

Viscera of Slaughtered Ruminants and Potential Threats to Human Health in the Czech Republic

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Abstract

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In the present study, potential human health threats posed by the viscera of slaughtered ruminants were investigated. The categories of ruminants monitored included the cattle (except calves), calves, sheep and goats. In all these categories, the lungs, heart, liver, spleen, stomach and forestomachs and intestines were examined. The potential threat posed by individual organs from the food safety point of view was calculated as a ratio between the number of organs condemned by veterinary inspection as unfit for human consumption and the total number of animals slaughtered; and the potential threat trends were computed as the index of the ratio between the number of condemned viscera in the period between 1999 and 2002 and in the period between 1995 and 1998. The highest levels of potential threats were found in the lungs (cattle except calves 29.34%, calves 37.76%, sheep and goats 38.6%). A growing trend of potential threats to human health posed by organs of the cattle was identified. This is particularly true about intestines (index 3.29), while the increase in other organs is less pronounced (indices between 1.60 and 1.05). The growing potential threat has also been identified in organs of the calves, especially the heart (index 1.80); the increase in other organs is less pronounced (1.48 to 0.99). With sheep and goats, a steep increase in potential health threats has been found in the spleen (index 5.99), but a marked decrease has been recorded in all other organs (indices between 0.76 and 0.58). With the exception of the lungs in calves, where they were statistically significant ($P=0.0154$), the above trends were statistically highly significant for all the organs of the cattle ($P\leq 0.010$), calves ($P\leq 0.010$), sheep and goats ($P\leq 0.010$). The study showed that the highest-threat organs of ruminants are the lungs, and the trends analysis also highlighted the cattle intestines as a potentially high-threat organ. The study emphasizes the important role of veterinary inspection at abattoirs that can very significantly reduce any potential human health threats posed by the viscera of ruminants slaughtered there.

Findings at abattoirs, threat, cattle, calves, sheep, goats

Viscera of slaughtered animals pose a certain threat for food safety and hence for human health. The sources are many: infectious diseases, parasites, fungi, non-infectious organ diseases, non-infectious changes in organs, toxic substances, radiobiological hazards, residua of exogenous substances, or they may be technological in character, arising in the process of production of the organs as products of animal origin. Potential threats posed by the viscera for consumers are eliminated by their veterinary post mortem inspection. Nevertheless it has to be stated that not all the viscera eliminated by veterinary inspection after slaughter must necessarily contain factors posing threat to human health. At the same time not all factors posing threat to human health can be always detected by veterinary inspection of slaughter animal viscera. It may be assumed that the threats to be eliminated by official veterinary surgeons inspecting viscera at abattoirs will be different in different organs and in different categories of ruminants. From the point of view of food safety, it is important to determine the amount of threat posed to man by individual organs and

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categories of ruminants, and also to identify the long-term trends in that area. The results are important mainly for the assessment of individual categories of ruminants and their organs from the point of view of enhancing food safety should the issue of preferences for different organs of ruminants for human consumption arise.

Potential human health threats posed by carcasses of ruminants were investigated by Kozák et al. (2002). At abattoirs in the Czech Republic, they monitored the numbers of carcasses of selected categories of slaughter animals that were passed for human consumption, conditionally passed for human consumption and condemned. They reported an increase in potential threats posed by cows brought to abattoirs because the ratio of condemned carcasses jumped from 6.43% in the 1989 -1994 period to 8.64% in the 1995 -2000 period. They also reported a slight increase in threats in calf carcasses because the ratio of calf carcasses not fit for human consumption grew from 19.26% in the 1989 - 1994 period to 20.28% in the 1995 - 2000 period. They also found that sheep and goats represented less threat for human health because ratios of condemned carcasses of sheep and lambs and goats and kids dropped between the 1989 – 1994 period and the 1995 – 2000 period from 2.11% to 0.65% and from 7.55% to 2.65%, respectively.

Data that might reflect potential threats for human health posed by the viscera of slaughter animals have also been reported by a number of other authors. Those authors, however, studied specific threats for human health posed by the occurrence of some specific diseases in the slaughterhouse. In his study of cattle carcasses, Lis (1997) investigated 1.7 million carcasses in Poland in 1994 and reported pathological findings in 21.9% animals. Lis (1999) compared the frequency of pathological findings in cattle carcasses in 1987 and that in 1997, and reported pathological findings in 43.9% and 20.5% of the cattle slaughtered, respectively. Pathological findings in calves were found in 23.53% and 2.85% of cases in 1987 in 1997, respectively.

Works by other authors tend to focus on specific findings at abattoirs. Pavlík et al. (2002) monitored tuberculous lesions in cattle in the Czech Republic during the period of 1990–1999. Tuberculous lesions were found in 0.019% of slaughtered animals. Between 1996 and 1999 the proportion of cattle with tuberculous lesions decreased. The most frequent findings of Julini (1993), who examined cattle at abattoirs in Alessandria (Italy, Piedmont region) between 1980 and 1985, were chronic bronchopneumonias, TBC, distomatoses, liver abscesses, fibroplastic nephritis and cysticercosis in bullocks, TBC, distomatoses and pyelonephritis in cows, and chronic bronchopneumonias and hepatoses in calves. Examining cattle carcasses at abattoirs in the Turin and Cuneo areas (Italy, Piedmont region), Giaccone et al. (1994) reported distomatoses as the principal reason for the condemnation of the liver. Biss et al. (1994) reported the results of their analysis of findings made during inspections of condemned calf carcasses. In their set of 370 calves, they found that the most frequent findings were the disease of the navel (138 cases), enzootic pneumonia (75 cases), arthritis of the joints (32 cases), focal interstitial nephritis (35 cases), injury (23 cases), and a few cases of icterus, generalized peritonitis and liver abscesses. Green et al. (1997) studied the relationships between abnormalities detected in live lambs on farms and those detected at post mortem meat inspections. Post mortem inspections of older calves revealed larger numbers of findings on the lungs, pleura and joints. Between 1981 and 1990, Klimas et al. (1994) analyzed the results of meat inspections of over 400,000 sheep carcasses from abattoirs in Erfurt (Germany), with a special attention to the incidence of dicrocoeliosis on pastures.

The objective of the present study was to identify potential human health threats posed by various organs of ruminants slaughtered at abattoirs in the Czech Republic on the basis of relative frequencies of viscera condemnations, and to outline long-term trends in the development of potential human health threats from the viscera of slaughtered ruminants.

Material and Methods

To assess the threats for human health posed by individual organs and categories of ruminants, the authors monitored the frequency with which viscera of ruminants slaughtered at abattoirs between 1995 and 2002 were condemned. For each animal slaughtered, veterinary inspectors in the whole of the Czech Republic recorded whether the animal's inspection resulted in the condemnation of its lungs, heart, liver, spleen, kidney, stomach and forestomachs, or intestines. Laboratory examinations of samples of the organs taken by the veterinary inspectors were used to further details for condemnation decisions. The inspection of the organs after slaughter and subsequent carcass classification was based on the procedures set out by current legal regulations of the State Veterinary Administration for the inspection of slaughter animals and meat in the Czech Republic. Although it is not possible to exactly define the level of reliability of the procedures with regard to the success rate in detection of all cases requiring condemnation of viscera, on the basis of experience in long term it can be stated that the level of protection of human health against the threats originating from slaughter animal viscera is very high. Obviously a 100% reliability of the procedure can never be granted due to various reasons, including the fact that the agents of disease or certain stages of disease simply may not be revealed through pathological changes detectable by routine methods of veterinary inspection after slaughter. Condemnation records identified the carcass and the relevant organ condemned. The categories of ruminants monitored were the cattle (except calves), calves, sheep and goats.

The results were put in a computer and sent for centralized processing to the Information Centre of the State Veterinary Administration, where the numbers of slaughtered animals were recorded together with the quantities of individual organs condemned over the entire period of monitoring (1995 – 2002) for each of the categories of ruminants. In each of the categories, ratios between individual organs condemned and total number of animals of that category slaughtered were calculated. To assess trend lines in human health threats posed by individual organs and individual categories of ruminants over the entire period monitored, that period was divided into two shorter periods (1995 to 1998 and 1999 to 2002) and these were evaluated separately. To compare the shorter periods, an index was calculated as a ratio between the relative frequencies of condemnations in the 1999 to 2002 period and the 1995 to 1998 period. An index higher than 1.00 meant that the number of condemned organs in question in the 1999 to 2002 period grew compared with the situation in the 1995 to 1998 period, i.e. that human health threats posed by that organ and that category of ruminants increased. If the index equalled 1.00, it meant that there was no increase in the number of condemned organs. A index below 1.00 indicated a smaller number of condemned organs in question in the 1999 to 2002 period compared with the 1995 to 1998 period, i.e. that there was a reduction in human health threats posed by that particular organ of that particular category of ruminants. To calculate the statistical significance of trends in human health threats posed by individual organs of the different types of ruminants investigated, the results were statistically processed by the Unistat (Unistat Statistical Package - Unistat Ltd) module allowing frequency comparisons.

Results

Potential food safety threats posed by individual organs of ruminants expressed as a relative frequency of condemned organs incidence, and trends in potential threats posed by individual organs of ruminants expressed as an index of increasing or decreasing relative frequency of the incidence of condemned organs are given in Tables 1 and 4, 2 and 5, 3 and 6.

Among the organs of the cattle (except calves) (Tab. 1 and 4), the highest potential human health threats are posed by the lungs (at a very high level of 29.34%), followed by kidneys (at a very high level of 24.05%), liver (15.19%) and intestines (12.77%). For the stomach and forestomachs, spleen and the heart, the threat levels were 7.28%, 6.25% and 2.96%, respectively. An increase in potential human health threats was the highest in intestines (index 3.29), followed by the spleen (index 1.60), kidneys (index 1.28), stomach and forestomachs (index 1.22), liver (index 1.20), heart (index 1.18) and the lungs (index 1.05). These trends were statistically highly significant ($P \leq 0.01$). It follows from the results for the cattle that the highest potential human health threats are posed by the lungs and kidneys, and long-term trends show the highest increase in the potential human health threats in the intestines and the spleen.

Among the organs of the calves (Tab. 2 and 5), the highest potential human health threats are posed by the lungs (at a very high level of 37.76%), followed by the kidney (at a very high level of 20.12%), intestines (20.04%) and the stomach and forestomachs (16.32%). Food safety threats posed by other organs were 12.44% (liver), 9.56% (spleen)

Table 1
Potential threats for food safety and human health posed by the viscera of the cattle (except calves)
in different period and trends

Period	Entire period (1995 – 2002)		Part I (1995 – 1998)		Part II (1999 – 2002)		trend ratio (%) (C/B index)	Statistical significance (P)
	number of findings	A threat ratio (%)	number of findings	B threat ratio (%)	number of findings	C threat ratio (%)		
lungs	1173589	29.34	661644	28.71	511945	30.18	1.05	**0.00
heart	118223	2.96	63282	2.75	54941	3.24	1.18	**0.00
liver	607771	15.19	323249	14.03	284522	16.78	1.20	**0.00
spleen	250173	6.25	114829	4.98	135344	7.98	1.60	**0.00
kidneys	961998	24.05	495122	21.49	466876	27.53	1.28	**0.00
stomach and forestomachs	291195	7.28	153281	6.65	137914	8.13	1.22	**0.00
intestines	510801	12.77	149329	6.48	361472	21.31	3.29	**0.00
Animals slaughtered	4000372		2304288		1696084			

Table 2
Potential threats for food safety and human health posed by the viscera of the calves
in different periods and trends

Period	Entire period (1995 – 2002)		Part I (1995 – 1998)		Part II (1999 – 2002)		trend ratio (%) (C/B index)	Statistical significance (P)
	number of findings	A threat ratio (%)	number of findings	B threat ratio (%)	number of findings	C threat ratio (%)		
lungs	75110	37.76	43607	37.98	31503	37.45	0.99	*0.02
heart	14943	7.51	6443	5.61	8500	10.10	1.80	**0.00
liver	24753	12.44	12996	11.32	11757	13.98	1.23	**0.00
spleen	19013	9.56	9467	8.25	9546	11.35	1.38	**0.00
kidneys	40035	20.12	19199	16.72	20836	24.77	1.48	**0.00
stomach and forestomachs	32473	16.32	18394	16.02	14079	16.74	1.04	**0.00
intestines	39875	20.04	19647	17.11	20228	24.05	1.41	**0.00
Animals slaughtered	198936		114812		84124			

and 7.51% (heart). The trend analysis showed the highest increase in potential human health threats for the hearts (index 1.80) followed by the kidneys (index 1.48), intestines (index 1.41), spleen (index 1.38), liver (index 1.23), and stomach and forestomachs (index 1.04), and a slight decrease in the number of condemned lungs (index 0.99). These trends were statistically highly significant ($P \leq 0.01$), with the exception of the trend in the lungs of the calves, which was statistically significant ($P \leq 0.05$). It follows from the results ascertained in calves that the highest potential human health threats are posed by their lungs and kidneys, and that the most prominent long-term upward trend of potential threat was found in the heart, kidneys, intestines and the spleen of the calves.

Among the organs of the sheep and goats (Tab. 3 and 6), the highest potential human health threats are posed by the lungs of both the sheep and goats (at a high very level of 38.60%), followed by the spleen (10.89%), liver (8.07%) and the intestines (7.44%). Food safety

Table 3
Potential threats for food safety and human health posed by the viscera of the sheep and goats in different periods and trends

Period	Entire period (1995 – 2002)		Part I (1995 – 1998)		Part II (1999 – 2002)		trend (C/B index)	Statistical significance (P)
	number of findings	A threat ratio (%)	number of findings	B threat ratio (%)	number of findings	C threat ratio (%)		
lungs	32300	38.60	18579	44.13	13721	33.00	0.75	**0.00
heart	1411	1.69	839	1.99	572	1.38	0.69	**0.00
liver	6751	8.07	4208	10.00	2543	6.12	0.61	**0.00
spleen	9116	10.89	1318	3.13	7798	18.75	5.99	**0.00
kidneys	3058	3.65	1859	4.42	1199	2.88	0.65	**0.00
stomach and forestomachs	5545	6.63	3522	8.37	2023	4.86	0.58	**0.00
intestines	6222	7.44	3550	8.43	2672	6.43	0.76	**0.00
Animals slaughtered	83679		42096		41583			

Legend to Tables:

*= the difference in the number findings between Period I a Period II is statistically significant $P \leq 0.05$

**= the difference in the number findings between Period I a Period II is statistically highly significant $P \leq 0.01$

Table 4
Potential threats for food safety and human health posed by the viscera of the cattle (except calves) by individual years

	1995	1996	1997	1998	1999	2000	2001	2002
	%	%	%	%	%	%	%	%
lungs	25.8	32.6	28.1	28.4	28.5	29.7	31.8	31.1
heart	2.6	2.6	3.0	2.8	2.9	3.0	3.6	3.4
liver	13.5	13.1	14.8	14.8	15.9	16.2	17.3	17.9
spleen	4.5	4.7	5.5	5.3	6.2	7.5	9.4	9.2
kidneys	18.3	19.0	23.9	25.2	25.1	25.8	28.9	30.8
stomach and forestomachs	7.0	6.5	6.7	6.3	7.2	8.1	8.9	8.5
intestines	7.2	6.9	5.9	5.8	6.7	7.5	24.2	49.6

Table 5
Potential threats for food safety and human health posed by the viscera of the calves by individual years

	1995	1996	1997	1998	1999	2000	2001	2002
	%	%	%	%	%	%	%	%
lungs	40.3	36.5	38.6	36.4	39.1	37.9	36.9	35.3
heart	6.6	4.9	5.1	6.0	8.8	11.4	10.3	10.4
liver	14.2	10.8	10.3	10.6	13.2	14.3	14.0	14.7
spleen	10.0	8.5	7.4	7.6	10.1	12.1	11.7	11.9
kidneys	19.4	12.3	17.4	17.4	22.6	26.1	24.8	26.2
stomach and forestomachs	23.3	15.3	13.4	13.7	16.8	18.5	16.6	15.1
intestines	25.2	15.7	13.9	15.4	17.5	19.3	23.6	37.1

Table 6
Potential threats for food safety and human health posed by the viscera
of the sheep and goats by individual years

	1995	1996	1997	1998	1999	2000	2001	2002
	%	%	%	%	%	%	%	%
lungs	38.0	43.7	45.7	50.9	39.1	31.8	27.7	33.7
heart	3.0	1.6	1.6	1.6	2.2	1.7	0.9	0.7
liver	10.8	11.2	8.2	9.4	7.8	6.3	4.6	5.9
spleen	4.3	2.7	2.2	3.1	13.2	11.3	15.1	33.3
kidneys	6.3	4.6	2.8	3.5	4.4	3.3	2.1	2.0
stomach and forestomachs	10.3	11.7	5.2	5.3	8.4	5.4	4.4	1.9
intestines	9.6	11.6	5.6	6.2	9.0	5.5	6.6	4.9

threats posed by other organs were 6.63% (stomach and forestomachs), 3.65% (kidneys) and 1.69% (heart). The trend analysis showed an increase in potential human health threats for the spleen (increased threat index 5.99), while potential human health threats posed by the intestines, lungs heart, kidney, liver, stomach and forestomachs decreased (increase threat indices 0.76, 0.75, 0.69, 0.65, 0.61, 0.58, respectively). These trends are statistically highly significant ($P \leq 0.01$). It follows from the results that the highest potential threat for food safety of the organs investigated is posed by the lungs and the spleen, and that the most prominent long-term upward trend among sheep and goats in potential health threats is in the spleen.

Discussion

A better understanding of potential human health threats posed by different organs of ruminants slaughtered at abattoirs is important from the point of view of increasing food safety and possible preferential use of those organs for human consumption. The potential health threat level may be expressed as the relative number of organs with a pathological finding that was the reason for the condemnation of that organ or its part as not fit for human consumption at the carcass veterinary inspection. The large number of carcasses examined and the length of the monitoring period provided a wealth of data for the calculation of the levels of potential human health threats posed by different organs of slaughtered ruminants.

It follows from the results of the present study that in the cattle (except calves) category, the highest-threat organs are the lungs, kidneys, liver and, to some extent the intestines. This is in agreement with the findings of Julini (1993) who reported chronic bronchopneumonias as the most frequent finding in bullocks and pyelonephritides as one of the most frequent finding in cows. Our results are also in agreement with the findings of Giaccone et al. (1994), who reported liver lesions as the most frequent pathological finding in the cattle. With regards to trends, the most prominent was the upward trend in the numbers of condemned intestines and the spleen. This trend is the result of measures taken at abattoirs for cows in connection with the BSE. An upward trend of condemned organs incidence, i.e. a higher level of human health threats from cattle organs, was observed in all of the categories of ruminants monitored. This is in agreement with the trends reported by Kozák et al. (2002) for the numbers of condemned cow carcasses. In his studies at Polish abattoirs, Lis (1997, 1999), however, reported a decrease in the numbers of pathological findings in cattle carcasses. Partial trends in the occurrence of manifestations specific for a certain disease may be also revealed by monitoring the findings in cattle viscera at slaughterhouses, as it was reported by Pavlík et al. (2002).

The calf organs that carry the highest threat for human health were the lungs, followed by kidneys, intestines, and the stomach and forestomachs. Julini (1993) arrived at similar conclusions with regard to the lungs of calves. Besides navel diseases, Biss et al. (1994) found a large proportion of pneumonias among calves compared with the other diseases monitored in their study. The growing trend of potential health threats posed by the viscera of calves corroborated results published by Kozák et al. (2002), but it was contrary to the trend reported from Poland by Lis (1999), who found a marked decrease in pathological findings in calves at abattoirs.

The organs of sheep and goats that carry the highest potential threats are the lungs, followed by the spleen and the liver. These results are in agreement with the findings published by Green et al. (1997), who reported the most frequent post mortem pathological findings on the lungs and the pleura mainly among older lambs. Their results are in agreement with those published by Klimas et al. (1994), who studied the occurrence of *Dicrocoelium dendriticum* among sheep on pastures. Trends among sheep and goats are positive because, with the exception of the spleen, potential human health threats among the viscera of the sheep and goats are decreasing.

The assessment of the level of a potential threats for human health posed by organs of different categories of ruminants plays an important index with regard to preferences for increasing food safety for consumers. We found that the highest-threat organ among the cattle, calves and the sheep and goats are the lungs. In the cattle (except calves) and in calves, the highest increases in the potential health threat trends were recorded for the intestines (which is explained by measures implemented in connection with the BSE) and the heart, respectively. Among sheep and goats, markedly decreasing trends of potential human health threats were found for all the organs investigated with the exception of the spleen.

Orgány jatečných přežvýkavců z pohledu potenciálního rizika pro onemocnění člověka

V práci byla zjišťována potenciální rizika onemocnění pro člověka z jednotlivých orgánů přežvýkavců poražených na jatkách. Byly sledovány následující kategorie přežvýkavců : skot (s výjimkou telat), telata, ovce a kozy. U všech kategorií přežvýkavců byly sledovány následující orgány: plíce, srdce, játra, slezina, ledviny, žaludek a předžaludky a střeva. Potenciální riziko z hlediska bezpečnosti potravin pro jednotlivé orgány bylo určeno jako četnost orgánů označených úředním veterinárním lékařem za nepoživatelné pro člověka z celkového počtu poražených zvířat, trend vývoje potenciálního rizika byl určen jako index podílu výskytu nepoživatelných orgánů v období 1999 až 2002 k období 1995 až 1998. Nejvyšší úroveň potenciálního rizika byla zjištěna u skotu (s výjimkou telat) pro plíce (na úrovni 29,34%), u telat pro plíce (37,76%), u ovcí a koz pro plíce (38,6%). Z hlediska trendů vývoje potenciálního rizika pro onemocnění člověka zjišťované pro orgány skotu stoupá a to zejména pro střeva (index 3,29), pro ostatní orgány pak stoupá již méně výrazně (index 1,60 až 1,05). Obdobně stoupá potenciální riziko vyplývající z orgánů telat a to zejména pro srdce (index 1,80), pro ostatní orgány pak již méně výrazně (1,48 až 0,99), pro orgány ovcí a koz byl zaznamenán výrazný vzestup pro slezinu (index 5,99) u ostatních orgánů ovcí a koz pak výrazný pokles potenciálního rizika onemocnění člověka (index 0,76 až 0,58). Tyto trendy byly zjištěny jako statisticky vysoce významné pro orgány skotu, telat a ovcí a koz s výjimkou plic u telat ($P \leq 0,01$) a statisticky významné pro plíce telat ($P \leq 0,05$). Z práce vyplývá, že rizikovým orgánem jsou plíce přežvýkavců a z hlediska trendů vývoje se stávají rizikovým orgánem také střeva skotu. Práce zdůrazňuje významné postavení veterinárního dozoru na jatkách, který velmi výrazně potenciální rizika onemocnění pro člověka z jednotlivých orgánů přežvýkavců poražených na jatkách eliminuje.

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