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Occurrence of *Strongyloides papillosus* associated with extensive pulmonary lesions and sudden deaths in calves on a beef farm in a highland area of South Bohemia (Czech Republic)

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Summary

Prevalence and intensities of excretion of Strongyloides papillosus eggs were determined in a highland area of South Bohemia (Czech Republic) in cattle of beef herds under three types of management systems (pasture, semipasture, cowshed during winter season). Strongyloides papillosus infection was found on 6 of 9 examined farms and from the 1902 fecal samples, 4.3 % were positive. Eggs excretion intensities were generally low. The high prevalence (57 %) and high intensities of excretion (more than 5.000 EPG) were found on one cowshed farm associated with 25 % mortality of calves without previous clinical signs was observed. Pulmonary pathological changes caused by migration of larvae were histologically characterized as suppurative granulomatous inflammation with young connective tissue and predominance of eosinophils in inflammatory infiltrates. The cause of death of calves was determined as the sudden death syndrome.

Key words: *Strongyloides papillosus*; beef calves; prevalence; sudden death syndrome

Introduction

Economic pressure and overproduction, especially of milk, have increased importance of beef cattle farming as an extensive, low cost system of beef production. One of the major factors which negatively influences the performance of beef calves breeding are endoparasitic infections. The ne-matode *S. papillosus* is considered as less pathogenic and dangerous than strongylid nematodes (Eysker *et al.*, 2005). Nevertheless, *Strongyloides* can be a cause of sudden death syndrome of juvenile animals due to hyperinfection with infective larvae without previous clinical signs (Taira & Ura, 1991). Fatal strongyloidosis of calves have been reported under natural and experimental conditions (Vergos, 1954; Taira & Ura, 1991; Taira *et al.*, 1992; Nakanishi *et al.*, 1993). The sudden death syndrome of calves

was associated with sawdust litter and favorable humidity and temperature during calf rearing (Taira & Ura, 1991; Chompoochan *et al.*, 1998). The aim of the present study is to report the occurrence of *S. papillosus* infection and sudden death syndrome of calves in beef herds in various management systems in a highland area of South Bohemia in the Czech Republic.

Material and Methods

Farms and animals

The research was performed on nine beef farms in highlands in South Bohemia, Czech Republic. The farms are localized at 600 - 900 m above sea-level. The climate of the study region is characterized by an average annual rainfall of 600 - 900 mm and an average annual temperature 4 -7° C. Pasture season begins from the second-half of April to May. The farms were selected randomly without foreknowledge of infection status and the selection represented all of the most frequent management systems used in the Czech Republic. The farm technologies involved were as follows:

(i) *COWSHED*, four farms, where calves were kept in the same cowshed as their dams, with direct contact in the first three-four months of age during winter. Deep straw bedding was used in the cowshed and changed after the winter season;

(ii) *SEMI-PASTURE*, one farm, where calves were calved in the cowshed and then were together with dams on the pasture with unlimited access to cowshed during the whole year;

(iii) *PASTURE*, four farms, where calves were born on the pasture and were kept together with dams during the whole year. All farms were visited once a month, at least 20 % of animals (randomly selected) was examined. The percentage of calves' mortality during first two months of age and the individual increase of weight in 120 days of animals'

Table 1. Scale for semiquantitative evaluation of infection intensi	y levels using light microscopy at	a magnification of 200× a	and eggs per gram (EPG)
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Level	of infection intensity	Evaluation	EPG			
+/-	Sporadic infection	Random occurrence of eggs	< 250			
+	Weak infection	1-2 egg in one field	250 - 500			
++	Medium infection	2-6 eggs in one field	500 - 1.500			
+++	Severe infection	6-20 eggs in one field	1.500 - 5.000			
++++	Intense infection	more than 20 eggs in one field	> 5.000			

Table 2. Occurrence of Strongyloides papillosus on beef farms during year 2005

Month	Cowshed								Semi- Pasture				Pasture					
Month 1		2		3		4	4		5		6		7		8		9	
	n	р	n	р	n	р	n	р	n	р	n	р	n	p	n	р	n	р
I.	47	1*			8	0^{*}									5	0^{*}		
II.	30	12			10	0									23	0		
III.	31	14			12	0	14	0^{*}	16	1^*	30	0^{*}			10	0	6	0^{*}
IV.	35	20	22	0^{*}	10	0	14	$0^{ m g}$	23	0	20	0	10	0^{*}	20	0	18	0
V.	26	7 ^g	22	0^{g}	19	0^{g}	22	0	20	0	22	2	12	2	13	0	23	0
VI.	29	8	15	0	18	0	15	0	22	1	29	0	10	0	23	0	23	0
VII.	31	3	22	0	20	0	15	0	22	0	20	0	10	0	32	0	15	0
VIII.	39	2	20	0	20	0	15	0	20	0	20	0	10	0	20	0	8	0
IX.	34	1	33	0	24	0	20	0	27	1	20	0	10	0	44	0	14	0
Х.	20	2	20	0	11	0	20	0	30	0	20	0	10	0	30	0	13	0
XI.	30	2	20	0	10	0	20	0	20	1	20	0	10	0	30	0	16	0
XII.	34	1	20	0	20	0	20	0	30	1	20	0	10	0	20	0	16	0

n - number of examined samples; p - number of positive samples; *calving ; gat grass

age on all farms were observed.

Results

Samples collection and examination

Fecal samples were obtained at each site by random selection and collected directly from the rectum or immediately after defecation on beef farms. Animals were examined from fifth day of age. Samples were individually placed in plastic dishes without any fixation at 4°C. All samples were analyzed within 6 h after collection and examined by Sheather's floatation-sedimentation method, using a sugar solution with a density of 1.20, and larvoscopic method by Baermann-Wetzel, since L1 larvae of Strongyloides can hatch from eggs during a short time after shedding (Peeters & Villacorta 1995; Eckert 2000). Preparations were examined by light microscopy at a magnification 200 and 400 ×. Numbers of eggs were scored semiguantitatively (Table 1). Three calves (2 - 3 months of age) from farm no. 1 selected at random were slaughtered and internal organs were standardly examined macroscopically, parasitologically and bacteriologically. Samples for histological examination were collected from the oesophagus, rumen, reticulum, omasum, duodenum, jejunum, ileum, caecum, colon and rectum, liver, large biliary ducts at the porta heaptis, choledochus, gallbladder, pancreas, lungs, and spleen. Tissue samples for histology were fixed in 10 % buffered formalin. The samples for histological examination were processed by the usual paraffin method and stained with haematoxylin and eosin (HE).

Strongyloides papillosus infection was found on 6 of 9 farms examined. Out of 1902 fecal samples examined in 2005, 82 (prevalence 4.3 %) were positive for *S. papillosus* eggs or larvae. The occurrence of *S. papillosus* in the beef herds was sporadic, except for the herd No. 1 (Table 2). *Strongyloides papillosus* infection was found in two months old animals and in one case in an eight months old animal on three farms with pasture management system. Sporadic *S. papillosus* infection was found in animals during the whole year on the farm with combination of cowshed and pasture management system.

Strongyloides papillosus was found infection on one of the four farms with the cowshed management system during winter season. The highest occurrences of *S. papillosus* were found on the farm No. 1 (Table 2), where 2 - 4 months old animals were the most infected (prevalence 40-57%). Egg excretion intensities were generally low (sporadic infection) on the farms with pasture and semi-pasture management of breeding and on the most of cowshed farms. Figure 1 shows the distributions of infection intensity levels according to semiquantitative scoring class on the farm No. 1. The mean weight of calves on farm No. 1 at 120 day after calving was only 65 – 70% of weight in comparison with the type of race and animals' age. The animals' weigh on the other farms were 90 - 107%. Calves' mortality during two months of their lives was be-

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Fig. 1. *Strongyloides papillosus* eggs excretion intensity according to semiquantitative scoring class on the farm No. 1

low 5 % on all farms except for the farm No. 1, where 25 % mortality was observed. The calves on the farm No. 1 died without previous clinical signs. Multiple nodular lesions, brownish in colour were macroscopically observed in lungs of three slaughtered calves from farm No. 1. Histologically, pulmonary changes were characterized by suppurative granulomatous lesions with fibroblasts and predominance of eosinophils in inflammatory infiltrates. The multiple suppurative granulomatous inflammatory lesions were accompanied with catarrhal suppurative bronchitis and bronchiolitis. Neither macroscopic nor microscopic changes caused by migration of larvae in the other internal organs were found. Levels of S. papillosus infection intensity of slaugtered calves were medium, or severe in one case. In addition, bacteriological and parasitological examinations of feces of all animals were negative for pathogenic bacteria and revealed sporadic-weak infection of Eimeria spp., sporadic-severe infection of C. andersoni and sporadic infection of strongylid nematodes (data not shown). On the basis of above mentioned results the sudden death syndrom was determined as cause of death of calves.

Discussion

The prevalence of *S. papillosus* on farms with pasture and semi-pasture management system and on most cowshed farms recorded was generally low. In contrast, the prevalence of *S. papillosus* on the present farms was much lower than that reported Bussato *et al.* (1998) and Lentze *et al.* (1999) in calves in Switzerland. High prevalence of *S. papillosus* we found on one farm with a cowshed management system during winter season in this study. Borgsteede and Dercksen (1996) reported *S. papillosus* infection predominantly in goats which had never been outdoors. We observed cumulative prevalence of *S. papillosus* in months 2 and 4 after birth, with maximum prevalence of 57 % on the 4th month of age. During pasture season the prevalence decreased to 3 % (animals 12 months old). Our results cor-

respond to the findings of Jäger *et al.* (2005). They reportted *S. papillosus* eggs in approximately 15 % of all fecal samples of cattle collected during housing and the subsequent decrease to 6 % during pasture; *S. papillosus* prevalence ranged from 10 to 53 % in weeks 5 and 9 after birth, respectively.

The excretion intensity of egg was mostly low, peaked 2 - 3 months after birth and without detectable clinical conesquences. This corresponds to conclusions of Jäger *et al.* (2005). Fecal samples of 4 % of calves at the age of 2 - 4 months from the farm No. 1 contained more than 5.000 EPG.

Sudden deaths associated with hyperinfection with Strongyloides larvae in calves were described by Vergos (1954), Taira and Ura (1991) and Nakanishi et al. (1993). We observed the sudden death of calves on one farm where the calves which appeared healthy, died during 6 - 12 hours without any clinical signs, during that time apathy and inappetence were observed. We found similar pulmonary pathological changes caused by migration of larvae through the lungs as observed by Taira and Ura (1991), Taira et al. (1992) and Nakanishi et al. (1993) in naturally and experimentally infected calves. High prevalence of S. papillosus and sudden death of beef calves is associated with rearing of animals in small pens with sawdust litter (Taira & Ura, 1991; Chompoochan et al., 1998). The positive effect of warm and humid climate on survival of pre-parasitic stages was reported (Durie, 1961; Pandav et al., 1994). The risk of sudden death of calves caused by hyperinfection of S. papillosus in animals during first month of their lives in cowshed with sawdust litter on beef farms under extensive system in a mountain area of the temperate zone was supported by results of this study and at the same time the influence of other pathogens on sudden deaths were excluded by parasitological and bacteriological examinations. The management system may represent a potential risk technology in connection with the sudden death of calves caused by S. papillosus.

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References

BORGSTEEDE, F. H. M., DERCKSEN, D. P. (1996): Coccidial and helminth infections in goats kept indoors in the Netherlands. *Vet. Parasitol.*, 61: 321 – 326

BUSATO, A., STEINER, L., GOTTSTEIN, B., GAILLARD, C. (1997): Häufigkeiten und Ursachen von Kälberverlusten in Mutterkuhbetrieben. *Dtsch. Tierärztl. Wschr.*, 104: 191–195

CHOMPOOCHAN, T., PRASITIRATANA, P., NAKAMURA, Y. (1998): Preliminary study of nematode infections of cattle

in six provinces of Thailand in the dry season. J. Vet. Med. Sci., 60: 527 – 529

DURIE, P. H. (1961): Parasitic gastroenteritis of cattle: the distribution and survival of infective strongyle larvae on pasture. *Aust. J. Agric. Res.*, 12: 1200 – 1211

ECKERT, J. (2000): Helminthologische methoden. In ROM-MEL, M., ECKERT, J., KUTZER, E., KÖRTING, W., SCHNIE-DER, T. (Eds.): *Veterinärmedizinische Parazitologie*. 5 Auflage, Parey Buchverlag, Berlin

EYSKER, M., BAKKER, N., KOOYMAN, F. N. J., PLOEGER, H. W. (2005): The possibilities and limitations of evasive grazing as a control measure for parasitic gastroenteritis in small ruminants in temperate climates. *Vet. Parasitol.*, 129: 95 – 104

JÄGER, M., GAULY, M., BAUER, C., FAILING, K., ERHARDT, G., ZAHNER, H. (2005): Endoparasites in calves of beef cattle herds: Management systems dependent and genetic influences. *Vet. Parasitol.*, 131: 173-191

LENTZE, T., HOFER, D., GOTTSTEIN, B., GAILLARD, C., BU-SATO, A. (1999): Prevalence and importance of endoparasites in calves raised in Swiss cow-calf farms. *Dtsch*. Tierärztl. Wschr., 106: 275 – 281

NAKANISHI, N., NAKAMURA, Y., URA, S., TSUJI, N., TAIRA, N., TANIMURA, N., KUBO, M. (1993): Sudden death of calves by experimental infection with *Strongyloides papillosus*. III. Hematological, biochemical and histological examinations. *Vet. Parasitol.*, 47: 67 – 76

PEETERS, J., VILLACORTA, I. (1995): Concentration techniques for oocysts. In ECKERT, J., BRAUN, R., SHIRLEY, M. W., COUDERT, P. (Eds.): *Biotechnology – Guidelines on Techniques in Coccidiosis Research*, ECSC-EC-EAEC, Brussels-Luxembourg

TAIRA, N., NAKAMURA, Y., TSUJI, N., KUBO, M., URA, S. (1992): Sudden-death of calves by experimental-infection with *Strongyloides papillosus*. 1. Parasitological observations. *Vet. Parasitol.*, 42: 247 – 256

TAIRA, N., URA, S. (1991): Sudden death in calves associated with *Strongyloides papillosus* infection. *Vet. Parasitol.*, 39: 313 – 319

VERGORS, H. H. (1954): Experimental infection of calves with *Strongyloides papillosus*. *Am. J. Vet. Res.*, 15: 429 – 433

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