

Risk assessment of alimentary transmission of tick-borne encephalitis viruses from goats to humans by means of milk and milk products in Swiss alpine regions

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Background

- Tick-borne encephalitis (TBE) is a severe neurological disease caused by the tick-borne encephalitis virus (TBEV), which is usually transmitted to humans by infected ticks.
- In Switzerland, the virus has spread rapidly in recent years. Transmission usually occurs through tick bites, mainly by *Ixodes ricinus*. In Switzerland, 0.5 - 5% of these are infected with TBEV.
- TBEV can be transmitted to humans also by the alimentary route, which is mediated through the consumption of raw milk products from infected ruminants such as sheep, goats, and cows. This usually does not cause any illness in the animals, but they can excrete the virus in their milk during an acute phase lasting several days. The alimentary route of TBEV was recognised in the early 1950s and is regarded as a relevant factor contributing to the overall increase in TBE incidences in Europe.

Aim

- Compilation of a risk assessment for TBEV contaminated goat's milk in the Swiss alpine regions based on literature data and a study conducted in Valais canton on the seroprevalence of TBE-specific antibodies in goats.

Variable	Description	Value	Unit	Reference
a	Estimated duration of viral excretion	7	d	Van Tongeren, 1955
b	Number of grazing periods (based on the average age (=3.4 years); 95% confidence limits (CL): 2.8 - 4.1 years) of a seropositive goat in the canton of Valais.	3-4	-	Rieille et al., 2017
c	Average lactation period of a goat	240	d	Ringdorfer, 2009
d	Seroprevalence in the canton of Valais	4.25	%	Rieille et al., 2017
e	Annual quantity of goat's milk produced (Switzerland, 2018)	23.3	10 ³ t	SBV/USP et al., 2019
f	Household milk (raw milk)	0.9		
	Fed milk	7.4		
	Marketed milk	15.0		
g	Number of goat sera analysed in the canton of Valais	4114	-	Rieille et al., 2017
h	Number of herds examined in the canton of Valais	277	-	Rieille et al., 2017
n	Percentage of milk potentially consumed raw as a proportion of total local production (f/e)	0.038	-	
m	Average herd size (g/h)	14.85	-	

Calculations and results

The probabilities were calculated using the parameters shown in the table below as follows:

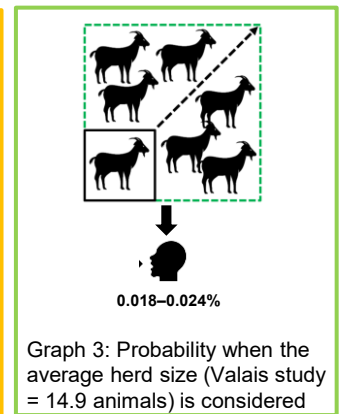
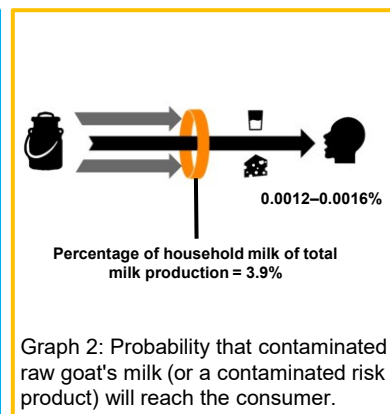
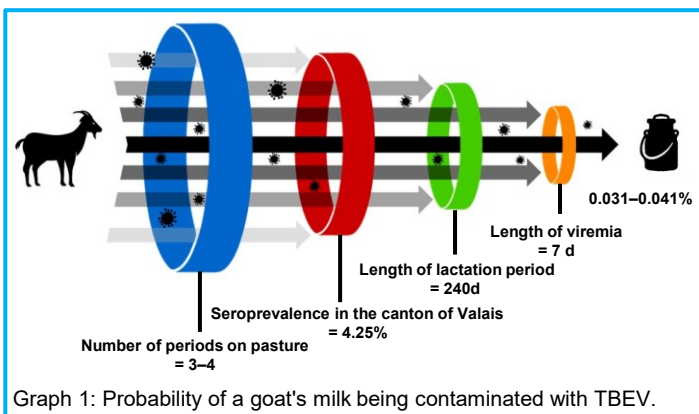
- The average milk production of the animals was used to calculate the probabilities (SBV et al., 2019). The assumed duration of viremia of an infected goat (a) was divided by the length of the critical period of 720 or 960 days, which is itself the product of the number of periods in the field (b) and the average length of a lactation period (c).
- Multiplying by the seroprevalence experimentally demonstrated in the canton of Valais (d) gives the range of probability that a goat will be milked during the viremic phase, i.e. 0.031 - 0.041%.
- These probabilities, multiplied by the percentage of household milk (f) in relation to the total annual quantity of goat's milk (e), give the probability range for household milk contaminated with infectious TBEV, i.e. 0.0012 - 0.0016%.
- In the study of Rieille et al. (2017), 4,114 goat sera (g) from 277 herds (h) were analysed, giving an average herd size of 14.9 animals. In addition, the hypothetical worst-case scenario was calculated, in which all goats in an average herd would be infected with TBEV during the 3-4 lactation periods. The calculated probabilities of 0.0012 - 0.0016% were multiplied by the average herd size of 14.9 animals. This results in probabilities for contaminated household milk of 0.018 - 0.024%.

$$P_{\text{contaminated raw milk}} = \left(\frac{a \cdot d}{b \cdot c} \right) \cdot \left(\frac{f}{e} \right) \cdot \left(\frac{g}{h} \right) = 0.018 - 0.024 [\%]$$

1. Probability of a goat's milk being contaminated with TBEV

2. Percentage of milk potentially consumed raw in relation to total local production.

3. Average herd size.



Summary

The calculation results in a very low probability of 0.018 - 0.024% that contaminated raw goat's milk (or a contaminated risk product) will reach the consumer. This estimate is based on numerous assumptions and average values. We therefore tried to compare this value with known cases of food transmission in Switzerland, Germany and Austria and arrived at an average annual probability of 0.018% for Germany and Austria (8 cases out of 4,422, 2009 - 2018) and 0.012% for Switzerland (3 cases out of 2,307, 2010 - 2020). These values are of a similar order of magnitude to those calculated in the study.