Scientific Opinion on the public health risks related to the consumption of raw drinking milk

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BACKGROUND

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SCIENTIFIC OPINION

Scientific Opinion on the public health risks related to the consumption of raw drinking milk[1]

EFSA Panel on Biological Hazards (BIOHAZ)[2,3]

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ABSTRACT

Raw drinking milk (RDM) has a diverse microbial flora which can include pathogens transmissible to humans. The main microbiological hazards associated with RDM from cows, sheep and goats, horses and donkeys and camels were identified using a decision tree approach. This considered evidence of milk-borne infection and the hazard being present in the European Union (EU), the impact of the hazard on human health and whether there was evidence for RDM as an important risk factor in the EU. The main hazards were *Campylobacter* spp., *Salmonella* spp., shigatoxin-producing *Escherichia coli* (STEC), *Brucella melitensis*, *Mycobacterium bovis* and tick-borne encephalitis virus, and there are clear links between drinking raw milk and human illness associated with these hazards. A quantitative microbiological risk assessment for these hazards could not be undertaken because country and EU-wide data are limited. Antimicrobial resistance has been reported in several EU countries in some of the main bacterial hazards isolated from raw milk or associated equipment and may be significant for public health. Sale of RDM through vending machines is permitted in some EU countries, although consumers purchasing such milk are usually instructed to boil the milk before consumption, which would eliminate microbiological risks. With respect to internet sales of RDM, there is a need for microbiological, temperature and storage time data to assess the impact of this distribution route. Intrinsic contamination of RDM with pathogens can arise from animals with systemic infection as well as from localised infections such as mastitis. Extrinsic contamination can arise from faecal contamination and from the wider farm environment. It was not possible to rank control options as no single step could be identified which would significantly reduce risk relative to a baseline of expected good practice, although potential for an increase in risk was also noted. Improved risk communication to consumers is recommended.

- **Self-task mandate of the BIOHAZ Panel**
- **Adopted in December 2014**

TERMS OF REFERENCE

1. Identify the main microbiological hazards of public health significance that may occur in raw drinking milk from different animal species;

2. Assess the public health risk arising from the consumption of raw drinking milk;

3. Assess the likelihood of raw drinking milk being a significant source of antimicrobial resistant bacteria/resistance genes;

4. Assess the additional risks associated with the sale of raw drinking milk through vending machines and via the internet;

5. Identify and rank potential control options to reduce public health risks arising from consumption of raw drinking milk.

TOR 1: HAZARD IDENTIFICATION

- Step 1: is there evidence that the hazard is transmissible through milk?

- Step 2: is there evidence of the hazard being associated with the milk-producing animal population in the EU?

- Step 3: what is the impact of the hazard on human health in the EU?

- Step 4: is there evidence for raw drinking milk as an important risk factor in the EU?

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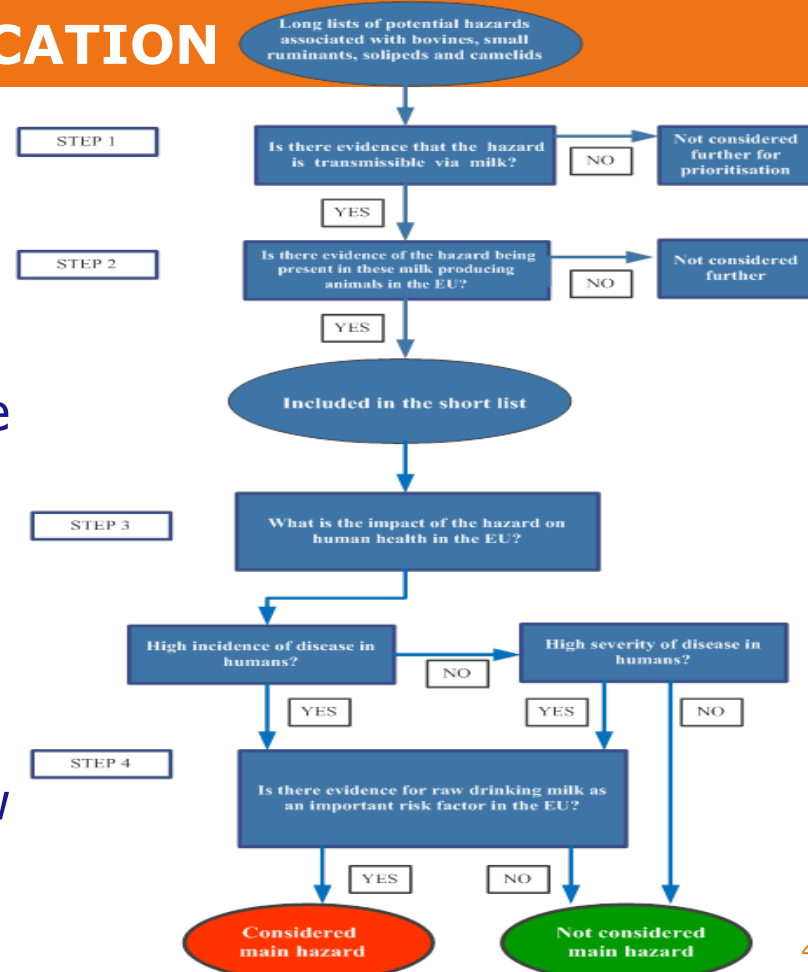
TOR 1: HAZARD IDENTIFICATION

Step 4: is there evidence for raw drinking milk as an important risk factor in the EU?

The following were considered in order of priority:

- epidemiological evidence that the hazard has been associated with illness from the consumption of RDM in the EU (outbreak and other);

- the extent of occurrence of the hazard in different milk-producing species in the EU where available;

- the prevalence of the hazard in milk bulk tanks or retail RDM in the EU where available; and

- expert opinion.

TOR 1: HAZARD IDENTIFICATION – END OF STEP 2

Microbiological hazards	Cows	Goats and sheep	Horses and donkeys	Camels
Bacillus cereus	Yes	No	Yes	No
Brucella abortus	Yes	No	Yes	No
Brucella melitensis	No	Yes	No	Yes
Campylobacter spp. (thermophilic)	Yes	Yes	Yes	No
Corynebacterium spp.	Yes	No	No	No
Listeria monocytogenes	Yes	Yes	Yes	No
Mycobacterium bovis	Yes	No	Yes	No
Salmonella spp.	Yes	Yes	Yes	No
Staphylococcus aureus	Yes	Yes	Yes	No
Streptococcus equi subsp. zooepidemicus	Yes	No	Yes	No
Shigatoxin-producing E. coli (STEC)	Yes	Yes	Yes	No
Yersinia enterocolitica	Yes	No	Yes	No
Yersinia pseudotuberculosis	Yes	Yes	Yes	No
Cryptosporidium parvum	Yes	No	No	No
Toxoplasma gondii	Yes	Yes	Yes	Yes
Tick-borne encephalitis virus (TBEV)	Yes	Yes	No	No

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TOR 1: HAZARD IDENTIFICATION – END OF STEP 4

Hazard	Main hazard for RDM in the EU
Bacillus cereus	No
Brucella abortus	No
Brucella melitensis	Yes[a]
Campylobacter spp.	Yes
Corynebacterium spp.	No
Listeria monocytogenes	No
Mycobacterium bovis	Yes
Salmonella spp.	Yes
Staphylococcus aureus	No
Streptococcus equi subsp. zooepidemicus	No
Shigatoxin-producing E. coli (STEC)	Yes
Yersinia enterocolitica	No
Yersinia pseudotuberculosis	No
Cryptosporidium parvum	No
Toxoplasma gondii	No
Tick-borne encephalitis virus (TBEV)	Yes[a]

[a] Hazards which are restricted to certain parts of Europe, although in the case of TBEV the range appears to be expanding (*B. melitensis*, TBEV)

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TOR 2: ASSESS THE PUBLIC HEALTH RISK ARISING FROM THE CONSUMPTION OF RAW DRINKING MILK

Review of published QMRAs

Article	Country/ region	Scenarios considered	*Campylobacter*	STEC	*L. monocytogenes*	*Salmonella* spp.
FSANZ (2009)	Australia	1a. Farm gate consumption 2. Off-farm sales 3. Retail outlet sales	✓ *Campylobacter* spp.	✓	✓	✓
Latorre et al. (2011)	USA	1b. Farm gate sales 2. Off-farm sales 3. Retail outlet sales			✓	
Giacometti et al. (2012a)	Northern Italy	Best storage condition Worst storage condition	✓ *C. jejuni*	✓		
Soboleva (2013)	New Zealand	1a. Farm gate consumption 1b. Farm gate sales 2. Off-farm sales 3. Retail outlet sales	✓ *Campylobacter* spp.	✓	✓	✓

TOR 2:   ASSESS THE PUBLIC HEALTH RISK ARISING FROM THE CONSUMPTION OF RAW DRINKING MILK

TOR 2: Conclusions

- Owing to data gaps, model uncertainties and broad origin of data sources, risk estimates provided by models **cannot be extrapolated to the European situation**.

- From the model used in the Australian study, it can be concluded that **improving on-farm hygiene leads to a decrease in the number of predicted cases** of illness attributed to *Campylobacter* spp., *Salmonella* spp. and STEC O157 from the consumption of raw drinking milk.

- A QMRA could have helped in further estimating the public health risks and evaluating the effect of the mitigation options in Europe for these hazards, but could not be undertaken because of **limited country and EU-wide data**.

TOR 3: ASSESS THE ADDITIONAL RISKS ASSOCIATED WITH THE SALE OF RAW DRINKING MILK THROUGH VENDING MACHINES AND VIA THE INTERNET

Questionnaire

- Q1. Data on **volume of total liquid milk production**
- Q2. Data on the total **volume of liquid milk consumption**; specifically to the volume of raw drinking milk consumed
- Q3. Data on number of **registered producers of raw drinking milk**
- Q4. Data on number of raw drinking milk **vending machines**
- Q5. Data on mean and range for **Total Bacterial Count** (CFU/mL) of liquid raw milk

TOR 3: **ASSESS THE ADDITIONAL RISKS ASSOCIATED WITH THE SALE OF RAW DRINKING MILK THROUGH VENDING MACHINES AND VIA THE INTERNET**

Questionnaire

- Q6. Information on **how raw drinking milk is sold** to consumers

- Q7. Information on the **shelf-life (days)** for raw drinking milk sold

- Q8. Information on any **food safety advice to consumers** of raw drinking milk

- Q9. Data on any **foodborne outbreaks** involving raw drinking milk in your country in 2013

TOR 3: Conclusions on vending machines

- There is little indication of milk from species other than cows being sold through vending machines.

- Consumers are usually instructed to boil the milk prior to consumption. If consumers comply with these instructions, the microbiological risks associated with raw milk would be eliminated.

- The temperature of raw milk in vending machines is expected to be kept below 4 ° C, and variability in milk temperature is more likely to arise between the farm and vending machine and between the vending machine and point of consumption.

TOR 3: **ASSESS THE ADDITIONAL RISKS ASSOCIATED WITH THE SALE OF RAW DRINKING MILK THROUGH VENDING MACHINES AND VIA THE INTERNET**

TOR 3: Conclusions on internet sale

- Fresh and frozen raw drinking milk of different species (cow, goat, sheep, horse, donkey and camel) is available via internet sales

- No data on the microbiological or temperature controls from bulk tank through to the point of consumption

- Temperature must be controlled and correctly maintained during all steps from the farm to the consumer

- In case of frozen raw milk, instruction should be given to consumers about appropriate conditions for thawing the milk

TOR 4:   THE LIKELIHOOD OF RAW DRINKING MILK BEING A SIGNIFICANT SOURCE OF ANTIMICROBIAL-RESISTANT BACTERIA/RESISTANCE GENES

TOR 4: Conclusions

- Antimicrobial resistance has been reported in several EU countries in isolates of *Campylobacter* spp., *Salmonella* spp., STEC and *S. aureus* from raw milk or associated equipment such as milk filters and may be significant for public health.

- In the EU only one report of antimicrobial resistance in *Salmonella* spp. from outbreaks associated with raw/unpasteurised milk in the UK.

- Antimicrobial resistance has been reported in a water buffalo raw milk-associated STEC O26 outbreak in Italy.

- Resistant strains of *Campylobacter* spp. and MRSA not known to have caused human infections linked to consumption of raw milk.

TOR 5:   DESCRIPTION OF POTENTIAL CONTROL OPTIONS TO REDUCE PUBLIC HEALTH RISKS ARISING FROM CONSUMPTION OF RAW DRINKING MILK

TOR 5: Conclusions

- Observance of good animal health and husbandry together with the application of GAPs and GHPs are essential to minimise opportunities for contamination

- No single step could be identified which would provide a significant reduction in risk relative

- The reviewed QMRA models identified on-farm hygiene control and maintenance of the cold chain as factors influencing the outcome of the models for some pathogens

- Reviewed QMRAs show that the risk associated with *L. monocytogenes* can be reduced significantly if the cold chain is well controlled, the shelf-life of raw milk is limited to a few days and there is consumer compliance with these measures/controls.

RECOMMENDATIONS

- Studies should be undertaken to systematically collect data for source attribution for the hazards identified and to identify and rank emerging milk-borne hazards.

- Because of the diverse range of potential microbiological hazards associated with different milk-producing animals, hazard identification should be revisited regularly.

- The models reviewed here only involved raw cow's milk. There is a need for validated growth and survival models for pathogens in raw drinking milk of different milk-producing species, particularly in relation to the temperature and storage time from the producer up to the point of consumption.

- There is a need for improved risk communication to consumers, particularly susceptible/high risk populations, regarding the hazards and control methods associated with consumption of raw drinking milk.

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