2000/13/EC (Harmonization of package labelling, presentation and advertising of foodstuffs) and Regulation No. 853/2004 (Regulation laying down specific hygiene rules for food of animal origin). The presence or absence of specific information relevant to food composition, including storage requirements, was recorded. Internet product description was compared with EC Regulation No. 1169/2011 (Regulation on the provision of food information to consumers) and any discrepancies noted (EC, 2000, 2004, 2011).

Cheese pH and $a_w$ values were measured in respect of the declared shelf-life data at two or three separate time points. Initial measurements took place immediately, or at the latest three days, following delivery. When the time between receipt and the declared end of expiry (use by date) date was longer than two weeks, second or third measurements were made during the second half of this elapsed period, in which the samples were stored at 7 °C. If the declared "use by date" was under two weeks, the second measurement was omitted. The final measurement took place at the end of expiry date.

Temperatures were measured using an Electronic TLC 730 cheese thermometer (ebro Electronic, Ingolstadt, Germany). Cheese pH values and $a_W$ values were directly measured both at the surface of the cheese and at the interior using a SenTix SP probe electrode MultiCal pH 526 (WTW, Weilheim, Germany) and a LabMaster-$a_w$ device (Novasina, Lachen, Switzerland). Water activity ($a_w$) values were measured following sectioning of the cheese samples into small pieces of approximately 4 g in weight, using a sterile knife, to compare surface and interior parts of the cheese samples. The $a_w$ values were measured at 25 °C, which took into account the humidity equilibrium between the probe and a controlled airspace. The device was programmed to display a stable $a_w$ value within 5 min when the temperature change within the chamber was less than 0.1 °C and the change in the $a_w$ value was less than 0.001. Measuring precision was estimated at ±0.003 $a_w$.

### 2.3. Microbiological examinations

Microbiological examinations were performed for *Listeria* spp. and *Listeria monocytogenes* qualitatively and quantitatively, according to ISO 11290 1+2 (ISO, 1996a, 1996b); *Salmonella* spp., according to ISO 6579 (ISO, 2002); *Escherichia coli*, according to the modified ISO Standard 16649 (with chromID Coli; ISO, 2001) and coagulase-positive staphylococci, according to ISO 6888 (ISO, 1999a, 1999b). EC Regulation No 2073/2005 (EC, 2005) and the Austrian national guidelines on the microbiological criteria for milk and milk products were used to interpret microbiological results.

### 2.4. Detection of Listeria spp. and L. monocytogenes

Twenty-five gram cheese samples were added to 225 ml Half Fraser (HF) broth (Biokar Diagnostics, Beauvais, France) and mixed in a stomacher bag and homogenized with a stomacher blender, according to the texture of the cheese, followed by 24 h of incubation at 30 °C. 100 μl aliquots of HF pre-enrichment broths were transferred to 10 ml of Full Fraser (FF) (Biokar) and incubated at 37 °C for 48 h, according to ISO 11290-1. Broth streaks from HF and FF broths were made onto Aloa (Merck, Darmstadt, Germany) and Palcam agar (Biokar). Following incubation, plates were inspected for the presence of typical *Listeria* colonies.

When colonies were present, plates were rinsed with 1 ml of 0.01 M Tris buffer and DNA isolated by the quick isolation method with Chelex, described by Walsh, Metzger, and Higuchi (1991). DNA was examined for the presence of the *iap*-gene (Bubert et al., 1999) and the 16 sRNA/*hly*-gene (Border, Howard, Plastow, & Siggens, 1990) using PCR following electrophoresis of fragments in 1.5% agarose gel with 0.5 × TBE Tris borate electrophoresis buffer (TBE) and the addition of 3.5 μl SYBR Safe DNA gel stain (Invitrogen, Eugene, Oregon, USA) at 120 V for 25 min. GeneRuler 100 bp (MBI Fermentas, St Leon-Rot, Germany) was used as a standard.

### 2.5. Enumeration of Listeria spp. and L. monocytogenes at end of expiry (use by date)

10 g samples of cheese were homogenized with 90 ml peptone water (CM1049, Oxoid) and left for 1 h for resuscitation. Then, 1 ml suspensions and further dilutions were plated onto Aloa and Palcam plates in triplicate, resulting in 333 μl per plate type. Plates were incubated at 37 °C for 48 h and inspected for suspicious