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CLINICAL AND MICROBIOLOGICAL STUDIES ON SPONTANEOUS CASES OF ACUTE INDIGESTION IN RUMINANTS

By

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Feeding experiments with sheep have shown that overfeeding with various readily fermentable carbohydrates led to characteristic alterations in the rumen and that these alterations were associated with an acute indigestion with fairly uniform clinical symptoms (*Krogh* 1959, 1960, 1961). Spontaneous cases of indigestion in cattle and sheep due to accidental overeating or overfeeding with various feeds have also been submitted to similar studies. The results of these studies are given in the present paper.

MATERIALS AND METHODS

The investigations are confined to three dairy cows and two sheep from different farms which were sent to the Department of Internal Medicine for clinical study and treatment. All three cows had broken into feed bins during nights, whereas the sheep had deliberately been overfed with concentrates.

In addition to clinical examination, blood samples were analysed for lactic acid, alkali reserve, glucose, acetone, calcium, phosphorous, magnesium and nonprotein nitrogen. The concentration of rumen lactic acid was also determined in cases with lowered rumen pH.[1])

Samples of the rumen contents were obtained by use of a rumen tube constructed by the author and which enables a quick

[1]) The chemical analyses were carried out by the Department of Biochemistry at this college.

sampling of ample amounts of rumen fluid (*Krogh* 1954). The procedures and media employed in examination and microbiological cultivation of the rumen samples were similar to those described previously by the author (*Krogh* 1959, 1960).

CASE REPORTS

Case 1 (Cow 1). The cow which had calved two weeks previously, produced 20—25 kg. milk per day and had been maintained on a high-plane diet consisting of hay, roots, marrow-stem kale, brewer's grains and a concentrate mixture containing about 16 % digestible protein. The cow had consumed an unknown quantity of the two last-named feed substances some 36 hrs. before arriving at the clinic.

The cow was found very dull and depressed and could hardly stand when examined by a veterinary practitioner some 18 hrs. after overeating. At this time there was anorexia, cessation of rumination, and a diarrhoea had developed. The rumen proved to be somewhat distended and doughy to the touch without noticeable contractions. The pulse was accelerated and the temperature subnormal. At this stage the cow was given 1 g. thiamine hydrochloride intravenously.

On arrival at the clinic the cow had apparently improved slightly. The temperature had risen to normal level and rumen motility was registered, although the contractions were feeble and infrequent. However, the cow still appeared weak and depressed and had rapid pulse, laboured respiration, inappetence, somewhat enlarged rumen, a greyish diarrhoea, and the milk yield was only 3—4 kg. a day. The animal preferred to lie down. Closer examination showed that the inner hooves of the forefeet were sore.

The urine appeared to be acid (pH 6.1) with positive protein reaction (Esbach test 0.05 %), whereas the specific gravity was found normal and the acetone test negative.

A blood sample collected immediately after arrival revealed a marked increase in blood glucose and possibly a slight rise in NPN, whereas the concentrations of the other blood constituents were found to be within normal ranges (cp. Table 1).

The cow was treated with thiamine intravenously and recovered gradually over a period of about a week. The urine contained protein until the reaction became alkaline after 8 days.

Table 1. Concentrations of blood constituents in cases of acute indigestion in ruminants.

	Cow 1	Cow 2	Cow 3	Sheep 1
Alkali reserve (vol.% CO_2)	58.0	68.0	51.0	27.0
Lactic acid (mg.%)	18.0	20.2	45.0	45.0
Glucose (mg.%)	103.0	80.0	50.0	62.0
Acetone (mg.%)	2.4	1.6	7.0	14.5
NPN (mg.%)	57.0	35.0	43.0	31.0
Serum Ca (mg.%)	10.1	9.9	9.3	9.8
Serum P (mg.%)	5.7	3.9	9.0	7.2
Serum Mg (mg.%)	2.0	2.7	2.1	2.8

Case 2 (Cow 2). This cow was kept on a ration of hay, roots and concentrates containing about 24 % digestible protein. The cow overate 6 weeks after calving on the concentrate mixture and 3—4 kg. boiled potatoes.

The cow arrived at the clinic about 12 hrs. after the overeating had occurred, The clinical symptoms exhibited by this animal were distinctly milder than those found in Case 1 and were characterized by dullness, inappetence, slightly diminished rumen motility, somewhat unyielding rumen contents and loose faeces.

The urine was found to be normal with a pH of 8.3, and apart from a moderately elevated glucose level, the blood analyses gave no pathological findings.

No treatment was found necessary in this case and the cow started eating hay the same afternoon and appeared normal the following day.

Case 3 (Cow 3). This cow which had calved two weeks previously, gave 22 kg. milk a day and was being fed a ration of hay, roots, silage, concentrates and some alkali-treated straw. The cow overate on barley and oat meal (protein contents about 8 %).

The morning after overeating the cow consumed a little hay, but became severely ill later in the day. When examined by a veterinary practitioner the following morning the cow was recumbent and showed laboured respiration, weak pulse, elevated temperature, rumen stasis and a profuse greyish diarrhoea. The animal was given 0.5 g. thiamine intramuscularly and sent to the clinic the same afternoon.

On arrival at the clinic some 40 hrs. after overeating, the animal was *in extremis* and a fatal outcome seemed most likely. The

cow lay in a milk fever-like position and groaned, the eyes were sunken and the pulse was soft and rapid. The rumen was enlarged with doughy contents, rumen motility could hardly be registered and a fetid, greyish diarrhoea was still present.

A blood sample collected at this stage showed a moderate rise in lactic acid and a slightly lowered alkali reserve (see Table 1). The rumen fluid revealed an insignificant increase in lactic acid (9 mg. %), and the urine was found acid (pH 6.1) with weakly positive protein reaction.

The animal was given 2.5 g. thiamine and 2.0 g. methylene blue intravenously, and a remarkable improvement was noticed the following morning. The cow was then standing on her feet and ate hay. The rumen was less distended, had a fairly normal motility and the consistency of the faeces had improved. Blood analyses at this stage showed that the concentration of lactic acid had fallen to 20 mg.% and the alkali reserve increased to 58 vol.%.

However, the cow exhibited signs of pain when walking and seemed to be lame on all four feet. Closer examination revealed increased pulsation in the metacarpal and metatarsal arteries and the outer hooves of the hind feet as well as the inner hooves of the forefeet appeared to be tender to pressure.

Another thiamine injection was given and the cow appeared normal after a few days.

Case 4 (Sheep 1). A breeding ram of about 80 kg. body-weight had been fed hay only. The feed was changed abruptly to hay and a concentrate mixture containing about 13 % digestible protein. According to the caretaker the ram was given approximately 0.5 kg. concentrates the first day and about ¾ kg. the day after. The following morning the animal was lying down and showed signs of severe intoxication. The breathing appeared strained, the pulse was frequent and weak, but the temperature was normal. The rumen contractions were markedly depressed and a diarrhoea had developed. When forced, the ram rose with difficulty, but was unsteady and lay down again almost immediately. It was also noticed that the ram preferred to keep the left foreleg in a flexed position and the distal part of this limb proved to be tender to pressure.

A blood sample collected at this stage showed diminished alkali reserve and increased concentrations of lactic acid and

acetone, whereas the other blood constituents were within normal values (Table 1). The pH of the rumen was 4.7 and the concentration of lactic acid 607 mg.%. Unfortunately, no urine sample could be obtained.

One gram thiamine was injected intravenously and within 20 minutes the ram was standing on his feet and began to eat hay with apparently good appetite. The following morning the animal seemed to be perfectly normal and lameness could no longer be demonstrated.

Case 5 (Sheep 2). This case represents a sub-acute indigestion induced by a somewhat protracted unbalanced feeding. The flock of sheep as a whole was fed hay, roots and small amounts of concentrates, but one animal suffering from pleuro-pneumonia and having poor appetite was fed more concentrates than the others. The faeces of this animal gradually became soft and when arriving at the clinic, a regular diarrhoea had developed. On the basis of this sign and the informations regarding the feeding, the rumen contents were examined. This examination disclosed a picture similar to that encountered in cases of acute overeating. However, the clinical symptoms exhibited were obviously due to two different disorders and it is difficult to say to what extent the indigestion *per se* influenced the well-being of the animal.

RESULTS OF THE MICROBIOLOGICAL STUDIES OF THE RUMEN

Case 1. The first rumen sample withdrawn revealed a rumen fluid of thicker consistency and of lighter colour than normally seen, whereas the pH value was within the normal range (6.2). Direct microscopy of fresh and iodine-stained preparations of rumen fluid disclosed a fairly dense iodophilic flora, mainly consisting of cocci, a liberal number of epithelial cells, probably originating from the rumen mucosa, whereas protozoa were not observed at all. Gram-stained films were completely dominated by Gram-positive rods and cocci, the former obviously outnumbering the latter. The complex Gram-negative flora usually present in healthy animals seemed to be markedly reduced in number and appeared faintly stained.

The cultures from this sample gave growth to Gram-positive rods morphologically resembling those seen by direct microscopy and the colony count was in the order of 10^9 per ml. rumen fluid.

The colony count of Gram-positive cocci was near the normal range which, compared with the concentration of these micro-organisms in the inoculum, seemed to be less than expected. This could be due to the fact that a certain portion of the cocci present in the rumen was no longer viable. Lack of viability also appeared among the cellulolytic bacteria as no visible growth of cellulose-digesting organisms occurred in the cultures (see Table 2).

Table 2. Fluctuations in rumen pH, protozoa and colony counts in Cow 1.

			Number of colonies/ml. rumen fluid		
Time	Rumen pH	Protozoa	Strepto-cocci	Gram-pos. rods	Cellulolytic bacteria
1. day	6.2	0	1.3×10^{7}	1.0×10^{9}	0
2. day	5.6	0	7.0×10^{6}	3.2×10^{8}	1.1×10^{5}
3. day	6.5	0	7.0×10^{5}	1.5×10^{8}	7.5×10^{5}
5. day	6.4	+	1.0×10^{6}	6.5×10^{7}	1.0×10^{6}
6. day	6.6	+++++	1.3×10^{6}	8.0×10^{5}	1.0×10^{6}

During the following few days the physical properties as well as the microbial population of the rumen fluid gradually returned to normal. Direct microscopy of rumen samples revealed that the density of Gram-positive rods and cocci decreased from day to day. A sudden rise in Gram-negative organisms, especially tiny cocci, had occurred on the third day and the protozoa started reappearing on the fifth day and multiplied enormously during the next 24 hrs. Epithelial cells could hardly be observed in samples withdrawn after one week.

The cultures gave growth to cellulolytic bacteria already on the second day, although the colony count was lower than normal. The colony counts of Gram-positive rods decreased gradually towards values usually found under normal feeding conditions, and this decrease seemed to be in good agreement with the lowered density of these organisms in the rumen (Table 2).

Case 2. The rumen fluid of this cow was found to be very different from that in the previous case. The macroscopic appearance did not differ noticeably from the normal and the pH was 6.6. Microscopic examination disclosed motile protozoa and a rich Gram-negative flora consisting of a mixed population of distinctly stained organisms. Gram-positive rods were very sparse and epithelial cells were not observed. However, the iodine-stained

preparation showed a large number of strongly iodophilic cocci and Gram-stained films disclosed a high concentration of Gram-positive cocci.

The cultures made from this sample gave a colony count of Gram-positive cocci in the range 10^8—10^9 per ml. rumen fluid, whereas Gram-positive rods were only found in the lowest dilutions, indicating a number not exceeding 10^3 per ml. Cellulolytic bacteria were growing in the cellulose cultures, but the colony count was only 10^3—10^4 per ml. rumen fluid.

The following day the rumen flora showed a marked change towards normal conditions. The density of Gram-positive cocci in the rumen sample proved to be far less than the day before. This finding was confirmed by cultures which gave a colony count of 2.8×10^6 per ml. rumen fluid. The colony count of cellulolytic bacteria had risen to 4.0×10^6, whereas the number of Gram-positive rods was the same as earlier.

Case 3. The rumen sample collected the first day appeared greyish-brown, had a slightly sour smell and pH 6.0. The microbial picture was found to be similar to that of Case 1. Thus, no protozoa were present and the bacterial flora was dominated by Gram-positive rods and cocci. The Gram-positive rods were present in the highest concentration and were morphologically very similar to those encountered in the first case. Although the normal Gram-negative flora seemed to be destroyed to a great extent, a great number of large Gram-negative cocci was observed. These cocci apparently grew well in the CYG medium since such colonies were found up to the highest dilutions, indicating a colony count of about 10^9 per ml. rumen fluid. The colony count of Gram-positive rods, which resembled those seen in the rumen sample, was found to be in the order of 10^9—10^{10}. The colony count of Gram-positive cocci was found to be within the normal range of 10^6—10^7 per ml. rumen fluid.

Except a rise in pH, no marked change in the rumen fluid seemed to occur in the next 24 hrs. However, the Gram-positive rods began to decrease in number the following day and a distinctly stained Gram-negative flora, consisting mainly of small cocci, appeared at the same time. After 4—5 days the bacterial flora of the rumen was approaching the normal picture and a couple of days later the protozoa started to reappear.

Case 4. The first day the rumen fluid had a greyish-brown colour, a sour smell and a pH of 4.7. No motile protozoa could be seen in fresh samples, but a few partially iodophilic specimens were found in iodine-stained preparations. These stained preparations were also fairly rich in iodophilic cocci and epithelial cells, whereas yeast-like cells usually present in ample amounts in the rumen of healthy sheep, were present only in very small numbers. Gram-positive rods resembling those observed in Cow 1 and 3 were seen in great numbers and the concentration of Gram-positive cocci also seemed to be higher than that found in animals on a normal feeding schedule. The Gram-negative flora appeared destroyed, i. e. consisted mainly of large, swollen and weakly stained cells.

The cultures gave growth to uniform Gram-positive rods similar to those seen by direct microscopy of the rumen fluid. The colony count was 1.6×10^9. Gram-positive cocci were only found in the lowest dilution indicating a number less than 10 microorganisms per ml. rumen fluid, which would indicate that most of the cocci in the rumen were no longer viable.

The following day the pH of the rumen had risen to 6.3, but alterations in the microbial flora were not observed. However, a marked increase in Gram-negative organisms, especially small cocci, and some decrease in the concentration of Gram-positive rods had occurred one day later. This change continued over the next two days, and a fairly normal bacterial flora had been established in the last sample which was collected on the fourth day. Epithelial cells were found only in very small numbers in this last sample, and protozoa and yeast-like cells were still absent.

Case 5. The macroscopic appearance of the rumen fluid did not differ significantly from that seen under normal feeding conditions, but the smell was slightly sour and the pH was low (5.3). The microbial population was, in general, very similar to that observed in three of the previous cases, i. e.: No protozoa, a dominating Gram-positive flora consisting mainly of rods, a more or less reduced Gram-negative flora, and a very few yeast-like cells. The colony count of Gram-positive rods was found to be in the range of 10^8—10^9, whereas the streptococcal count proved to be less than 10^3 per ml. rumen fluid.

Another rumen sample examined the following day appeared

to be similar to the first one, except that the pH had risen to 6.3 and the streptococcal count to 1.7×10^6. At this time the animal was sacrificed because of the severity of the primary disease.

Identification of the Gram-positive rumen flora. Several strains af Gram-positive rods and cocci isolated from the initial cultures were studied further for classification. All rods isolated proved to be various species and varieties of lactobacilli, and all but one of the coccal strains showed physiological properties characteristic of *Streptococcus bovis*. A detailed description of the isolates will be presented in a subsequent paper.

DISCUSSION AND CONCLUSION

The cases of spontaneous indigestion in cows and sheep which have been described consisted of one mild and four more severe cases. The differences in the clinical syndrome were also clearly reflected in the microbial population of the rumen. Thus, in the mild case the only obvious change in the rumen was a marked rise in the streptococcal flora, whereas the rumina of the other animals showed a lactobacillosis associated with destruction of the rumen fauna and markedly affecting the Gram-negative flora. These findings are in agreement with those in sheep experimentally overfed with carbohydrates and which showed that the wellbeing of the animals was only slightly affected by the streptococcal rise preceding the rumen lactobacillosis, whereas the latter was invariably associated with more serious clinical manifestations.

The rumen pH was found to be fairly normal in spite of the difference in the rumen flora and fauna and in the clinical symptoms presented by the three cows. However, a certain time, varying from some 12 hrs. in the mild case and up to nearly two days in the most severe case, had elapsed between the overconsumption and the examination of these animals. It is, therefore, reasonable to assume that the pH might have been lower at an earlier stage. This suggestion is supported by observations made in earlier feeding experiments with sheep (*Krogh* 1959, 1960, 1961). Thus, these experiments showed that the viability of the cellulolytic bacteria was affected when the rumen pH was below 5.5, that the protozoa were killed when the pH fell to about 5 or lower, that the streptococcal colony counts started decreasing at a pH below 5 and that no growth of these microorganisms was

usually obtained when the rumen pH was approaching 4.0. Judging from these observations one may assume that the rumen pH of the least affected cow had been down to about 5.5—5.0 since the growth of cellulolytic bacteria was markedly depressed, live protozoa, although apparently reduced in number, were still present, and the streptococci showed high colony counts.

On the other hand, the rumen fluids of the other two cows were completely lacking in protozoa, the streptococcal colony counts appeared to be low compared to the concentration of Gram-positive cocci in the rumen contents, and when cultured, no growth of cellulolytic bacteria occurred, which indicated that the rumen pH had been lowered to between 4 and 5. In addition, the acid urine found in the latter two cows suggests a production of acid sufficient to influence the acid-base balance. Finally, the epithelial cells observed in abundance in the rumen fluid of one of the latter cows indicated an increased desquamation of the rumen mucosa. A similar desquamation of rumen epithelium was frequently noticed in the feeding experiments when the rumen pH fell to low values (1959, 1960, 1961).

The two sheep, contrary to the cows, showed a markedly lowered rumen pH obviously because they were submitted to examination at an earlier stage. The microbial picture of the rumen, on the other hand, resembled that of the most severely affected cows and the acidity of the rumen contents had been sufficiently high to kill the protozoa and to depress nearly all growth of streptococci and in one case, to cause increased desquamation of rumen epithelium.

The present studies indicate that the microbial changes occurring in the rumen of cattle and sheep in cases of overeating are very similar and are developing along a pattern similar to that observed in sheep overfed with readily fermentable carbohydrates (*Krogh* 1959, 1960, 1961). Thus, in spite of the fairly high protein contents of the concentrates consumed, the alterations in the microbial population of the rumen seemed to be attributed the carbohydrates present in the food.

The results of the blood analyses did not shed much light upon the exact causes of the clinical syndrome. Apart from the low alkali reserve found in the ram, the biochemical factors determined could hardly account for the symptoms exhibited by the animals. However, it seems most likely that the peak of the concentration of blood lactic acid had passed in the severely

affected cows at the time for sampling. *Broberg* (1960) found the highest level of blood lactic acid some 24 hrs. following the overeating. A close relationship between the level of blood lactic acid and the clinical symptoms is not always necessary since it was occasionally found in the previous feeding experiments with sheep that the clinical condition was aggrevated in spite of a fall in lactic acid towards normal values. It seems reasonable, therefore, to assume that other factors may be responsible for the clinical manifestations under such conditions, say pure toxic substances absorbed from the digestive tract (cp. *Dougherty and Cello* 1949, 1952, *Rodwell* 1953, *Dain et al.* 1955), an after-effect of a previous acidosis, or the organism may in some way have become exhausted or deficient in vital substances.

In regard to the other blood constituents measured, a few of them showed deviations from normal values. Thus, a hyperglycaemia was found in two of the cows, a finding also recorded by other workers in cases of overfeeding in ruminants (*Bullen and Scarisbrick* 1957, *Broberg* 1960). One of the animals, the ram, showed a rise in blood acetone, which was also frequently observed in experimentally overfed sheep.

The animals showed clinical symptoms similar to those commonly ascribed to acute overeating and also similar to those observed in experimentally overfed sheep (*Krogh* 1960, 1961). The lameness observed in three of the animals was apparently due to laminitis. Laminitis it not uncommon in cattle and according to *Nilsson* (1958) and the author's experience, most cases occur during the first weeks after calving. The case histories of the two cows showing signs of laminitis, gave no informations whether lameness had been present prior to the overeating. In one case, however, this disorder seemed to be linked to the acute indigestion since all signs of lameness disappeared when the animal recovered from its primary disease. This was also the case with the ram which showed no signs of lameness prior to the indigestion. Similar findings were also made in some of the sheep experimentally overfed with sucrose or starch (*Krogh* 1960, 1961). The cause of the laminitis is probably a histaminosis similar to that recorded in the horse (*Åkerblom* 1934), since high concentrations of histamine have been found in the rumen of overfed animals (*Rodwell* 1953, *Dain et al.* 1955).

It is also worth noting that all animals, even the cow showing a milk fever-like attitude, proved to have normal concentrations

of calcium in the blood serum. This finding is in accordance with the results obtained by *Broberg* (1960), as well as with those made in the previous feeding experiments with sheep (*Krogh* 1960, 1961). These results would indicate that a hypo-calcaemia does not usually play any essential role in the development of the clinical syndrome.

It may also be mentioned that the proteinuria frequently noticed in clinical and experimental cases of acute indigestion seemed to be benign in nature since it disappeared when the urine regained its normal pH. In fatal experimental cases no detectable damage of the kidneys could be found at the time of necropsy.

It is difficult to say whether the protein contents of the consumed food in some way modified the detrimental effect of the carbohydrate fermentation in the rumen, since no informations were usually available concerning the quantity eaten. It may be mentioned, however, that the least affected cow had been overeating on the most protein-rich concentrates (24 %), whereas the two most severely affected animals had been consuming a feed which was less rich in protein (8 and 13 %). Thus, one of the latter animals, the ram, became severely ill when the diet was changed from hay to hay plus concentrates although the daily amount of concentrates eaten in two days was only some 10 g. per kg. bodyweight. This quantity is comparable to the amount of wheat starch required to induce acute indigestion in sheep (*Krogh* 1961), but far less than the quantity of wheat, *viz.* 60—80 g. per kg., which according to *Turner and Hodgetts* (1949—1953) was needed to kill sheep.

Contrary to the ram, the cows were on a high-level feeding schedule prior to the overconsumption and overate on feeds to which they were accustomed. As mentioned before, no exact informations were available regarding the quantities consumed, but in the author's opinion these quantities need not necessarily have been very large. Thus, the feeding experiments with sugar showed that a moderate increase in the daily quantities given could suddenly induce an acute indigestion (*Krogh* 1959), and according to *Scarisbrick* (1954) a wether kept on 12 lbs. mangolds a day got seriously ill when the ration was increased by another 3 lbs. It appears, therefore, as if the rumen function under certain conditions may be in a labile state and vulnerable to relatively small changes in feeding.

The therapy used was that recommended by *Broberg* (1960), who demonstrated a significant fall in urinary thiamine in cases of acute overeating and reported good effects by large intravenous doses of thiamine, or thiamine combined with methylene blue. The results of this treatment seemed to be remarkably good in the two most severely affected animals.

Although many textbooks and authors postulate that the main object of treatment is to re-establish rumen contractions, no such therapy has been used in the present cases. In the author's opinion, the rumen atony which usually develops in cases of acute overeating presents an important link in the defense mechanism of the animal because toxic substances cause less harm when arrested in the rumen than after being rapidly absorbed from the digestive tract.

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SUMMARY

Spontaneous cases of acute indigestion in cows and sheep due to overeating or overfeeding with various readily digestible feeds have been studied.

A rumen lactobacillosis with depression and destruction of the noralm rumen flora and fauna was found in severe cases, whereas an increased concentration of amylolytic streptococci only was associated with mild clinical symptoms.

The clinical symptoms as well as the alterations occurring in the rumen were found similar to those observed in sheep experimentally overfed with readily available carbohydrates.

ZUSAMMENFASSUNG

Klinische und mikrobielle Untersuchungen spontaner Fälle akuter Indigestionen bei Weiderkäuern.

Bei Kühen und Schafen wurden spontane Fälle akuter Indigestionen untersucht, die durch Ueberfressen oder Ueberfütterung durch verschiedenes leichtverdauliches Futter verursacht worden waren.

In ernsten Fällen wurde im Pansen eine Laktobazillose mit Depression und Destruktion der normalen Flora und Fauna ermittelt, während eine Vermehrung amylolytischer Streptokokken nur von schwachen klinischen Symptomen begleitet war.

Sowohl die klinischen Erscheinungen als auch die mikrobiellen Veränderungen im Pansen zeigten grosse Ähnlichkeit mit denjenigen, welche man beim Schaf nach Ueberfütterung mit verschiedenen leichtverdaulichen Kohlehydraten wahrgenommen hat.

SAMMENDRAG

Kliniske og mikrobielle undersøkelser av spontantilfeller av akutte indigestioner hos drøvtyggere.

Det er foretatt undersøkelser av spontantilfeller av akutte indigestioner hos ku og sau forårsaket av foretning eller overforing med forskjellig lettfordøyelig for.

I alvorlige tilfeller ble det i vommen påvist en lactobacillose med depresjon og destruksjon av den normale flora og fauna mens en økning i mengden av amylolytiske streptokokker bare var ledsaget av svake kliniske symptomer.

Såvel de kliniske symptomer som de mikrobielle forandringer i vommen viste stor likhet med dem en fant hos sau overforet med forskjellige lettfordøyelige kullhydrater.

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