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EFFECTS OF ORALLY ADMINISTERED ENROFLOXACIN (BAYTRIL®) ON THE RUMINAL FUNCTIONS OF ADULT CATTLE (*IN VIVO*)

(With 3 tables and 10 figures)

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تأثير إعطاء عقار انروفلوكساسين (بيتريل®) عن طريق الفم على وظائف الكرش للأبقار.

على صديق

كان الهدف من الدراسة هو استبيان تأثير إعطاء عقار الانروفلوكساسين (مضاد حيوى مخلق) عن طريق الفم على مؤشرات وظائف الكرش فى الأبقار. استخدم لهذا البحث عدد ٥ (خمسه) بقرات سليمة إكلينيكيا من سلاله السيمنتال تتراوح أعمارها بين ٥-٧ سنوات، غير حلابة، كانت هذه الأبقار تتغذى على مخلوط علف مركز مع سيلاج مجفف . قسمت الدراسة إلى ٣ مراحل، المرحلة (أ) يومان قبل إعطاء العقار ، المرحلة (ب) مرحله إعطاء العقار عن طريق الفم بجرعه ٥ مجم / كجم مرتين يوميا لمده ٥ أيام . المرحلة (ج) مدتها يومان بعد مرور ٥ أيام من إعطاء الجرعة ألا خيره للعقار . تم ملاحظة الأبقار إكلينيكيا كما تم اخذ عينات من سائل الكرش و عينات دم خلال المراحل الثلاثة للبحث . أظهرت الدراسة ضعف حركه الكرش فى بقرتين فقط فى اليوم الرابع و الخامس من استخدام العقار. كما اوضح الفحص المعملى لسائل الكرش التأثير السلبى المؤقت للعقار على نشاط البكتيريا و البروتوزوا ابتداء من اليوم الثالث من استخدام العقار و الذى تمثل فى زيادة وقت النشاط الترسيبى لسائل الكرش و زيادة الوقت اللازم لاختزال لون الميثيلين الأزرق و كذلك انخفاض مستويات الأحماض الدهنيه الطيارة بسائل الكرش ، كما أوضحت الدراسة ارتفاع طفيف فى تركيز الأمونيا و الكلورايد بسائل الكرش بعد إعطاء الدواء للأبقار. أوضح الفحص المجهرى لسائل الكرش نقصا فى كثافة العدد الكلى للبروتوزوا و قله حركتها و حيويتها . اظهر فحص الدم انخفاض تدريجى و حاد فى تركيز الامونيا .أوضحت الدراسة عوده نشاط البكتيريا و البروتوزوا لسائل الكرش تدريجيا بعد ٥-٧ أيام من توقف إعطاء العقار و خلصت الدراسة الى امكانيه إعطاء العقار عن طريق الفم للأبقار، حيث أن تأثيره السلبى طفيف و مؤقت و سرعان ما يعود لنشاطه الطبيعى و لكن يجب أن يقصر استخدام العقار عن طريق الفم فى حالات الضرورة و التى تستوجب معها إعطاء العقار عن هذا الطريق.

SUMMARY

The aim of the study was to investigate the effects of oral application of enrofloxacin (Baytril®) on the indices of ruminal functions of adult cattle (in vivo). Five clinically healthy Simmental cows, 5-7 years old were used as a material of study. The study was designed to 3 phases: Phase A (2 days before oral application of Baytril®), phase B (in which Baytril® was given orally in a dose of 5 mg/kg body weight twice daily for a period of 5 successive days and phase C (5 days after withholding of Baytril® and lasted for another 2 days). Ruminal fluid and blood samples were taken twice daily and examined during the course of study. The study revealed a negative temporary influences of orally applied Baytril® on the activity of ruminal flora and fauna, which were represented by weakness of rumen motoric activity in 2 cows, three days after application of drug, increased time of sedimentation activity test (SAT), increased time of methylene blue reduction test, reduced levels of acetic and propionic acids associated with slight increase in ruminal ammonia and chloride. Microscopical examination of ruminal fluid showed decreased density, viability and activity of protozoa. Blood examination revealed significant decrease in plasma ammonia. Ruminal flora and fauna resumed its biological activities 5-7 days after withholding of the drug. It could be concluded that in vivo application of Baytril® 5 mg/kg body weight over a 5 successive days revealed a minimal detrimental effect on rumen fermentation which returned back to its normal pattern one week after withholding of the preparation and the drug could be used orally when indicated.

Key words: Cattle-ruminal functions-Enrofloxacin.

INTRODUCTION

Physiopathological studies on the rumen indicated that undisturbed function of the rumen is of central significance for the equilibrium of energy, protein , fat, mineral and vitamins metabolism of ruminants (DIRKSEN, 1989). Digestion in ruminants depends mainly on the activity of the microflora of the forestomachs which are capable of digestion of cellulose and other carbohydrates giving volatile fatty acids as an end products of carbohydrate metabolism. Ruminal microflora converts nitrogenous substances to ammonia and protein (PAYNE, 1989). Additionally microflora serves as a host defense barrier in the prevention of diseases by agent seeking entry via the intestinal tract and the microbial inhabitants condition the

immunological components of the gastrointestinal tract to respond to antigenic materials in a highly efficient manner (DWIGHT, 1980). The author added that antimicrobial drugs can interfere with the normal defense barrier of gastrointestinal tract to such a degree that serious illness can results secondary to antimicrobial treatment . This reaction occur because of bulk of the normal microbial flora is inhibited or killed by the commonly used antibacterial agents. Oral administration of antibiotics and sulfonamides may also adversely affect bacteria, yeast and protozoa in the rumen (RADOSTITS et al, 1994).

Oral application of therapeutic drugs is considered the convenient, practical , painless and economic method for treatment of diseased domestic animals, not only for massive treatment, prophylaxis and control of gastrointestinal disorders but also for respiratory and other systemic diseases (ROSENBERGER, 1990). It is the route of choice for continuing medication as it is within the capability of any owner (RADOSTITS et al., 1994). The effects of medicaments on the fermentation pattern and ecosystem of ruminal flora and -fauna are questionable. Special attention should be paid to insure that the multifunctions of the rumina flora are not dramatically influenced by such medicaments.

The influences of oral administration of some commonly used therapeutics on the fermentation pattern of the rumen were examined i.e. Furazolidon (SCHOLZ and WIEMANN, 1988; Baquiloprim/Sulfadimidin (HOLTERSHINKEN et al., 1991); Nitrofurantoin in vitro and in vivo (SCHOLZ et al., 1991); Active charcoal (SCHOLZ et al. 1992); Virginiamycin in vivo (SKRIVANOVA and MAROUNEK, (1993); Copper sulfate (ODENKIRCHEN et al. (1994). These studies indicated a widely variable influences of these preparations on the ruminal flora and fauna.

Enrofloxacin (Baytril®) is a synthetic antibacterial chemotherapeutic agent which belong to the second generation of quinolones (fluoroquinolones). It has a wide antibacterial spectrum against gram negative, gram positive bacteria and mycoplasma*. Its bactericidal effect achieved by inhibition of protein synthesis of bacterial cell through blocking of the bacterial DNA gyrase, leading to a reduction in supercoiling and serious disruption of the spatial arrangement of bacterial DNA (BRANDER, 1991). In the last 10 years Baytril® was used world wide in veterinary practice and proved its effectiveness as a veterinary drug for poultry, dogs, cats, pigs and calves. Oral and parentral dosing of enrofloxacin yielded*-

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*: *From the product information, Baytril- International Edit. (Bayer-Ag, Leverkusen).*

similar serum concentration in all species (SCHEER, 1987). It demonstrated a good antibacterial activity alternative to other commonly used antibiotic against many infections in cattle (HIGHLAND et al., 1994 and SCHÄKEL 1994).Oral application of enrofloxacin (Baytril®) to young calves showed an effective blood concentration in a short time (FISHER and KAMMERMEIER, 1986) and proved an effective prevention against respiratory diseases in calves (BAUMGARTNER and PANGERL, 1990). Available information about the uses of oral application of Baytril® for treatment of adult cattle and its effects on the microbial activity of forestomach were lacked.

The present work aimed to threw a light on the effect of orally administered enrofloxacin (Bayrtril®) on the activity of ruminal microflora and fauna in adult cattle (in vivo).

MATERIAL and METHODS

Animals:

The study was carried out at the 2nd Veterinary Medical Clinic, Vet. Med. Univ. Vienna - Austria. Five "Fleckvieh" (Simmental) adult healthy cows, 5-7 years old, not lactating and not pregnant , 450- 550 kg body weight were used .They were kept individually in a closed stable. Cows proved to be healthy with clinical and laboratory examinations.

They were fed twice a day (at 5.00 a.m. and at 5.00 p.m.). The ration was consisted of hay and concentrate mixture (maintenance requirements). Their ration was free from any feed additives containing any antibacterial drugs. Water was available ad. lib. The study was designed into three phases (tab.1):Phase A (2 days before oral administration of Baytril®), phase B (major phase) for oral administration of Baytril® for 5 consecutive days) and phase C (5 days after administration of the last dose of Baytril® and lasted for another 2 days). The cows were not given any antibacterial drugs either orally or parentrally one month prior to the beginning of the study. Cows were examined daily throughout the study for signs of alimentary disorders (appetite, rumen activity and character of feces) in addition to the other general systemic indices of illness.

Application of enrofloxacin.

Enrofloxacin (Baytril®) was available in a concentration of 10 % solutions Fa Bayer (each 1 ml contain 100 mg enrofloxacin).The applied dose was 5 mg/kg (25 ml Baytril® 10 % solution incorporated into 1 liter of water and given by stomach tube twice daily/ head for 5 successive days (phase B). The calculated doses were according to the previous studies on

pharmnacokinetics of enrofloxacin (FISHER and KAMMERMEIER, 1986). The recommended dose was given 1 hour before morning and evening feeding.

- Sampling.

1- Ruminal fluid:

About 200- 300 ml ruminal fluid was collected by means of a ruminal tubes, 3 hours after morning and evening feeding. It was collected twice daily for 2 days before the first application of enrofloxacin (phase A) as control samples, then twice daily for a period of 5 consecutive days (phase B) and lastly, 5 days after withholding of enrofloxacin for another 2 days (phase C). The first collected fluid (about 50 - 100 ml) was discarded to diminish the effects of saliva on the characters of ruminal fluid.

The collected ruminal fluids were twice sieved through two folds of medical gauze directly after collection. A portion of ruminal fluid was strictly separated in a clean centrifuge tubes with stopper in ice container for determination of ammonia . For other analysis, a portion of ruminal fluids were twice centrifuged , (10 min., 4000 rpm) and the clear supernatant was kept deeply frozen (-20 °C).

2- Blood: EDTA and Serum samples were collected parallel with that of uminal samples.

Adopted methods:

A- Ruminal fluid examination (after ROSENBERGER, 1990).

1- Physical examination of included color, odor, viscosity and sedimentation activity tests.

2- Microscopical examination included density (qualitative), mass activity, individual motility and viability of infusoria and percent of predominant size of protozoa (small, medium and large ones).

3- Chemical examination of ruminal fluids included:

a- Estimation of pH values by pH indicator papers of minor graduation of 0.2 (Merck).

b- Methylene blue reduction tests after (Dirksen,. 1969).

c- Estimation of chloride contents (Mercuirmetric chloride titration - Merckotest).

d- Estimation of ammonia content. (Kodak Ektachem Dt. slide of NH3- Dry chemistry).

e- Estimation of volatile fatty acids concentrations (Acetic, propionic and butyric acids)* by means of High Pressure Liquid Chromatography (HPLC) according to the method described by HORSPOOL and McKELLAR (1991): For this purpose ruminal fluids were twice sieved, twice centrifuged at 4,000 rpm for 10 minutes, the supernatant was collected and recentrifuged again at 30,000 rpm for 10 minutes. The clear supernatant was directly injected (10 µl) in HPLC (SH1011 -Showa Denko K.K. Shodex- Analytical Instr. Group). The separation time was 60 minutes for each sample. The working temperature was 50° C. Separation mechanism is that of Size and Ion Exclusion Chromatography. Dissolving solution was 0.01N H_2SO_4 - 0.8 ml/minute. Detector: UV 210 nm. The VFA,s levels were plotted and calculated through specific integrator.

B- Blood examination:

1- Estimation of ammonia concentration in blood plasma (Kodak Ektachem Dt. slide of NH3 - Dry chemistry)**.

2- Estimation of blood serum chloride (Mercurimetric Chloride titration - Merckotest). Statistical analysis were performed by the help of SPSSWIN soft ware.

RESULTS

1- Clinical examination of cows during the course of study.

Clinical examination of cows before oral application of Baytril® (Phase A) showed no signs of diseases. On the basis of the clinical indices (internal body temperature, pulse, respiration, characters of feces and examination of the rumen, all cows showed no special abnormalities during phase B. Rumen motoric activity became weak in 2 cows only at the 6th & 7th days, resuming their normal activity within the next 5-7 days .

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*- *Acetic , butyric and probionic acid standards were obtained from Fa Aldrich and Other chemical and solvents were obtained from Fa Merck- Vienna - Austria*

**- *EDTA blood samples were collected and directly kept in ice container, centrifuged and analyzed.*

2- The results of physical , microscopical and chemical examinations of ruminal fluid in addition to plasma NH3 and serum chloride were illustrated in tables 2, 3 and fig. 1-10.

DISCUSSION

Enrofloxacin (Baytril®) as an oral antibacterial preparation was examined for treatment of certain diseases of poultry, dogs , cats , calves and sheep (WASSMUTH, 1987). Studies about the use of oral Baytril® solutions for adult cattle and its effects on the activity of ruminal flora and - fauna were not available.

Clinical examination of cows during the course of this study showed reduced ruminal motoric activity in 2 cows, 3 days after oral application of Baytril® that reflect the negative influence of this preparation on ruminal flora. Such result was expected and coincide with RADOSTITS et al., (1994) indicating that oral administration of antimicrobials have an inhibitory effect on the activity of ruminal flora and fauna.

The color, odor and viscosity of ruminal fluid in the all 5 cows during the course of study were slightly altered. The color of the obtained ruminal fluid varied from olive to olive brown all over the course of study. Decreased viscosity of ruminal fluid was noticed, 4 days after Baytril® application in phase B, resuming its viscosity in phase C. Odor of ruminal fluid was not greatly differed during the three phases of the study, where it was aromatic in phase A, aromatic to slightly ammoniac in Phase B . The study declared that oral application of Baytril® has a slight non significant influences on color, odor and viscosity of ruminal fluid. The fluctuation in color, odor and viscosity of ruminal fluid during the course of study are accepted as a non pathological changes.

Sedimentation- Activity Test (SAT, Fig. 1).

Sedimentation activity test provide a rapid evaluation of microbial activity of the rumen (ROSENBERGER, 1990). The required time for testing sedimentation and floatation activities of ruminal fluid has significantly ($P < 0.01$) increased from 2.5 - 4.5 minutes before oral application of Baytril® (phase A) reaching 8-14 minutes at the end of phase B and then significantly ($P<0.01$) decreased again to reach 4-5 minutes, 5 days after with-holding of oral Baytril® (phase C). This significant difference could be attributed to the negative effect of oral Baytril on the activity of

ruminal flora and fauna. There was non significant difference in the time of sedimentation activity between morning and evening ruminal samples.

pH values (Fig. 2).

Two days before oral application of Baytril® (Phase A), the collected ruminal fluid in all 5 cows, 3 hours after feeding showed a pH range of 5.2 - 6.4. In the 5th and 6th days of phase B, these values reached 6.6 - 7.0 , however in phase C, the pH values decreased again to reach 6.0- 6.5 . In this study the effect of salivary secretion was more or less reduced because the firstly collected ruminal fluid was excluded, where collected ruminal fluid with the help of ruminal tube have an increased pH value of about 12- 14 % (ROSENBERGER, 1990). The slight non significant increase of ruminal pH after oral application of Baytril® could be explained through the parallel decrease in acetic and propionic acids or it may be due to increased levels of ammonia during this phase which could reflect the decreased activity of ruminal flora after oral application of the drug.

Methylene blue -reduction tests (Fig. 3).

This test is indicated for semiquantitative estimation of redox potential and reflect the anaerobic fermentative metabolism of bacterial population (Rosenberger, 1990). Two days before oral application of Baytril®, the required time for the reduction of methylene blue has ranged from 2.0 - 5.2 minutes, reaching 14 - 15 minutes at the end of phase B and decreased again to 5 - 8 minutes (Phase C). Increased time for sedimentation activity in association with increased time of methylene blue reduction after oral application of Baytril® (phase B) confirm the negative effects of the orally applied Baytril® on the fermentation capacity of ruminal flora and fauna, which may be achieved through reduction of their number and activity. These results are in accordance with that obtained by BRAUN et al., (1988) indicating that methylene blue reduction time was increased in association with ruminal inactivity of forestomach flora and fauna in cattle. Similar observations were reported by SCHOLZ et al., (1992) concluding that oral application of medicament (Charcoal) significantly influence the ruminal flora in cattle. Rapid return of the fermentative pattern of ruminal flora, 5 days after withholding of the preparation indicate that the fluctuation in number of bacterial flora of the rumen that occur as the results of various stimuli are transient and resume its normal state just after removal of such disruptive influence (DWIGHT, 1980).

Microscopical examination:

Microscopical examination of strained ruminal fluid before and after oral application of Baytril® indicated the normal active flora and protozoa

during phase A, however reduction in density, viability, mass and individual activity of infusoria were noticed, 3- 4 days after application of Baytril®. The number and activity of large infusoria were also decreased at the end of the major phase indicating the negative effects of orally administered Baytril®, which returned into its full activity during phase C. The ruminal protozoa affect the number and types of ruminal bacteria and eventually ammonia and volatile fatty acid production in the rumen (ARAKAKI et al, 1994).

Ammonia (Fig . 7 & 9).

The study showed significant ($P < 0.05$) increased levels of ammonia, 2- 3 days after oral application of Baytril® and then return back to its normal levels at the end of major phase. The high values of ammonia in the rumen may be explained by reduction in building up of the already formed ammonia in the rumen which could attributed to the effects of Baytril® on the bacterial function in the rumen. As rapidly as ammonia is produced from the fed protein and non protein nitrogen, it is rapidly removed by bacteria for rebuilding into protein. The speed at which this occurs depends on the energy provided into bacteria by fermentation of carbohydrate, which also supply the vital carbon skeleton for the synthesis of amino acids in bacteria (PAYNE , (1989).

On contrary its blood plasma concentrations showed significant reduction ($P<0.01$) after the first application of oral Baytril® and still very little till the end of the study. Some ammonia passes directly through rumen wall and via portal vein to liver, where it is converted to urea . Reduced levels of ammonia in blood serum after oral application of Baytril® could be attributed to rapid and efficient removal of ammonia by the liver or due to decreased passage of non protein nitrogen into the intestine and by turn its absorption that require a further investigations.

Chloride (Fig. 8 & 10).

Chloride content of the ruminal fluid was steadily increased after first application of oral Baytril® and reached its higher values at the end of the study (phase C). The chloride content of blood serum increased at 4th and 5th days of phase B in both morning and evening samples. Elevated rumen fluid chloride may suggest secondary indigestion due to lowered activity of ruminal flora. BRAUN ET AL., (1988) reported a similar finding in cattle with chronic inactivity of ruminal microflora and fauna.

Volatile fatty acids pattern in ruminal fluid (VFA,s).

In ruminants VFA,s are the end products of microbial fermentation of carbohydrate and are the main energy source. Acetic, propionic and butyric

acids account for 95 % of VFA,s produced in the rumen (PAYNE, 1989). In this study acetic and propionic acids levels significantly ($p < 0.05$) decreased at the 5th-7th days (phase B) and returned to their levels at phase C. Butyric acid showed non significant changes but only small increase at the end of phase B and C. The reduction in acetic and propionic acid during the major phase confirm the negative effect of Baytril® on the fermentation pattern of carbohydrate fermenting bacteria in the rumen. In a study of SATO et al. (1993) stating that feeding of calves on Medical-chemical triglyceride led to marked reduction in protozoal count, ammonia and VFA,s production. In a study of ARAKAKI et al., (1994) NH3 and VFA,s production increased after inoculation of protozoa i.e. the decrease in the number and types of protozoa after oral application of Baytril® affect markedly not only the number and constituents of bacteria, but also the NH3 and VFA,s production in the rumen.

Finally it could be concluded that oral administration of Baytril® to adult cattle has a temporary negative influence on fermentation pattern of ruminal flora and fauna and can be safely used when it is indicated.

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REFERENCES

Arakaki, C; Mitsumori, M; Itabashi, H; Shirasaka, S and Minato, H.(1994): Influence of the presence of protozoa on the rumen microbial population of cattle. J. General and Applied Microbiology, 40:3, 215-226

Baumgartner, W. and Pagnerl , R. (1990): Efficacy of orally administered enrofloxacin (Baytril) solution against respiratory diseases of calves. Tierartz. Umshau , 45: 9, 641- 644

Brander, G.C. (1991): Veterinary applied pharmacology and therapeutics. 5th Ed. Bailliere, Tindall. pp. 484- 490.

Braun, U; Rihs, T and Eicher R. (1988): Pansensaftuntersuchungen bei Kuhen mit chronischer Inaktivitaet der Vormagenflora und fauna vor und nach Therapie und Futterumstellung. Schweizer -Archiv- fuer Tierheilkunde, 130: 10, 545-558.

Dirksen, G. (1969): Ist die Methylenblauprobe " als Schnelltest für die Klinische Pansaftunter-suchung geignet ?. Dtsch. Tierärztl.Wschr., 76. 305-309.

Dirksen, G. (1989): Rumen function and disorders related to production disease. Proc. VII Intern. Conf. Prod. Dis. in Farm Animals , Ithaca, N. Y.

Dwight C. Hirsh (1980): Microflora, mucosa and immunity in Vet. Gastroenterology Neil V. Anderson, Lea & Fabiger, Philadelpgia 1st Ed.

Fischer,W. and Kammermeier,J. (1986): Pharmacokinetics of the absorption of BAY vp 2674 (Baytril) after oral adminstration to calves. Proc. of 14th Intern. Cong. on Cattle Diseases ,- Dublin , vol. 2: 1174-1178

Heigland R., Copeland, D., Davidson, J. TerHune T. , Lechtenberg, K., Jhonson, E., Miles, D., Apley, M. and Wray, M. (1994): Dose determination and clinical evaluation of the efficacy of enrofloxacin injectable solution in the treatment of bovine respiratory disease. XVIII World Buiatrics Cong. 627- 630.

Höltershinken, M.; Scholz, H. and Stöber, M. (1991): Auswirkung oral zu verabreichender Therapeutika auf die fermentationsvorgänge im Ruminal fluid ruminierendre Rinder. 3. Mitt.: Baquiloprim/ Sulfadimidin (in vitro).Tierärztl. Umschau 46, 265-268.

Horspool, J. and McKellar, Q.A. (1991): Determination of short chain fatty acids in equine coecal liquor by ion exchange HPLC after solid phase extraction. Biomed- Chromatograph. , 5 (5): 202-206.

Osenkirchen, S.; Hölterschinken, M. and Scholz, H. (1994): Auswirkung oral zu verabreichender Therapeutika auf die fermentationsvorgänge im Ruminal fluid ruminierendre Rinder. 6.Mitteilung: Kupfersulfat. Dtsch. Tierärztl. Wschr. 10, 1-40 Heft 1.

Payne, J.M. (1989): in Metabolic and Nutritional Diseases . 1st Ed. pp 80-84 Blackwell Scientific Publication Oxford London Edinburgh.

Radostits O.M; Blood, D. C. and. Gay C.C. (1994): Veterinary Medicine. A Text book of the diseases of cattle, sheep, pigs, goats and horses, 8th Ed. Bailliere, Tindall..

Rosenberger G. (1990): Die Klinische Untersuchung des Rindes: 3. Auflage herausgegeben von Dirksen, G., Gründer H.-D and Stöber M. S. 670-677: Verlag Paul Parey. Berlin and Hamburg.

Sato, H., Watanabe, A. and Matsumoto, M. (1993): Effects of medium chain triglyceride feeding on rumen fermentation, plasma metabolite levels and feed digestion in calves fed on low protein diets. Animal Sci. and Technology , 64: 10, 1017-1023

ScHäkel, W. (1994): The use of enrofloxacin (Baytril®) in clinical shipping fever of calves. XVIII World Buiatrics Cong. 619-622.

Scheer, M. (1987): Concentration of active ingredient in the serum and tissues after oral and parentral administration of Baytril. Veterinary Medical Review (German Federal Republic), no. 2, 104 - 118

Scholz, H. and Wiemann, B.(1988): Auswirkung oral zu verabreichender Therapeutika auf die fermentationsvorgänge im Ruminal fluid ruminierendre Rinder. 1. Mitteilung: Furazolidon. Dtsch. Tierärztl. Wschr. 95, 353-408

Scholz, H.; Herz, A.; Hölterschinen, M. and Rehage, J. (1991): Auswirkung oral zu verabreichender Therapeutika auf die fermentationsvorgänge im Ruminal fluid ruminierendre Rinder. 2. Mitt.:Nitrofurantoin. Tierärztl. Umschau 46, 138-143.

Scholz, H., Hölterschinken, M. and Feldmann, M.(1992): Auswirkung oral zu verabreichender Therapeutika auf die fermentationsvorgänge im Ruminal fluid ruminierendre Rinder. 5. Mitt.:Aktivkohle (in vitro). Tierärztl. Umschau 47, 351-354.

Skrivanova, V. and Marounek, M. (1993): Effect of Virginiamycin on feed intake, daily gains, ruminal volatile fatty acids and blood Parameters in veal calves. Archives of Animal Nutrition, 1993, 44: 1, 41-46.

Wassmuth, H. (1987): Baytril - a new anti-infective chemotherapeutic agent for vet. medicine. Veterinary Medical Review , Germany No. 2, 87-153.

Tab. 1: Study design for the effects of the orally administered enrofloxacin (Baytril®) on the forestomach function of adult cattle (in vivo).

Phases of the study	Phase A 1st - 2nd day	Phase B 3rd - 7th day	Phase C 13th - 14th day
Oral administ. of Baytril (10 %) 25 ml twice daily.	Two times daily at 04.00 a.m. and 4.00 p.m.		
Time of feeding	Two times daily at 5.00 a.m. and 5.00 p.m.		
Time of sampling	Two times daily at 8.00 a.m. and 8.00 p.m.		
Collected samples	- Ruminal fluid , EDTA blood and Serum samples.		
Schedule of examination throughthe three phases of the study	- Clinical examination of cows . Physical , microscopical and chemical examinations of ruminal fluid. - Determination of Plasma NH3 and Serum Cl.		

Tab. 2: Volatile fatty acids pattern , Ammonia and chlorid in ruminal fluid during the course of study.

		Phase A		Phase B					Phase C	
Parameter	Days / T	1st	2nd	3rd	4th	5th	6th	7th	13th	14th
Acetic acid	8.0 a.m.	41,61 ± 7,03	35,37 ± 3,53	39,17 ± 4,56	37,39 ± 7,55	27,60 ± 5,31*	27,14 ± 9,90*	33,23 ± 9,46	48,75 ± 7,41	40.22 ± 4,41
mmol/l	8.0 p.m.	40,68 ±1,77	34,55 ± 4,24	31,34 ± 3,66	36,28 ± 5,78	28,41 ± 2,76*	30,41 ± 10,03*	25,96 ± 5,25*	47,55 ± 7,62	38.22 ± 3,62
Propionic acid	8.0 a.m.	15,89 ± 1,11	13,40 ± 3,14	14,53 ± 3,35	11,00 ± 3,54	8,02 ± 3,78*	8,80 ± 4,08*	14,48 ± 3,03	28,50 ± 9,44	19,55 ± 5,21
mmol/l	8.0 p.m.	12,63 ± 2,49	12,93 ± 2,02	16,68 ± 4,32	14,20 ± 5,49	7,61 ± 3,29*	13,43 ± 4,65	14,90 ± 7,50	21,08 ± 5,067	20.25 ± 4,42
Butyric acid	8.0 a.m.	9,86 ± 0,82	6,87 ± 0,72	9,63 ± 1,69	9,91 ± 1.03	8,05 ± 3,57	8,39 ± 4,31	12,87 ± 2,50	16,58 ± 4,91	14.22 ± 3,91
mmol/l	8.0 p.m.	8,48 ± 1,47	8,01 ± 2,06	10,57 ± 2,75	12.18 ± 5,55	6,85 ± 2,21	10,03 ± 3,78	10,53 ± 4,91	15,16 ± 2,74	13.32 ± 6,62
Ammonia	8.0 a.m.	5268 ± 1366,31	4838 ± 1525,26	4568 ± 3319,51	6132 ± 3088,04*	5138 ± 1859,55	6352 ± 4185,31	6101 ± 1108,30	8154 ± 2318,83*	6500 ± 1820
umol/l	8.0 p.m.	5625 ± 1459,91	4996 ± 2113,45	4722 ± 2449,19	7964 ± 2302,23*	8960 ± 2390,75*	7245 ± 2415,15*	5368 ± 2294,54	5722 ± 1654,00	5500 ± 2300
Chlorid	8.0 a.m.	13,52 ± 3,54	12,44 ± 3,70	13,68 ± 3,62	14,44 ± 2,92	14,80 ± 3,38	16,28 ± 1,91	17,40 ± 1,21	18,88 ± 2,99	16.50 ± 2,41
mmol/l	8.0 p.m.	14,22 ± 2,66	12,42 ± 3,53	14,66 ± 3,65	15,50 ± 4,57	14,62 ± 2,56	17,34 ± 1,37	16,18 ± 2,05	14,12 ± 2,67	15,12 ± 1,62

Tab. 3 : Plasma ammonia and serum chlorid concentrations during the course of the study.

		Phase A		Phase B					Phase C	
Parameter	Days / T	1st	2nd	3rd	4th	5th	6th	7th	13th	14th
Ammonia	8.0 a.m.	117,40 ± 16,82	114,80 ± 9,26	47,20 ± 7,73**	54,00 ± 34,5**	30,80 ± 9,1**	11,00 ± 9,0**	19,00 ± 12,7**	41,16 ± 18,4**	55.26 ± 12,1**
umol/l	8.0 p.m.	125,20 ± 31,52	125,00 ± 21,51	56,60± 10,57**	19,80 ± 13,2**	16,6± 13,5**	11,40 ± 9,8**	11,40 ± 7,8**	38,80 ± 12,6**	39,80 ± 10,4**
Chlorid	8.0 a.m.	95,20 ± 11,65	92,80 ± 5,54	86,00 ± 5,79	86,80 ± 4,09	90,20 ± 4,92	101,40 ± 23,69	104,00 ± 10,07	101,20 ± 9,04	104,10 ± 4,04
mmol/l	8.0 p.m.	96,00 ± 8,77	86,80 ± 10,64	81,40 ± 2,88	89,60 ± 5,13	92,20 ± 14,55	98,80 ± 6,76	102,00 ± 8,15	102,20-±-7,85	103,30 ± 4,33

Phase A : (2 days before oral application of Baytril) Phase B : (5 Days 2 x daily oral Baytril)

Phase C : (at the 13th & 14th day i.e 5 days after the last dose of oral Baytril) T: Time of sampling. * = (P < 0.05) , ** (p < 0.01).

Fig. 1: Means of sedimentation activity test in ruminal fluid during the course of the study.

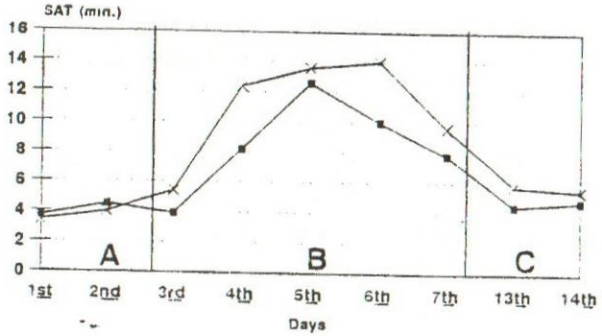


Fig. 2: Mean values of pH in ruminal fluid during the course of the study.

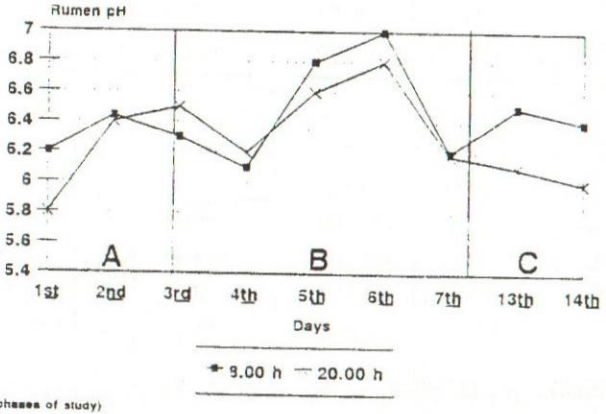


Fig. 3: Means of methylen blue reduction time in ruminal fluid during the course of the study.

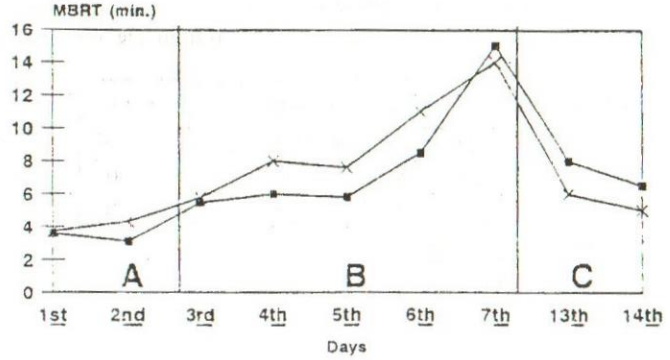


Fig. 4: Mean levels of Acetic acid in ruminal fluid during the course of the study.

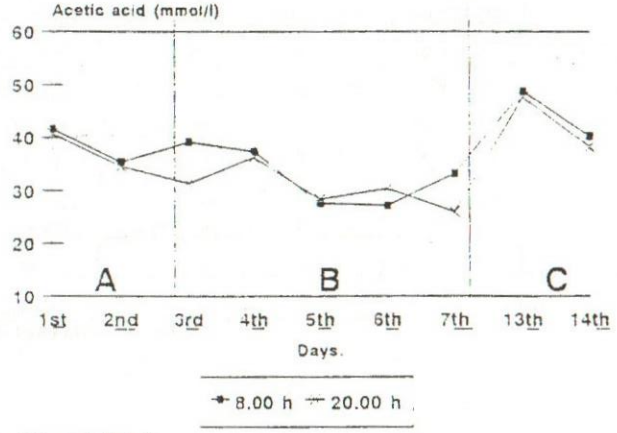


Fig. 5: Mean values of propionic acid in ruminal fluid during the course of the study.

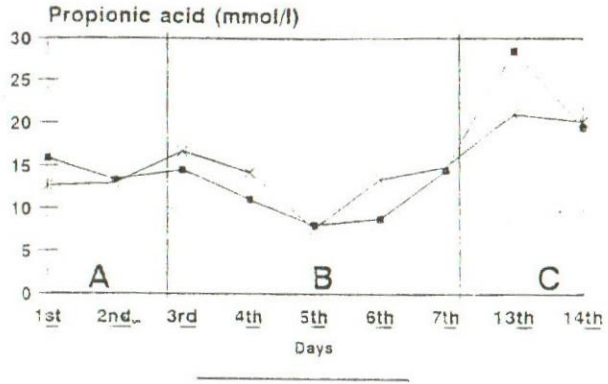


Fig. 6: Mean values of butyric acid in ruminal fluid during the course of the study.

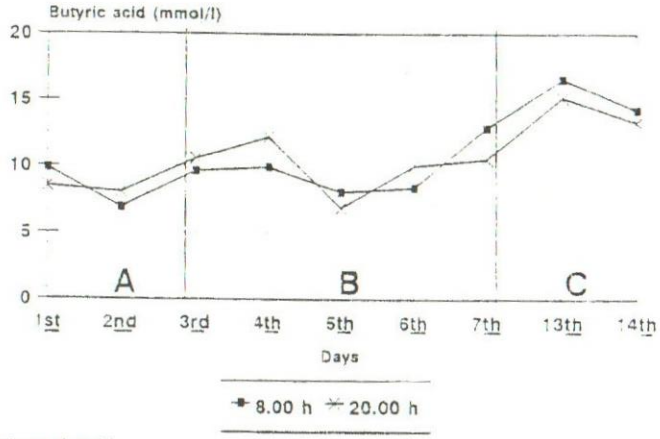


Fig. 7: Mean levels of Ammonia in ruminal fluid during the course of the study.

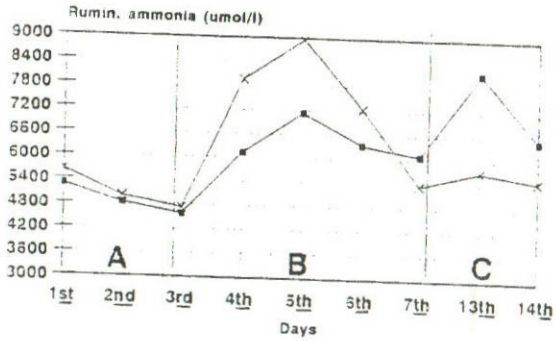


Fig. 8: Mean values of Chlorid conc. in ruminal fluid during the course of the study.

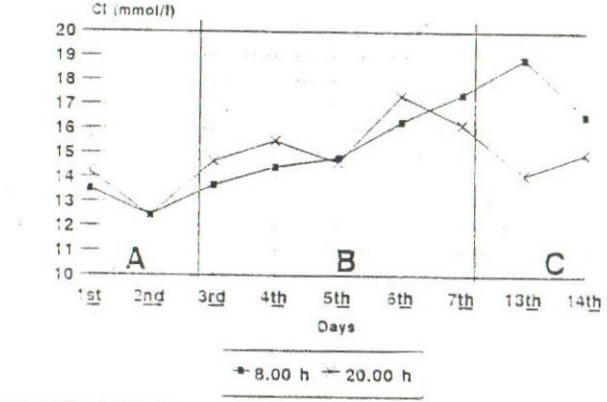


Fig. 9: Mean values of Ammonia in blood plasma during the course of the study.

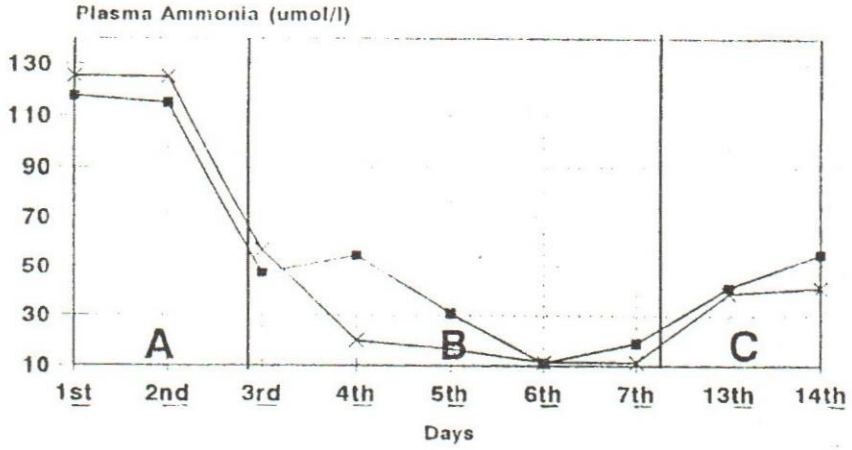
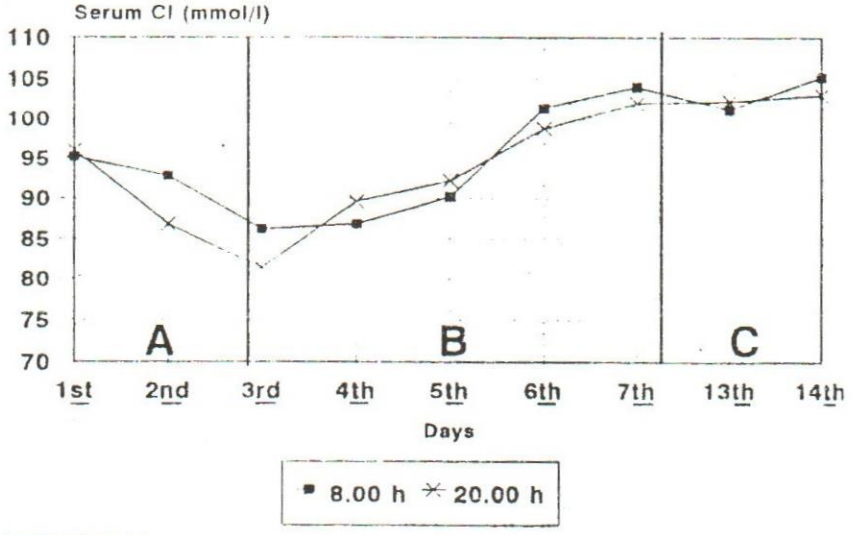


Fig.10: Mean values of chlorid in blood serum during the course of the study.



A,B,C (phases of study)