

RUMEN CILIATES IN LAMB POSTNATAL ONTOGENESIS

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Abstract

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The development of rumen microfauna in 7 Merino lambs from birth to 3 months was investigated. In the first week after birth, the genus *Entodinium* appeared; in the second week *Polyplastron multivesiculatum*; in the third week *Eremoplastron bovis* and *Enoploplastron triloricastrum*; in the 5th week *Diploplastron affine* and *Isotricha prostoma*; and in the 8th week *Ophryoscolex tricornatus* and *Dasytricha ruminantium*. The average numbers of ciliates were 7×10^3 .ml⁻¹ in the second and third weeks, 6×10^3 .ml⁻¹ in the 4th week, and later they oscillated between 3×10^3 and 1×10^4 .ml⁻¹rumen liquor.

Ciliates, rumen, ontogen, sheep

Knowledge of the forestomach microfauna in the young of ruminants is essential for understanding of their preruminant digestion (Oxford 1955; Bryant et al. 1958; Hungate 1966; Fonty et al. 1984). Contact with adults provides the original colonization by microfauna (Fonty et al. 1986). Data on rumen ecology are necessary for efficient use of various feed additives that may cause changes in rumen metabolism and digestion of the organic matter and thus substantially influence performance of the animals.

The aim of the present work is to study the occurrence of the individual ciliate species in the young ruminants and to compare their rumen microfauna with that of the contacted adult individuals.

Materials and Methods

A group of 7 Merino lambs born within a week in the Cooperative Farm Bořitov was used in the study. The animals were examined for 3 months from the first week of life. From birth to 3 weeks of age the lambs were placed in pens with their mothers and were separated from other animals. From week 4 they were placed with other lambs and had contact with their dams during sucking. Until week 9 they were allowed to suck at any day or night time from their mothers placed in a neighbouring pen. From the end of week 9, they were gradually weaned.

From week 3, the lambs were fed ground meal in the morning, from week 7 they were given granulated alfalfa. From week 8, they were fed a concentrate mixture for lambs, in the morning and hay with granulated alfalfa in the afternoon, and water. After weaning they were fed concentrate for lambs, hay and water.

Samples of rumen fluid were collected once weekly at the same time of day with a special oesophageal tube and underpressure pump. The collection apparatus was rinsed and disinfected prior to each sampling. The collected rumen fluid was immediately mixed with 10 % formaldehyde. To compare microfauna of mothers and their young, in the second week after delivery, the rumen fluid of the dams was collected, too.

Prior to microscopical examination each formaldehyde-treated sample was shaken, a part of it was placed into a Fuchs-Rosenthal counting chamber and the numbers of ciliates in 1 ml rumen

fluid were counted. From each rumen fluid sample a sediment portion was employed. Microscopic preparations for species determination were made from a sediment portion of each rumen fluid sample. The nuclei of ciliates were stained with methyl green, acetcarmine and hematoxylin (Heidenhein, Ehrlich, Garazzi), the skeletal plates were visualized by chlorzinciodine.

Results

Only two ciliate species, *Entodinium caudatum* and *Entodinium simplex* were found in the first week after birth in a single lamb (14.2 %). In the second week, ciliates were detected in five animals (71.1 %). In the first lamb, only one species, *Entodinium dubardi*, was found, in the second lamb only *Entodinium longinucleatum* occurred. In the third animal 2 species, *Entodinium caudatum* and *Entodinium simplex* were encountered. In the fourth lamb, 4 species were identified, namely *Entodinium bursa*, *E. longinucleatum*, *E. ovinum* and *E. simplex*. Also in the fifth lamb, four species were found; *Entodinium bursa*, *E. caudatum*, *E. dubardi* and *Polyplastron multivesiculatum*. From the third week after birth, infusoria were detected in all seven lambs (100 %), however, the species distribution differed. The species *Eremoplastron bovis* and *Enoploplastron trilorricatum* occurred. From the fifth week also *Entodinium nanellum*, *E. dilobum*, *Diploplastron affine* and *Isotricha prostoma* were identified. From the sixth week *Entodinium minimum* and *E. lobosospinosum*, from the eighth week *Ophryoscolex tricornatus* and *Dasytricha ruminantium* enriched the rumen fauna of lambs.

The species *Entodinium caudatum*, *E. dubardi*, *E. simplex* and *Polyplastron multivesiculatum* were identified in all or nearly all lambs from the fifth week after birth, *Isotricha prostoma* occurred in majority of lambs as late as from eleventh week (Table 1).

In lambs aged two to three weeks, the numbers of ciliates per 1 ml of rumen

Table 1
Ciliate species occurring in numbers of lambs aged 1 to 12 weeks

Week Species	1	2	3	4	5	6	7	8	9	10	11	12
<i>Entodinium bursa</i>	—	2	1	4	4	3	1	4	6	6	1	—
<i>caudatum</i>	1	2	4	4	6	7	6	6	6	7	7	6
<i>dilobum</i>	—	—	—	—	1	—	1	1	1	1	1	2
<i>dubardi</i>	—	4	3	5	6	7	7	7	7	6	6	7
<i>longinucleatum</i>	—	2	2	3	3	3	2	4	2	3	6	1
<i>nanellum</i>	—	—	—	—	2	2	4	3	—	1	1	4
<i>ovinum</i>	—	1	—	—	1	1	—	1	—	—	—	—
<i>simplex</i>	1	2	5	5	7	6	7	7	7	7	7	7
<i>Eremoplastron bovis</i>	—	—	1	1	—	—	—	—	—	—	—	—
<i>Diploplastron affine</i>	—	—	—	—	1	—	1	2	1	3	3	5
<i>Polyplastron multivesiculatum</i>	—	1	3	3	6	5	7	7	7	6	6	6
<i>Enoploplastron trilorricatum</i>	—	—	1	2	3	2	2	2	2	4	1	—
<i>Ophryoscolex tricornatus</i>	—	—	—	—	—	—	—	1	2	2	1	1
<i>Isotricha prostoma</i>	—	—	—	—	1	1	1	2	1	2	6	6
<i>intestinalis</i>	—	—	—	—	—	—	1	—	—	—	—	—
<i>Dasytricha ruminantium</i>	—	—	—	—	—	—	—	1	3	3	4	2

fluid oscillated around 7 thousands, increased until the fourth week to about 60 thousand and in the following weeks reached 300 thousand to 1 million individuals. In the development of ruminal microfauna, the most numerous was the genus *Entodinium* (Table 2). In the sixth week after birth, the largest numbers were those of the genus *Diploplastron* (38 thousand/ml). The genus *Dasytricha* showed higher numbers in the 9th (11 thousand/ml) and 12th (14 thousand/ml) week after birth.

In dams, the following numbers (in thousands) per 1 ml rumen fluid were found: a total of 274.4 ± 100.8 ciliates. Of this number, the genus *Entodinium* comprised 247.6 ± 97.0 , *Eudiplodinium maggii* 0.1 ± 0.2 , *Diploplastron affine* 1.3 ± 0.2 , *Enoploplastron triloricatum* 2.3 ± 1.3 , *Polyplastron multivesiculatum* 0.1 ± 0.2 , *Ostracodinium gracile* 0.4 ± 0.6 , *Ophryoscolex tricoronatus* 0.2 ± 0.4 , *Isotricha* 1.0 ± 1.0 and *Dasytricha ruminantium* 21.4 ± 17.6 individuals. Numbers of ciliates similar to their dams ($10^3 \times 2.7 \text{ ml}^{-1}$) were not encountered before week five in lambs.

The species *Entodinium bursa*, *E. caudatum*, *E. dubardi*, *E. longinucleatum* and *Polyplastron multivesiculatum* detected in lambs in the second week after birth, were also found in their mothers. Other ciliate species detected in dams in the second week after delivery were encountered in their lambs at various intervals as follows: *Diploplastron affine* in week 5, *Enoploplastron triloricatum* in week 3, *Ophryoscolex tricoronatus* in week 8, *Isotricha prostoma* in week 5 and *Dasytricha ruminantium* in week 8 after birth of lambs. The species *Eudiplodinium maggii* and *Ostracodinium gracile* found in dams were not detected in lambs at all.

Discussion

Occurrence of ciliates in young ruminants has repeatedly been studied. In calves, first ciliates were detected in the 12th to 15th day after birth (Beleňkij 1953). In calves living in contact with their dams, first ciliates occurred in week 13 while in those separated from their mothers no ciliates were found before week 19 after birth (Crha and Holub 1978). Borhami et al. (1967) detected ciliates in calves as late as at 4 months of age whereas Hungate (1966) reported their occurrence within the first week of life. The genera *Entodinium* and *Diplodinium* emerged as first (Oxford 1955), according to Bryant et al. (1958) the genus *Entodinium* was present before the genus *Diplodinium* that in turn occurred earlier than the family *Isotrichidae*. Crha and Holub (1978) detected in calves first the species *Entodinium simplex* and *E. bursa*, followed by *Epidinium ecaudatum* and *Isotricha prostoma*.

First occurrence of ciliates in lambs was described by Fonty et al. (1986) in the second and third weeks after birth. According to these authors, first the genus *Entodinium* occurs from day 10 onwards. This finding corresponds with our data. From day 20, these authors began to find the genus *Polyplastron* that was also detected in our study in the same period, and further, the genus *Eudiplodinium* and *Epidinium* that we did not encounter. On the other hand, we detected the species *Isotricha prostoma* as soon as in the fifth week whereas Fonty et al. (1986) reported its occurrence in the eighth week after birth of lambs. It is remarkable that in the present study several ciliate species occurring in mothers were not detected in their lambs despite their mutual contact.

Table 2
 Numbers of ciliates (thousands pre 1 ml) in rumen fluid of lambs aged 1 to 12 weeks

Week	1	2	3	4	5	6
Genus						
Entodinium	—	7.8 ± 6.6	6.7 ± 8.4	58.4 ± 63.5	305.4 ± 239.0	454.5 ± 725.9
Eremoplastron	—	—	0.2 ± 0.5	—	0.7 ± 1.8	38.4 ± 101.6
Diploplastron	—	—	0.4 ± 1.1	1.0 ± 0.9	1.8 ± 1.5	20.0 ± 29.0
Polyploastron	—	0.07 ± 0.18	0.1 ± 0.3	1.5 ± 2.5	1.7 ± 3.1	0.3 ± 0.6
Enoploplastron	—	—	—	—	—	—
Ophryoscolax	—	—	—	—	—	—
Isotricha	—	—	—	—	—	—
Dasytricha	—	—	—	—	—	—
Week	7	8	9	10	11	12
Genus						
Entodinium	328.7 ± 217.0	900.0 ± 660.0	1 025.6 ± 944.8	611.4 ± 403.9	425.7 ± 596.7	564.3 ± 501.7
Eremoplastron	—	—	0.2 ± 0.5	4.2 ± 9.6	4.3 ± 10.8	3.0 ± 4.8
Diploplastron	0.4 ± 1.1	0.1 ± 0.3	11.0 ± 15.4	1.3 ± 1.5	0.7 ± 1.8	0.5 ± 0.7
Polyploastron	5.5 ± 3.7	27.7 ± 46.9	0.07 ± 0.18	0.7 ± 1.1	—	—
Enoploplastron	0.5 ± 1.2	0.5 ± 1.1	0.5 ± 0.9	0.5 ± 1.1	0.1 ± 0.3	0.07 ± 0.18
Ophryoscolax	—	0.1 ± 0.3	0.5 ± 0.9	0.5 ± 1.1	4.5 ± 10.7	1.2 ± 1.6
Isotricha	—	4.9 ± 4.4	0.4 ± 1.1	0.5 ± 1.1	8.8 ± 14.7	14.5 ± 34.5
Dasytricha	—	2.2 ± 6.0	11.2 ± 29.0	4.1 ± 10.0	—	—

Bachoroví nálevníci v ontogeneze jehňat

Byl studován vývoj mikrofauny jehňat do tří měsíců po jejich narození. V 1. týdnu po narození jehňat byli u nich zjištěni zástupci rodu *Entodinium*, v 2. týdnu *Polyplastron multivesiculatum*, ve 3. týdnu *Eremoplastron bovis* a *Enoploplastron trilocricatum*, v 5. týdnu *Diploplastron affine* a *Isotricha prostoma* a v 8. týdnu *Ophryoscolex tricornatus* a *Dasytricha ruminantium*. Průměrný počet nálevníků ve 2. a 3. týdnu byl 7×10^3 ml⁻¹, ve 4. týdnu 6×10^3 ml⁻¹ a v dalších týdnech se pohyboval od 3×10^3 do 1×10^4 ml⁻¹ bachorové tekutiny.

Инфузории рубца в онтогенезе ягнят

Проводили исследования развития микрофауны ягнят до трех месяцев после их рождения. На первой неделе после рождения были выявлены представители рода *Entodinium*, на второй неделе - *Polyplastron multivesiculatum*, на третьей неделе - *Eremoplastron bovis* и *Enoploplastron trilocricatum*, на пятой неделе - *Diploplastron affine* и *Isotricha prostoma* и на восьмой неделе - *Ophryoscolex tricornatus* и *Dasytricha ruminantium*. Среднее число инфузорий в течение 2 и 3 недель достигало 7×10^3 мл⁻¹, 4 недели - 6×10^3 мл⁻¹ и в течение последующих недель - 3×10^3 - 1×10^4 мл⁻¹ жидкости рубца

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