dimension separated mould-ripened cheese from the others on the basis of musty/pungent aroma. The mould-ripened cheese were not separated by the second dimension, but this dimension separated the other samples largely on the basis of fruity aroma.

MUIR, D.D., HUNTER, E.A., WATSON, M.: **Aroma von Käse. 1. Sensorische Charakterisierung.** Milchwissenschaft **50** (9) 499–503 (1995).

54 Käse (Aroma)

Es wurde ein Protokoll für die Charakterisierung des Aromaprofils von Hart- und Schnittkäse entwickelt. Die Auswirkung der Meßtemperatur war gering, und es wurde festgestellt, daß die Aromaintensität bei 25°C am stärksten war. Alle untersuchten Proben wurden in Form von 9 Aromaeigenschaften angemessen beschrieben – Gesamtintensität, sahnig/milchig, schweflig/eiartig, fruchtig/süß, ranzig, Kuhgeschmack (unsauber, sauer, muffig und scharf).

Die Aromaunterschiede zwischen den Proben können am besten in Begriffen zweier sensorischer Dimensionen beschrieben werden. Die erste Dimension trennte schimmelgereifte Käse von den anderen auf der Grundlage des muffig/scharfen Aromas. Der schimmelgereifte Käse wurde nicht durch die zweite Dimension abgetrennt, aber diese Dimension trennte die anderen Proben vorwiegend auf der Grundlage des fruchtigen Aromas.

Bacteriological quality of a traditional Spanish blue cheese

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1. Introduction

Cheese made from raw milk and following traditional manufacturing procedures may possess a very diverse and rich microflora. The quality of the cheese at the state of consumption depends to a great extent on the composition of that microflora. Some microorganisms present are beneficial for the product, like lactic acid bacteria, but some of them may be undesirable. Both, the quality of the cheese and its harmlessness for the consumer may be at risk if some specific microorganisms are present.

High levels of enterobacteria and/or enterococci in cheese usually indicate poor bacteriological quality of the milk and, because of their fecal origin, poor hygienic practices during the manufacture that may have led to contamination by other undesirable bacteria. In addition, these flora may reduce the organoleptic quality of the cheese (1).

On the other hand, some pathogenic bacteria may be present in cheese, with *Salmonella* spp, *Escherichia coli, Listeria monocytogenes* and *Staphylococcus aureus* being the most likely to appear. They have been implicated in outbreaks by the consumption of cheese (2, 3). The first 3 are considered high risk microorganisms in cheese industry; *S. aureus* can be more easily controlled (3). The presence of these microorganisms in ripened cheeses depends on a number of factors: their release with the milk and its postcontamination, multiplication during the first stages of manufacture and inactivation during fermentation, ripening and storage (4).

In this report, the bacteriological quality of a cheese made with raw milk in a traditional way (Valdeón blue cheese, province of León, Spain) was investigated.

2. Materials and methods

2.1 Samples

A total of eleven cheeses purchased on the local market were analysed. Cheese sampling was performed according to the ICMSF (5). The manufacturing process was as follows: raw goat milk (occasionally mixed with cow milk) was coagulated (20 – 30°C for 1 – 2 h) with animal rennet (kids) or commercial rennet. The whey was removed with a saucepan, and the curd was filled into suitable cylindrical moulds (tinplates). Drainage proceeded for 2 d, and during this time, coarse salt was sprinkled over the surfaces. The first 10 – 15 d of ripening the cheeses were placed in a warm room (17–23°C and 70 – 90 % relative humidity, RH). For the next stage in maturing, the cheeses were moved to natural mountain caves (700-1,500 m altitude; 7-12°C and 95-99 % RH) and turned at intervals throughout the rest of the ripening period (several months) (6).

2.2 Microbiological analysis

Representative 25 g samples of cheese taken from the interior were homogenized in a Stomacher Lab-blender for 90 s, with 225 ml of warm (45°C) 2% aqueous solution of sodium citrate. Decimal dilutions were prepared in 0.1 % peptone water.

The microbiological groups studied and the media and incubation conditions used were as follows: a) mesophilic aerobes, Plate Count Agar (PCA, Oxoid), 30°C/48 h (7); b) enterococci, Kanamycin Aesculin Azide Agar (KAA, Oxoid), 35 °C/16-24 h (8); c) Enterobacteriaceae, Violet Red Bile Glucose Agar (VR BGA, Oxoid), 37°C/24 h (7); d) lactic acid bacteria, Man, Rogosa & Sharpe Agar (MRS, Oxoid), 30°C/48 h (9); e) Gram-positive, catalase-positive cocci (Micrococcaceae), Mannitol Salt Agar (MSA, Oxoid), 30°C/48 h (10);

The presence of *S. aureus, E. coli* and *Salmonella* spp in 25 g samples was examined using a method of filtration through hydrophobic membrane (11). The presence of *L. monocytogenes* was determined according to the International Provisional Norm FIL-IDF143:1990.

2.3 Chemical determinations

The following measurements were made during manufacture: pH (electrometrically, 12) at all stages, NaCl content (13) at all stages except milk and water activity (14) from curd onwards.

2.4 Organoleptic evaluation

Ten cheeses selected from a total of 30 were evaluated for taste, odour and visual appearance by a panel of 10 persons.

3. Results and discussion

The counts of enterobacteria in our samples were less than 3 log units/g as an average, with a standard deviation of 1 log units/g (Table 1) and in some cheeses counts up to 4.7. The presence of enterobacteria in ripened cheeses indicates the use of raw milk and probably the contamination of the product during manufacturing. As we could observe during sampling, there was an intense manual contact with the cheeses during the manufacturing process, mainly at the first stages, that could lead to the contamination of the product by some bacteria of fecal origin. In addition, high pH's, usual in blue cheeses for the deacidification by fungi (15), and low NaCl content are favourable conditions for this group (16, 17). In our study, those samples with higher enterobacteria numbers presented higher pH (>6) and lower NaCl content (<2.5 g/100 g) than the rest (5.6 and 3.3, mean values). BOER and KUIK (17) also found high counts of members of this family (>100 CFU/g) in 40% samples of blue veined cheese surveyed and numbers superior to 1000 CFU/g in 45% of samples of Gorgonzola.

Enterococci were present in our samples at levels close to 5 log CFU/g. In Roquefort, DEVOYOD (18) found higher levels (superior to 7 log CFU/g). In Cabrales cheese, MARCOS *et al.* (19) found similar levels to ours. This group is also indicative of hygienic quality (1), and its presence in our samples can be understood by the use of raw milk, contamination during manufacture and resistance of this group to adverse conditions (7). On the other hand, some species (*Enterococcus faecalis* and *E. durans*) have been used as starters in some varieties of cheese (20). In Roquefort cheese, DEVOYOD and MULLER (21) and DEVOYOD and DESMAZEAUD (22) found interesting associations between some species of this group and other lactic acid bacteria (*Leuconostoc* and lactic streptococci). However, recently this group has been associated to some problems concerning public health (possible pathogenicity and production of biogenic amines) (23), this making the presence of this bacterium in cheese a controversial topic.

Table 1: Bacteriological quality and physico-chemical parameters

Type of organism	Mean (log CFU/g)	*SD
Mesophiles	8.0	0.6
Micrococci	6.6	1.6
Lactic acid bacteria	8.0	0.5
Enterococci	4.9	1.1
Enterobacteria	2.7	1.0
S. aureus	absence in 25 g	
Salmonella spp.	absence in 25 g	
E. coli	absence in 25 g	
L. monocytogenes	absence in 25 g	
Physico-chemical parameters		
NaCl (g/100 g cheese)	3.27	0.54
a_w	0.89	0.02
pH	5.6	0.8

* Standard deviation

None of the pathogenic bacteria investigated was found in our samples (Table 1). BOER and KUIK (17) did not isolate *Salmonella* and *E. coli* enteropathogenic from their samples of blue cheese and isolated *S. aureus* only from 1 sample of Roquefort cheese and *L. monocytogenes* from 1 of Gorgonzola and 1 of Mascarpone. NORTHOLT (4) indicated that although most pathogens (*Salmonella, E. coli* and *S. aureus*) can grow during the first stages of manufacture of fermented dairy products, they are inactivated during ripening and storage. In general, acid pH, low temperatures and other factors characteristic of ripening and storage cause the inactivation. PAPAGEROGIOU and MARTH (24) found that, in blue cheeses, *L. monocytogenes*, if present in milk, grows until the pH decreases below 5. During ripening, while pH is low, the inactivation is important, but when pH increases as a result of consumption of lactic acid, its survival is higher. According to these authors, this species is able to multiply at refrigeration temperatures and is tolerant to salt, but cannot grow at pH's below 5. The absence of this pathogen in our samples suggests its absence in the milk.

The organoleptic quality of the samples evaluated was qualified in general as good, although some defects were found. The presence of blue eyes was often poor or with an irregular distribution, probably due to an excesively closed texture of the cheese. Some samples presented anomalous mould tastes and, in some cases, undesirable colours and appearance of the rind were reported.

4. Conclusions

Although none of the pathogenic bacteria surveyed was found, the presence of high numbers of enterobacteria and enterococci in some samples indicates problems with regard to the microbiological quality of the cheese at the state of consumption. This and the presence of some defects and alterations suggest a more strict hygienic and technological control of the manufacturing process. The level of sanitary practices throughout the whole process must be improved, but mainly in those points of the process more critical for the hygienic quality of the cheese. Thus, milking of goats and draining and moulding of the cheese, currently carried out manually, should be mechanised when possible or at least performed in the best hygienic conditions.

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6. Summary

LÓPEZ-DÍAZ, T.M., SANTOS, J.A., GONZÁLEZ, C.J., MORENO, B., GARCÍA, M.L.: **Bacteriological quality of a traditional Spanish blue cheese.** Milchwissenschaft **50** (9) 503–505 (1995).

56 Spanish blue cheese (bacteriological quality)

The bacteriological quality of a blue cheese made in a traditional way in Spain was investigated. The levels of the main microbiological groups, including enterobacteria and enterococci, and the presence of bacterial pathogens (*Salmonella* spp, *Escherichia coli, Staphylococcus aureus* and *Listeria monocytogenes*) were determined. Although the average bacteriological quality was good (levels of enterobacteria and enterococci lower than 3 and 5 log CFU/g, respectively), the high levels of these bacteria of fecal origin in some samples and the presence of some alterations in the cheese suggest a more strict hygienic and technological control of the manufacturing process. None of the pathogens surveyed was found.

LÓPEZ-DÍAZ, T.M., SANTOS, J.A., GONZÁLEZ, C.J. MORENO, B., GARCÍA, M.L.: **Bakteriologische Qualität eines traditionellen spanischen Blaukäses.** Milchwissenschaft **50** (9) 503–505 (1995).

56 Spanischer Blaukäse (bakteriologische Qualität)

Es wurde die bakteriologische Qualität eines in traditioneller Weise in Spanien hergestellten Blaukäses untersucht. Die Werte der wichtigsten mikrobiologischen Gruppen einschließlich Enterobakterien und Enterokokken sowie die Anwesenheit pathogener Keime (*Salmonella* spp, *Escherichia coli, Staphylococcus aureus* und *Listeria monocytogenes*) wurden bestimmt. Obwohl die durchschnittliche bakteriologische Qualität gut war (Enterobakterien und Enterokokken weniger als 3 bzw. 5 log KbE/g), machen die hohen Werte dieser Bakterien faekalen Ursprungs in einigen Proben und einige Veränderungen in diesen Käsen genauere hygienische und technologische Kontrollen des Herstellungsprozesses erforderlich. Keiner der untersuchten pathogenen Keime wurde gefunden.

Erratum

The following table completes the paper "**Influence of genetic variants of κ-casein and β-lactoglobulin in milk on proteolysis in Cheddar cheese**" by G.I. Imafidon, N.Y. Farkye, P.S. Tong and V.R. Harwalkar, Milchwissenschaft **50** (6) 321–325 (1995):

Table 3: Summary of reversed-phase HPLC parameters of water-soluble N in Cheddar cheese made from milk containing different variants of β-lactoglobulin and κ-casein

Type of protein variants in cheese	HPLC parameter[1]	HPLC parameter at various ripening time 1 d	1 mo	3 mo	6 mo
Control (bulk milk)	N	39	52	61	68
	T	55.89	56.81	73.26	109.98
κ-CN A+β-LG A	N	34	43	61	80
	T	47.25	70.51	86.88	116.74
κ-CN A+β-LG AB	N	31	50	64	71
	T	47.51	61,37	73.80	122.27
κ-CN A+β-LG B	N	34	58	67	78
	T	46.44	78.11	75.18	127.03
κ-CN AB+β-LG A	N	42	53	59	69
	T	62-86	60.76	97.63	115.37
κ-CN AB+β-LG AB	N	41	43	60	70
	T	44.21	65.98	71.05	91.22
κ-CN AB+β-LG B	N	36	46	55	70
	T	43.24	55.42	74.28	101.21

[1] HPLC parameters are: N = total number of peaks, and T = total area (arbitrary units) occupied by peaks. Each number is an average of 3 replicates.