Microbiological risks of the consumption of raw milk and raw milk dairy products

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Introduction

Objective: to evaluate the microbiological risks of the consumption of raw cow milk (Advice SciCom 15-2011, Claeys *et al*., 2013), of raw milk from animal species other than cows (Advice SciCom 11-2013, Verraes *et al*., 2014) and of dairy products made from raw milk (Advice SciCom 02-2015, Verraes *et al*., 2015).

• The scope includes raw milk from cows, sheep, goats, horses, donkeys, camels, llamas, buffaloes, yaks and reindeer and cheese, butter, cream and buttermilk made from raw milk from cows, sheep, goats and buffaloes. Only zoonotic microorganisms and microorganisms from the environment are taken into consideration.










Material and Methods

• The risk evaluation is based on an elaborate literature study and on expert opinion provided by experts in the field and by the members of the Scientific Committee of the FASFC.

Results

Pathogenic microorganisms possibly present in raw milk and sources of contamination

	Blood	Mas-titis	Faeces /skin	Environ-ment
Salmonella spp.	X		X	X
Brucella spp.	X	X		X
Mycobacterium bovis	X	X	X	X
Coxiella burnetii	X	X	X	X
Mycobacterium avium subsp. *paratuberculosis* (MAP)	X	X	X	X
Listeria monocytogenes	X	X	X	X
Human pathogenic verotoxin-producing *E. coli* (VTEC)			X	X
Campylobacter jejuni and *coli*			X	X
Corynebacterium pseudotuberculosis	(X)	(X)	X	X
Human pathogenic *Yersinia*	X	X	X	X
Bacillus spp.				X
Enterotoxin-producing *Staphylococcus aureus*	X		X	X
Streptococcus equi subsp. *zooepidemicus*		X	X	X
Leptospira	X			X
Rift Valley Fever virus	X			
Tickborne encephalitis virus (TBEV)	X			
Cryptosporidium parvum			X	X
Clostridium botulinum toxins	X		X	X
Helicobacter pylori			X	X
Toxoplasma gondii	X		X	X

Based on expert opinion, pathogenic microorganisms than can be present in raw milk were listed. A distinction can be made between an endogenous infection, i.e. contamination of the milk by direct transfer from the blood stream (systemic infection) or from an udder infection (mastitis), and a cross-contamination, i.e. contamination of the milk by faeces, the skin or the environment (external contamination during or after milking).

Frequencies of occurrence of pathogenic microorganisms in raw milk and raw milk dairy products (minimum frequency – maximum frequency in %)

	Cow milk	Goat milk	Sheep milk	Horse milk	Donkey milk	Camel milk	Buffalo milk	Yak milk	Cheese	Butter	Cream
Salmonella	0-2.9	0	0-5	0	0	9.5	0	/	0-4.3	0	0
VTEC	0-5.7	0-16.3	0-12.7	0	/	/	0-1.4	0.22.2	0-55.3	0-10	0
L. monocytogenes	2.2-10.2	0-7.8	0-3.3	0	/	/	0-25	/	0-42.0	0.2-29.9	0-8.3
Campylobacter	0-6	0	0-2.2	0	/	/	0	/	0	0	/
S. aureus	/	1-96.2	21-100	13	0-5	8.8-28.6	0-83.3	/	0-100	1.6-24.7	/
B. cereus	/	29.9	29	/	/	/	/	/	0-28	/	/
MAP	/	0-23	0-23.8	/	/	/	0-21.7	/	0-20	/	/
C. burnetii	/	1.8-4.5	0-5.7	/	/	1.4	/	/	57	0	50
S. equi subsp. zooepidemicus	/	/	/	/	2	/	/	/	/	/	/
H. pylori	/	8.7-25.6	0-60.3	/	/	/	3.6	23.4	/	/	/
TBEV	/	20.7	22.2	/	/	/	/	/	/	/	/




Worst case behavior of pathogenic microorganisms in different types of raw milk cheeses

	Hard cheese Production	Storage	Semi hard cheese Production	Storage	Soft cheese Production	Storage
Salmonella	Survival	Survival	Growth	Survival	/	/
VTEC	Growth	Survival	Growth	Survival	Growth	Survival
L. monocytogenes	Survival	Survival	Growth	Survival	Growth	Growth
Campylobacter	No survival	/	No survival	/	/	/
S. aureus	Survival	No survival	Growth	Growth	/	

The worst case behavior of the most relevant pathogenic microorganisms was estimated based on an international scientific literature search as well as on expert opinion.

Number of outbreaks linked to raw milk and raw milk dairy products

	Cow milk	Goat milk	Camel milk	Cheese	Cream
Salmonella	39	0	0	22	0
VTEC	28	6	0	17	1
L. monocytogenes	2	0	0	8	0
Campylobacter	39	6	0	5	0
S. aureus	/	1	0	4	0
Brucella	/	3	4	7	0
S. equi subsp. zooepidemicus	4	0	0	1	0
TBEV	1	6	0	1	0
T. gondii	/	3	0	0	0
Corynebacterium	2	0	0	0	0

Based on international scientific literature as well as on other reliable data sources worldwide, a list of reported human cases and outbreaks due to the consumption of raw milk and raw dairy products was established. Outbreaks were reported for raw milk from cows, goats and camels, but not for raw milk from other animal species. Outbreaks were also reported for cheese and cream made from raw milk, but not for raw milk butter or raw buttermilk.

Detection frequencies of human pathogenic microorganisms in raw milk and raw dairy products are based on a scientific literature search in Europe. It should be noted that detection frequencies can vary according to the sampling and methodological approach. Variation can also be explained by geographical differences, the season in which the samples were taken, the size of the farm, the density of the animal population, regional differences in the keeping and taking care of animals, etc.

Discussion and conclusions

• The main microbiological risks related to the consumption of raw cow, sheep and goat milk in Belgium are *Campylobacter*, *Salmonella* and VTEC. Raw donkey and horse milk has generally a higher microbial quality. In other European countries, additional microbiological risks are the TBEV in raw goat milk and *Brucella* spp. in raw camel milk.

• The microbiological hazards of raw milk dairy products in Belgium are mainly linked to *Listeria monocytogenes*, VTEC, *Staphylococcus aureus*, *Salmonella* and *Campylobacter*. The risks are higher for cheeses, especially (semi-)soft cheeses without acidification, and lower for butter and cream. Research showed that in butter there is a reduced growth potential of most pathogens such as *Listeria monocytogenes*. In endemic areas in Belgium or in other European countries, raw dairy products may also be contaminated with *Brucella* spp., *Mycobacterium bovis* or the TBEV.

• Heat treatment of milk before consumption and before manufacturing of dairy products is important to ensure the food safety.

For further information please visit http://www.favv-afsca.fgov.be/scientificcommittee/ > Opinions

References: **Claeys**, W. L., Cardoen, S., Daube, G., De Block, J., Dewettinck, K., Dierick, K., De Zutter, L., Huyghebaert, A., Imberechts, H., Thiange, P., Vandenplas, Y., Herman, L., 2013. Raw or heated cow milk consumption: Review of risks and benefits. Food Control 31, 251-262. **Verraes**, C., Claeys, W., Cardoen, S., Daube, G., De Zutter, L., Imberechts, H., Dierick, K., Herman, L., 2014. A review of the microbiological hazards of raw milk from animal species other than cows. International Dairy Journal 39, 121-130. **Verraes**, C., Vlaemynck, G., Van Weyenberg, S., De Zutter, Daube, G., Sindic, M., Uyttendaele, M., Herman, L., 2015. A review of the microbiological hazards of dairy products made from raw milk. International Dairy Journal 50, 32-44.