EFFECTS OF FASTING AND XYLAZINE SEDATIVE ON DIGESTIVE TRACT MOTILITY, RUMEN VFA AND CERTAIN BLOOD COMPONENTS IN RUMINANTS

Shigeo Hara[1], Kiyoshi Takahashi[1], Nobuyuki Tomizawa[1], Yoshiya Nakashima[2], Naoki Sasaki[3], Rolf. J Jorgensen[4]
[1]*Veterinary Medicine*
[2]*Agro-bioscience, Faculty of Agriculture, Iwate University, Morioka, Japan*
[3]*JRA, Inashiki, Japan*
[4]*The Royal Veterinary and Agricultural University, Denmark*

Abstract. Contraction motions of the stomach, small intestine and gallbladder were monitored in three cows with or without administered xylazine during fasting for 48 h were monitored using force transducers sutured on the organs. The concentrations of blood components, plasma electrolyte, and free endotoxin in blood were measured. In addition, the pH, the concentration of the total volatile fatty acids (VFA) and VFA composition in the rumen liquor were determined. The following results were obtained in this study:

1. The intervals of phase III observed in the duodenum, jejunum and ileum were shortened and became irregular, and those of resting states observed in the pylorus and gallbladder were prolonged compared to those in physiological state. No significant change in motility was observed in the rumen or abomasum. 2. Under the influence of xylazine, the contraction motions in the rumen, gallbladder, descending portion of the duodenum, jejunum and ileum were suppressed, whereas those in the pylorus were stimulated. It took 1.5-2.0 hours more for recovery of the motility of the digestive tract compared to the time for the recovery in normal feeding. The motility of the digestive tract was not significantly different between the first and second days. 3. The concentration of the total protein in blood significantly increased, and the pH of blood significantly decreased with time of fasting. The number of red blood cells, hemoglobin concentration and hematocrit were slightly increased. The concentration of sodium ions in blood was slightly decreased. These values were not significantly changed by administering xylazine. 4. The concentration of free endotoxin in blood was varied in the range of 3.94 to 5.13 pg/ml during the two days. It was always within a normal range during fasting, even when administering xylazine. 5. The pH in rumen liquor markedly increased, and the concentration of the total VFA markedly decreased with time of fasting. The content of acetic acid, which constitutes the largest portion of the total VFA, was not markedly changed, but the ratio of acetic and propionic acids (A/P) was increased due to fasting-induced reduction in the content of propionic acid. The changes in content of butyric, isobutyric, valeric and isovaleric acids were less than 10 % of the normal. These values were not significantly changed by administering xylazine.

Our results indicated that the motility of the stomach and small intestine was suppressed mainly due to the change in the pH or concentration of the total VFA, and the influence of the change in the concentration of free endotoxin or blood components on the suppression of the motility could be relatively small. When administering a sedative, the time of the suppression of the motility was prolonged, suggesting that controlled feeding is necessary if homeostasis of the rumen is to be kept intact.

Keywords: cattle, fasting, xylazine, digestive tract, motility, VFA's

BADAVIMO IR KSILAZINO ĮTAKA ATRAJOTOJŲ VIRŠKINIMO TRAKTO MOTORIKAI, PRIESKRANDŽIO TURINIO LAKIŲJŲ RIEBALŲ RŪGŠČIŲ KONCENTRACIJAI IR KRAUJO SUDĖČIAI

Santrauka. Jėgos davikliais, įsiūtais į atitinkamus organus, tirti trijų karvių skrandžio, plonosios žarnos ir tulžies pūslės kontrakciniai judesiai. Karvės nešertos 48 valandas. Vienoms karvėms skirta ksilazino, kitoms jo neduota. Nustatyta kraujo komponentų, plazmos elektrolitų, laisvųjų endotoksinų koncentracija kraujyje. Be to, matuotas pH, lakiųjų riebalų rūgščių (LRR) koncentracija ir sudėtis didžiojo prieskrandžio turinyje. Gauti tokie tyrimų rezultatai: 1) III fazės intervalai, stebėti dvylikapirštėje, tuščiojoje ir klubinėje žarnose, sutrumpėjo ir tapo netaisyklingi, o ramybės fazė prievartyje ir tulžies pūslėje užsitęsė, palyginti su fiziologine norma. Jokių žymesnių didžiojo prieskrandžio ir tinklainio motorikos pokyčių nepastebėta; 2) ksilazinas slopino didžiojo prieskrandžio, tulžies pūslės, nusileidžiančiosios dvylikapirštės žarnos dalies, tuščiosios ir klubinės žarnų kontrakcinius judesius ir aktyvino prievarčio kontrakcinius judesius. Virškinimo trakto judrumas normalizavosi per 1,5−2,0 val. Virškinimo trakto motorika pirmąją ir antrąją dieną nelabai skyrėsi; 3) bendrasis baltymų kiekis kraujyje smarkiai padidėjo, kraujo pH pastebimai sumažėjo, ilgėjant badavimo laikui. Kraujo raudonųjų kūnelių skaičius, hemoglobino koncentracija ir hematokrito vertė šiek tiek padidėjo. Natrio jonų koncentracija kraujyje truputį sumažėjo. Ksilazinas didesnės įtakos šiems rodikliams neturėjo; 4) laisvojo endotoksino koncentracija kraujyje dviejų dienų laikotarpiu įvairavo nuo 3,94−5,13 pg/ml. Badaujančių, net ksilazino gavusių, karvių ji liko normali; 5) badavimo laikotarpiu didžiojo prieskrandžio turinio pH smarkiai padidėjo, o LRR koncentracija pastebimai mažėjo. Acto rūgšties, sudarančios didžiąją LRR dalį, kiekis šiek tiek pasikeitė, bet acto ir propiono rūgšties santykis (A/P) padidėjo dėl badaujant sumažėjusio propiono rūgšties kiekio. Sviesto, izosviesto, valerijono ir izovalerijono rūgščių kiekis mažiau negu 10 % skyrėsi nuo normos. Taigi ksilazinas didelės įtakos šioms rūgštims neturėjo.

Mūsų tyrimai leidžia teigti, kad skrandžio ir plonosios žarnos motorika yra slopinama dėl pH ir LRR koncentracijos pokyčių, o pasikeitusios endotoksinų ar kraujo sudėties įtaka motorikos sulėtėjimui ne tokia ryški. Raminamieji pailgina motorikos slopinimo laiką, todėl, kad nesutriktų didžiojo prieskrandžio homeostazė, būtinai reikia kontroliuoti šėrimą.

Raktažodžiai: galvijai, badavimas, ksilazinas, virškinimo traktas, motorika, LRR.

I. Objective. In surgery ruminants are usually subjected to fasting before administering a sedative or anaesthetic drug to prevent bloat and abnormal swallowing of vomit (Booth and McDonald, 1988; Brown, 1986; Plumb, 1995; Turner and Mcilwraith, 1982). The fasting suppresses the metabolism, enabling the dosage of the drugs to decrease. In surgery of the digestive organs, fasting reduces the amount of substances remaining in the digestive tract, decreasing the risk of the surgery. However, the stomach of ruminants cannot be emptied of its contents by fasting. The digestive tract functions suppressed by disease, fasting, and sedative and anaesthetic durgs at the same time are thought to adversely affect the homeostasis, and to retard the postoperative restoration (Hara at al., 1996). With regard to ruminants, the effects of fasting before surgery are still unclear.

In this paper, the motility of the digestive tract in cows subjected to fasting before surgery was monitored. Also, the volatile fatty acids (VFA's) and pH of the rumen liquid, and components in blood, including blood endotoxin, were analyzed. Pre-operative care for safe sedative administration and surgery for ruminants will be discussed.

II. Materials and methods.

1. Subjects

Three cows (Holstein; weight of 400 to 580 kg) were used, and always tied to stanchions in this study.

2. Feeding

Each cow was given 3.0 to 3.5 kg of hay and 0.6 kg of bran twice a day (at 8:00 and 20:00), and allowed to arbitrarily take water (normal feeding group). The cows were forbidden to take any feed or water for 24 h or 48 h before administering of agents (complete starvation group).

3. Suturing of force transducers

Each cow was anesthetized by intramuscularly administering xylazine (Celactal; Bayer Japan, Japan) at a dose of 0.2 mg/kg after fasting for 24 h and laid on the left side in a recumbent posture. Hair around the right median cephalic part was shaved. The shaved skin was disinfected with a povidone iodine solution and alcohol. An incision was made in the right cephalic part. A force transducer was sutured on the serous membrane of each of the abomasum, pylorus and duodenal bulb, and then the incision was sutured. After the cow was awakened, hair around both flanks was shaved in a standing posture. The shaved skin was disinfected, and then an incision was made on it. A force transducer was sutured on each of the rumen, descending portion of the duodenum, jejunum and ileum. The leads of the sutured force transducers were allowed to come out from the right flank.

4. Monitoring of the motion of the stomach and small intestine

Contractions of the stomach and small intestine were monitored by the sutured force transducers. Each of them was connected to a terminal box having resistors (120 Ω) forming a Wheatstone bridge. The output from the terminal box was amplified with a strain amplifier (AP-621G; Nihon Koden,Japan), and continuously recorded with an eight channel thermal printer (WT-685G; Nihon Koden, Japan). The chart speed of the thermal printer was set at 1 mm/min.

5. Analysis of contractions

The contractions periodically arising in the duodenum, jejunum and ileum were classified into three phases by reference to reports written by Bueno and Fioramonti (1980) as follows: "phase I", in which no contractions were observed for a short time; "phase II", in which irregular contractions were observed for a longer time; "phase III", in which strong contractions were observed. The time interval from phase I to the next, during which phase I, phase II and phase III sequentially occurred, was defined as a period of contractions. The occurrence, duration time, period and propagation of each phase were monitored during the day. When administering a sedative, they were monitored for 10 h until the end of its efficacy.

6. Administration of agents

After 60 min of feeding in the morning, atropine sulfate was intramuscularly administered at a dose of 0.05 mg/kg. Xylazine was also intramuscularly administrated at a dose of 0.2 mg/kg after 15 min of the atropine sulfate administration (agent administering group). These agents were administrated at the same dose in a similar manner to the subject cows on the first and second days of fasting (fasting groups). Non-administered cows in the fasting groups were employed as reference.

7. Measurement of free endotoxin (Et) in blood

The amount of free endotoxin in blood was measured according to the methods reported by Binder & Mortensen (Binder and Mortensen, 1985; Mortensen and Binder, 1985) and Dougherty et al. (1975). In brief, sample blood was aseptically taken after 1.5, 4.5, 7.5 and 10.5 h of feeding, and after 13.5 16.5, 19.5, 22.5, 37.5, 40.5 43.5 and 46.5 h from the last feeding during fasting. Each blood sample was poured into a 15 ml Et-free plastic tube (Falcon, BioWhittaker Europe, France), and centrifuged at 3,000 rpm for 40 s to separate platelet rich plasma (PRP). The separated PRP was collected with an Et-free micro-pipette, and poured into a 1.8 ml Et-free Cryotube (Nunc,Fisher Scientific, Belgium). The collected PRP was stored at -80°C before use. Lyophilized limulus polyphemus amoebocyte lysate

(LAL) (ES-Test Wako; Wako Pure Chemicals, Japan) was aseptically dissolved in 5 ml of 0.1 M Tris-HCl buffered solution (pH 7.3), and stored at 4°C before use. 500 ng of a standard Et derived from UKT-B strain of escherichia coli (purified phenol extract) was aseptically dissolved in 5 ml of Et-free purified water. The standard Et solution was diluted to a concentration of 2.5 or 0.625 pg/ml.

The frozen PRP was melted in a water bath at 37° C. with a micro-pipette 100 µl of the melted PRP was put into an aluminum-capped test tube sterilized at 250° C for 2 h, and then tenfold diluted by adding 900 µl of Et-free purified water. The diluted PRP was heated in boiled water for 10 min and then cooled in a water bath at 4° C. 100 µl of the prepared LAL solution was poured into a special test tube for Et measurement (Wako Pure Chemicals, Japan), and then 900 µl of purified water used for diluting PRP, the standard Et solutions or the diluted PRP were added to the LAL solution. After 15 s of thoroughly mixing for 1-2 s with a mixer, the test tube was inserted to a turbidimetric toxinometer (ET0201; Wako Pure Chemicals, Japan). The gelation time (T_g) of each sample was measured. From an Et standard concentration curve, in which T_g (min) was plotted against the logarithm of the standard Et concentration, the Et concentration in each sample of PRP was determined.

8. Analysis of rumen liquid

Samples of rumen liquid were taken with a pump through a fistula connected to the rumen after 2, 5, 8 and 11 h of feeding, and after 14, 17, 20, 23, 38, 41, 44 and 47 h from the last feeding during fasting. After filtrating the collected rumen liquid with gauze, the pH was measured with a pH meter (F-H8T; Horiba, Japan). Several tens µl of saturated HgCl solution were added to the collected rumen liquid. The rumen liquid with added HgCl was stored in a frozen state before use.

The frozen rumen liquid was melted in a water bath. 10 ml of the melted rumen liquid was put in a flask, and 10 ml of 20 % $MgSO_4$ solution and 5 ml of 50 % H_2SO_4 solution were poured into the flask. The mixture in the flask was subjected to steam distillation to separate VFA in a solution form. 300 ml of the distillate was titrated with a 0.1 M NaOH standard solution to determine the total amount of VFA. Excess NaOH was added to the titrated sample to form Na salts of VFA's contained in the sample. The water in the sample was roughly removed using a rotary evaporator. The residue was laid on an evaporating dish, which was put in a hot water bath to completely remove the remaining water in the residue. The dried Na salts of VFA in a powdery form were stored in a sealed test tube at room temperature.

The dried VFA Na-salts were dissolved in several tens µl of a phosphate buffered solution. Approximately 0.5 ml of diethyl ether was added to the VFA Na-salts solution and thoroughly mixed each other. After resting for 10 min, the supernatant (diethyl ether layer) was collected with a micro-syringe, and injected into a gas chromatograph (G-80; Yanagimoto, Japan). In an obtained chromatogram, areas for acetic, propionic, isobutyric, butyric, isovaleric and valeric acids were measured. Solutions of the respective acids at predetermined concentrations (0.1-0.3 M) were mixed for a reference VFA mixture. The concentration of each VFA in the sample was determined by comparing the corresponding area measured for the reference mixture (Nakashima, 1979).

9. Analysis of blood components

The numbers of leukocytes, erythrocytes, and the concentration of hemoglobin (Hb) in blood were measured by an automatic blood cell counter (F-800; Sysmex, USA). The hematocrit (Ht) was measured by a high speed centrifuging method. The concentration of the total proteins (TP) was measured by a refractometric protein analyzer (Automatic Analyzer 7060; Hitachi, Japan). The concentrations of blood urea nitrogen (BUN) and aspartate aminotransferase (AST) were measured by a clinical spectrophotometer (105-50; Hitachi, Japan). The pH and the concentration of electrolytes (Na^+, K^+) in blood were measured by an automatic blood pH/gas/electrolyte analyzer (Ciba-Corning 288; Ciba-Corning Diagnostic,USA).

10. Statistical analysis

Data obtained by the respective measurements were expressed as mean +/- S.D. unless otherwise indicated. The difference between control and treated groups was analyzed for statistical significance using Student's t test.

III. Results. 1. Contractions of the stomach, small intestine and gallbladder during normal feeding

In he rumen, irregular contractions succeeded for 40-120 min after feeding. In the body of the abomasum, irregular and successive contractions were observed without any clear periodicity, whereas in the pylorus, an active state in which successive contractions continued for 60-80 min, and a quiescent state in which the contractions halted for 5-10 min were observed. In the gallbladder, an active state in which contractions succeeded for about 60 min, and a quiescent state in which the contractions halted for 5-15 min alternately arose. In the descending portion of the duodenum, jejunum and ileum, phase I, phase II and phase III were observed to occur periodically. In the gallbladder, the quiescent state occurred in response to the occurrence of phase III of the duodenal bulb. Phase III observed in the duodenum transferred sequentially to the jejunum and ileum (Fig.1). The average intervals of phase III were 66.8 min in the descending portion of the duodenum, 60.4 min in the jejunum, and 64.0 min in the ileum (Table 1).

2. Contractions of the stomach, small intestine and gallbladder during fasting

The intervals of quiescent states were prolonged in the pylorus of the abomasums and gallbladder, compared to those during normal feeding. Also, the frequency of occurrence of phase III in the duodenum, jejunum and ileum was slightly decreased. In contrast, no significant difference in the motility of the rumen or the body of the abomasum between fasting and normal feeding was observed. The interval of phase III in the duodenum was prolonged to 68.3 min on the second day of fasting (Fig.

2), and those in the jejunum and ileum were significantly different between fasting and normal feeding on the second day ($P < 0.01$) (Table1).

3. Effects of administration of xylaxine on the contractions of the stomach, small intestine and gallbladder

After a couple of minutes of intramuscularly administering atropine sulfate (0.05 mg/kg), the contractions of the rumen, abomasums and gallbladder were suppressed, whereas no change in motility was observed in the small intestine. When administering xylazine (0.2 mg/kg), the motility of the rumen was promoted once, and then suppressed. The frequency of contractions of the pylorus of the abomasum began to increase after a couple of minutes of administrating xylazine, and significantly elevated after 30 min. In the gallbladder, the contractions were promoted by successive xylazine administering, compared to administering atropine only. The contractions in the descending portion of the duodenum, jejunum and ileum were suppressed after a couple of minutes of administering xylazine.

Weak contractions were observed after about 3 h of administering xylazine in the rumen. It took about 6 h to restore the normal contraction. In the gallbladder, irregular contractions were observed after 1 h of xylazine administration. It took about 6 h also to restore the normal contractions, as well as in the pylorus of the abomasum. In the duodenum, weak contractions were observed after about 2 h of xylazine administration. It took about 5 h to restore the normal contractions, as well as in the jejunum and ileum.

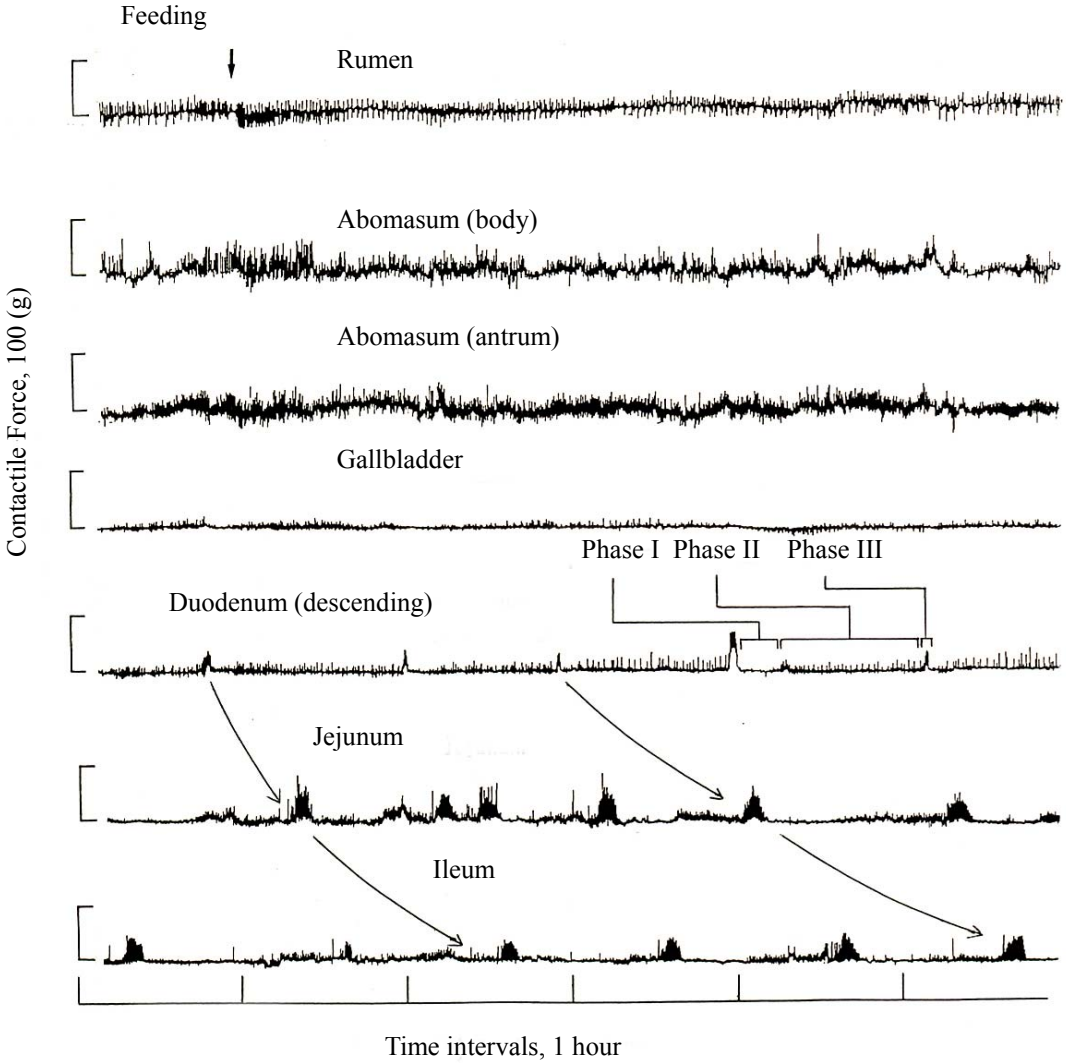

Fig. 1. **Contractions of the stomach, small intestine and gallbladder during normal feeding**

Migrating contractions (MC's) were transferred from the duodenum to the ileum, as indicated by arrows. Since the chart speed of the thermal printer was set at 1 mm/min, the active period, which synchronized with phase III in the duodenum, was not clear.

Table 1. **Duration time and period of the three phases in the small intestine**

Group		A	B	C	Significance
Time from the last feeding (h)		0-11	11-23	35 - 47	
Duodenum (descending)	Phase I	11.3+/-3.55	11.7+/-8.57	10.5+/-6.55	
	Phase II	51.8+/-11.03	51.2+/-23.69	59.7+/-25.90	
	Phase III	3.5+/-1.38	3.9+/-1.51	4.1+/-1.16	
	Period	66.8+/-11.94	65.8+/-30.39	68.3+/-30.32	
Jejunum	Phase I	20.9+/-11.28	22.0+/-11.50	21.6+/-12.13	
	Phase II	31.6+/-12.55	43.1+/-15.42	58.6+/-26.56	A-C: * *
	Phase III	7.9+/- 0.95	7.9+/-1.30	10.0+/-3.61	
	Period	60.4+/-17.23	73.0+/-12.45	87.6+/-26.01	A-C: * *
Ileum	Phase I	24.5+/-8.26	27.5+/-8.82	35.2+/-14.25	A-C: *
	Phase II	31.8+/-8.47	39.9+/-25.05	44.9+/-19.77	A-C: *
	Phase III	7.8+/-2.35	5.2+/-1.54	6.6+/-1.51	A-B: * *
	Period	64.0+/-9.85	66.8+/-33.24	86.7+/-18.69	A-C: * *

* : $p < 0.01$ * * : $p < 0.05$ (min; mean +/- S.D.)
A : Normal feeding B : First day of fasting C : Second day of fasting

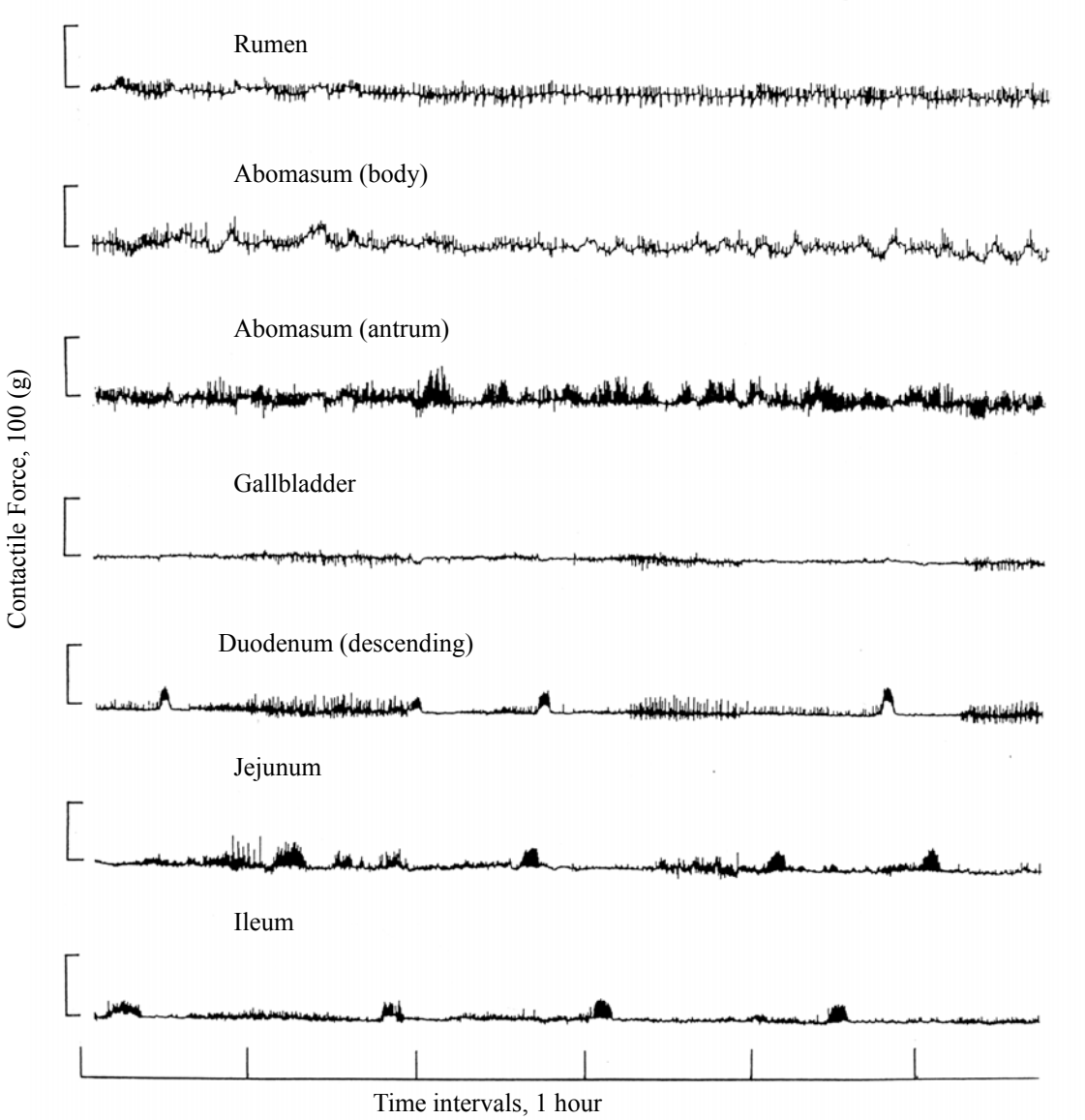

Fig. 2. **Contractions of the stomach, small intestine and gallbladder during the second day of fasting**

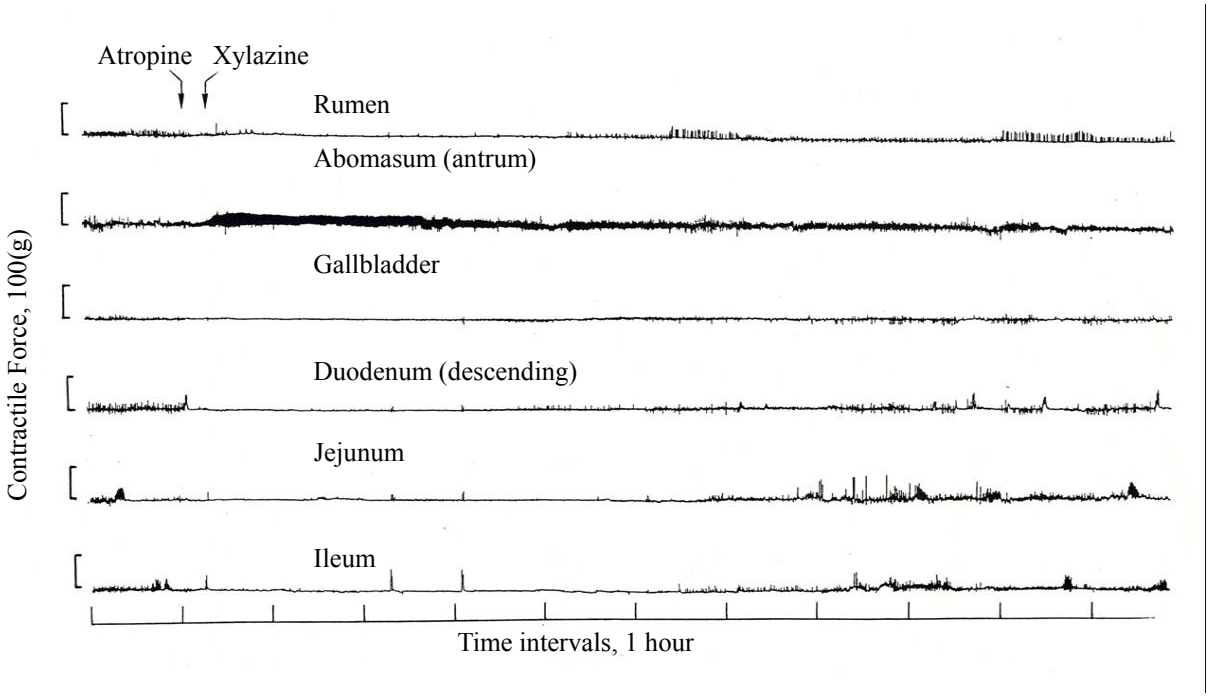

Fig. 3. **Effects of administration of xylaxine on the contractions of the stomach, small intestine and gallbladder**

During fasting, the effects of administering atropine or xylazine on the motility of the stomach and small intestine were not significantly different from those during normal feeding. The time required for restoring the normal contractions in the rumen was about 1 h longer than that in normal feeding, and they were still slightly irregular at the beginning of the restoration. On the first day of fasting, the contractions in the pylorus of the abomasum were promoted after about 4 h of xylazine administration. After the strengthened contractions lasted for about 1 h, the motility was gradually restored to the normal.

On the second day of fasting, such strengthened contractions as observed in the xylazine administrated cows in normal feeding, lasted for about 3 h. It took 1.5 to 2.0 h more to restore the normal contractions in the gallbladder, the descending portion of the duodenum, jejunum and ileum on both first and second days of fasting (Fig.3), compared to the time required for restoring in normal feeding. No significant difference in the delayed restoration was recognized between the first and second days of fasting.

4. Analysis of blood

On the first day the number of leukocytes was significantly decreased (to 5,900 /ml) by administering the agents (normal: 8,700 /ml) ($P < 0.05$). The number of erythrocytes was slightly increased on the second day of fasting, but the difference between fasting and normal feeding was not significant. The Hb concentration and Ht value were slightly decreased on the second day of fasting, but the difference between fasting and normal feeding was not significant. The concentration of TP was significantly increased (to 8.4 g/dl) by agent administration on the second day of fasting ($P < 0.01$).

The concentration of BUN tended to gradually increase with time of fasting. The concentration of AST remained normal even when administering the agents or being subjected to fasting. The pH of plasma tended to gradually decrease during fasting, and the difference between the first and second days was significant. The concentration of Na^+ tended to gradually decrease during fasting, and the difference was significant. The concentration of K^+ tended to gradually decrease during fasting, and the difference was significant. The concentration of free endotoxin in blood was slightly increased on the first day of fasting, but the increase was not significant.

5. Analysis of rumen liquid

The pH of rumen liquid was markedly increased during fasting (Fig. 4-a). The difference between fasting and normal feeding was significant both in the agent administered and non-administered groups ($P < 0.001$). The pH measured in the agent administered group was apparently lower than that in the non-administered group, but the difference was not significant.

The concentration of the total VFA was markedly decreased during fasting (Fig.4-b). The difference was significant both in the agent administered and non-administered groups ($P < 0.001$). No significant difference was recognized between the agent administered and non-administered groups.

The content of acetic acid was significantly decreased on the second day of fasting in the non-administered group ($P < 0.05$). On the first day of fasting, the content measured in the agent administered group was significantly lower than that in the non-administered group ($P < 0.05$).

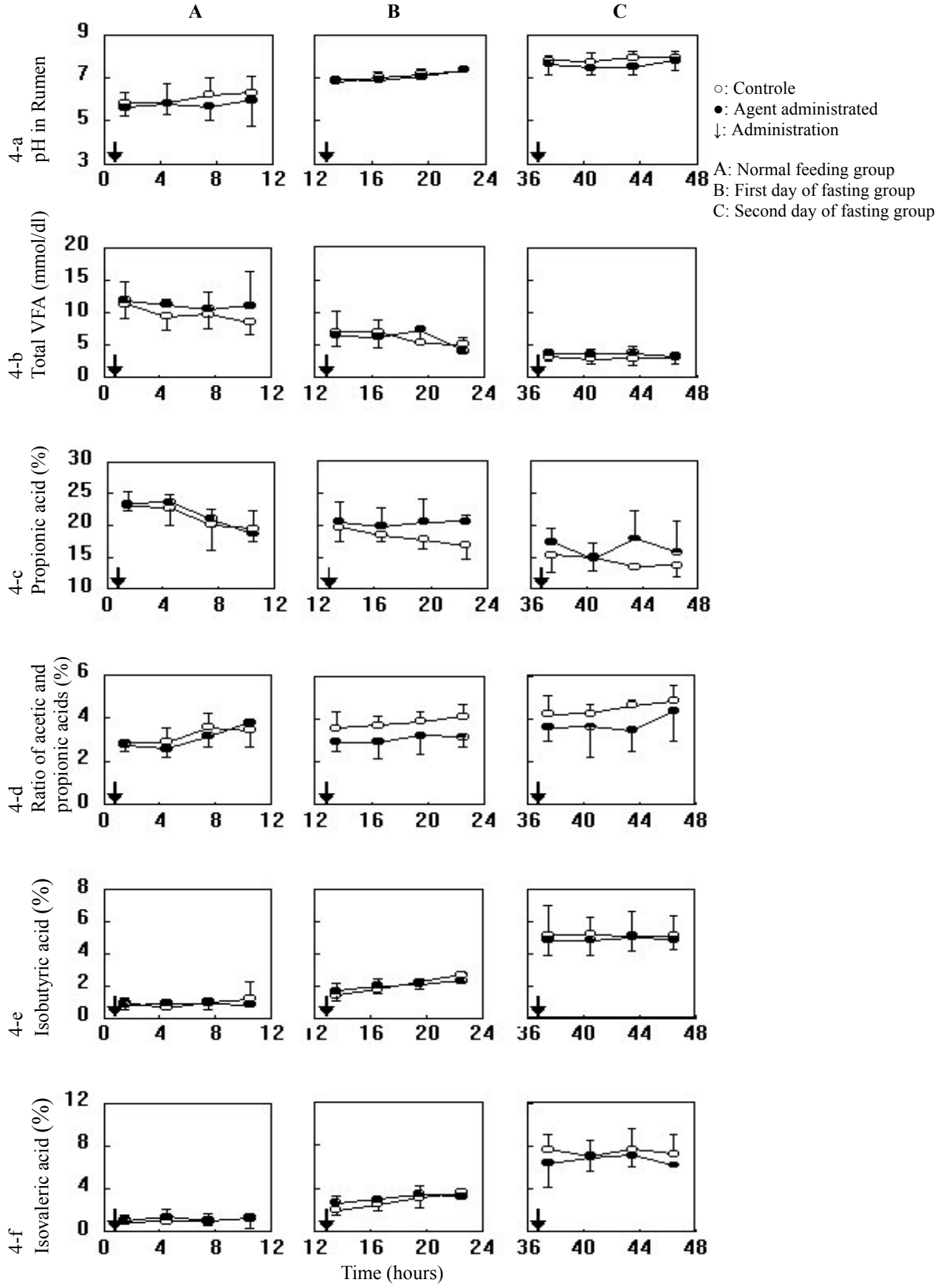

Fig. 4. **pH and volatile fatty acids (VFA's) in the rumen liquid**
4-a: pH 4-b: Total amount of VFA's 4-c: Propionic acid
4-d: Ratio of acetic and propionic acids (A/P) 4-e: Isobutyric acid 4-f : Isovaleric acid

The content of propionic acid was decreasing during fasting both in the agent administered and non-administered groups ($P < 0.001$). In the non-administered group, the content measured in the agent administered group was significantly lower than that in the non-administered group ($P < 0.001$). No significant difference was recognized between the agent administered and non-administered groups (Fig.4-c).

The ratio of acetic and propionic acids (A/P) was increased during fasting (Fig.4-d).

The increase was observed both in the agent administered and non-administered groups. The increase observed in the agent non-administered group was significant ($P< 0.001$). The difference in the A/P increase between the agent administered and non-administered groups was significant on the first day of fasting.

The content of isobutyric acid was increased about twofold on the first day of fasting, about fivefold - on the second day both in the agent administrated and non-administrated groups ($P< 0.001$). No significant difference was recognized between the agent administered and non-administered groups (Fig.4-e).

The content of butyric acid was significantly decreased on the second day of fasting in the agent administered group ($P < 0.05$). No significant difference was recognized between the agent administered and non-administered groups.

The content of isovaleric acid was significantly increased about threefold on the first day of fasting, six-to-sevenfold on the second day both in the agent administrated and non-administrated groups ($P < 0.001$). No significant difference was recognized between the agent administered and non-administered groups (Fig.4-f).

The content of valeric acid was significantly increased on the second day of fasting ($P < 0.05$). The difference between the first and second days was also significant ($P < 0.05$). No significant difference was recognized between the agent administrated and non-administrated groups.

IV. Discussions. Contractions of the gallbladder, which is innervated by vagus nerves, occurred almost in response to those of the abomasums, as in pigs (Hara, 2000) and dogs (Matsumoto et al., 1988). It has been reported that contractions of the gallbladder occur in response to migrating contractions (MC) of the stomach and duodenum, and the gallbladder is relaxed when the strongest contraction in phase III occurs in the stomach and duodenum (Hara, 2000). The relaxation was thought to facilitate the suction of gall into the gallbladder, suggesting that the MC were closely related to the functions of the gallbladder.

The volume of the rumen is very large, allowing ingesta in the rumen to continuously transfer to the abomasum even during fasting up to 48 h. Also, no significant change in the contractions of the rumen, pylorus of the abomasum and gallbladder was observed during fasting. These data indicated that the motility of the abomasum was not influenced by fasting up to 48 h. In contrast, the average intervals of the contractions in the descending portion of the duodenum, jejunum and ileum were significantly prolonged on the second day of fasting, suggesting that the change in the amount of fibers, pH, condition of bacterial floras, and concentration and composition of VFA in the rumen influenced the function of the autonomous and mural nerves systems, and of the receptors for humoral factors (Bueno and Fioramonti, 1980; Cheng et al., 1991; Cole, 1991; De Veth and Kolver, 2001; Dougherty et al., 1975; Galfi et al., 1991).

Longitudinal smooth muscles are regulated mainly by $bata_2$-receptors, circular smooth muscles - mainly by alpha $_2$-receptors. In smooth muscles of the digestive tract, alpha-adrenergic agents suppress the function of $bata_2$-receptors, and promote that of alpha $_2$-receptors(Eades, 1997; Gross and Tranquilli, 1989; Ruckebusch and Allal, 1987; Toutain et al., 1982). It has been reported that xylazine suppresses ruminative motions of the stomach (Booth and McDonald, 1988; Brikas et al., 1986; Hara, 2000; Kakinuma et al., 1986; Ruckebusch and Allal, 1987; Toutain et al., 1982), and it suppresses the motility of the rumen and reticulum, but promotes that of the omasum (Brikas et al., 1986) and abomasum (Hara, 2000; Kakinuma et al., 1986). It has been also reported that the effect of xylazine is different among sites of the colon in ponies (Roger and Ruckebusch, 1987). The suppression of motility in the rumen, gallbladder, descending portion of the duodenum, jejunum and ileum was thought to be induced by an alpha-adrenergic agent of xylaxine (Booth and McDonald, 1988; Plumb, 1995; Ruckebusch and Allal, 1987; Toutain et al., 1982). The marked promotion of contractions in the pylorus, in which circular smooth muscles were much developed, could be induced by $alpha_2$-receptors stimulated with xylazine. The retarded restoration of the digestive tract motility after administrating xylazine during fasting could be caused by a nerve system modulated with a changed property of the liquid in the digestive tract, or by altered pharmacokinetics.

It has been reported that no significant change in Ht or concentration of TP was observed in sheep during fasting for 5 days. Also, it has been reported, in contrast, that the number of erythrocytes, concentration of Hb, Ht and osmotic pressure of plasma in cows prohibited from drinking for 4 days are significantly increased, and the number of thrombocytes and concentration of TP tend to increase . It has been reported that, when the amount of plasma is reduced due to dehydration, water retention and Na^+ resorption are facilitated through the thermoregulation system, leading to an elevated Na^+ concentration in plasma (Galyean et al., 1981; Klopfenstein et al., 1966). In addition, it is known that ketoacidosis is caused by fasting. The increase in TP concentration, erythrocyte number, Hb concentration and Ht could be due to a plasma amount decreased by dehydration .The increased pH was thought to be caused by ketoacidosis.

The pH in the rumen is increasing during fasting, giving a preferred condition for proliferation of gram-

negative bacteria (Dougherty et al., 1975; Mullenax et al., 1966; Nagaraja et al., 1978). However, the concentration of free Et in blood was not significantly increased during fasting for 48 h, suggesting that gram-negative bacteria in the rumen could not proliferate, or bacteria grown in the rumen could be inactivated with a self-defense system in the liver (De Saedeler et al., 1991; Galyean et al., 1981).

The optimum pH in the rumen of cows producing milk is required in the range of 6.1 to 6.6. Although the pH in the rumen varies according to the quality or quantity of feeding, it is usually kept in the range of 5.0 to 7.0. It has been reported that an elevated pH directly affects the condition of bacterial floras (Cheng et al., 1991; De Veth and Kolver, 2001; Dougherty et al., 1975). The pH in the rumen of the cows used in this study became more than 7.0 after about 20 h of feeding, more than 7.5 on the second day of fasting, beyond its normal range. Also, the concentration of the total VFA in rumen liquid was decreased. It is known that the concentration is determined with a balance of the fermentation of ingesta and absorption of fermentates in the rumen. The decrease in pH was probably due to a reduced amount of ingesta in the rumen. In addition, alkaline saliva specific to ruminants flown into the rumen could promote the pH decrease. Humor in living animals, such as cytoplasm, blood and lymph fluid, is a buffered aqueous solution, suggesting that the increase in pH in the rumen cannot adversely affect the condition of cows acutely.

It is important for the homeostasis of the rumen that the contents and acetic and propionic acids, and the ratio of those acids (A/P) in rumen liquid should be maintained. The optimum pH for bacteria producing acetic acid has been reported to be relatively high (Mullenax et al., 1966). In this study, the content of acetic acid in the total VFA was 64 to 68 % even during fasting maintained in a normal range, whereas that of propionic acid was significantly decreased to 14 to 21 % by fasting. The decrease in the content of propionic acid was probably because an increased pH above 6.0, the optimum value for bacteria producing propionic acid, in the rumen suppressed their activity. It has been reported that intake of propionic acid to the rumen markedly reduces the motility of the rumen and salivation (Svendsen, 1975). An increased A/P during fasting observed in this study suggested that the motility of the rumen and salivation were not adversely affected by fasting even on the second day.

The results obtained in this study indicated that the condition of the rumen was markedly changed after fasting for more than 38 h. The data suggested that when patient animals, which suffered from aphylaxis, were subjected to excess fasting, it could adversely affect the stomach condition due to disruption of bacterial floras, lever functions and metabolism. When using an α_2-receptor stimulating agent, an antagonist of it was found to play an important role for a quick restoration. Operation time, as well as fasting time, and the amount of feeding, would be very important for safe surgery of ruminants.

References

1. Binder, M., Mortensen, K.The limulus amoebocyte lysatetest: detection of endotoxin in plasma of swine and cattle. II. in vivo investigations. Acta vet. Scand. 1985. Vol. 26. P.231-245.
2. Booth N. H., McDonald L.E. Nonnarcotic analgesics. In: N. H. Booth & L.E. Mcdonald (eds) :Veterinary Phamacology and Therpeutics. 6th edition. Ames: Iowa State University Press, 1988. P. 251-362.
3. Brikas P., Tsiamitas C., Wyburn R. S. On the effect of xylazine on forestomach motility in sheep. Zentralblatt fur Veterinarmedizin. (A). 1986. Vol.33. P. 174-179.
4. Brown, J. R.: Use of xylazine in cattle. Mod. Vet. Pract. 1986. Vol.67 P.125-126.
5. Bueno L., Fioramonti J. Rhythms of abomaso-intestinal motility. In:Y.Ruckebusch & P. Thivend(eds): Digestive physiology and metabolism in ruminants. Westport: AVI Publishing, 1980. P.53-80.
6. Cheng K J., Forsberg C.W., Minato, H. et al. Microbial ecology and physiology of feed degradation within the rumen. In: T.Tsuda, Y. Sasaki, R. Kawashima (eds): Physiological aspects of digestion and metabolism in ruminants. San Diego: Academic Press, 1991. P. 595-624.
7. Cole N. A. Effects of animal-to animal exchange of ruminal contents on the feed intake and ruminal characteristics of fed and fasted lambs. J. Anim. Sci. 1991. Vol. 69. P.1795-1783.
8. De Saedeler V., Wechsung E., Houvenaghel A. Endotoxin in the conscious piglet: its effects on some general gastrointestinal myoelectrical parameters. Vet. Res. Commun. 1991. Vol.15. P. 227-237
9. De Veth M. U. J., Kolver E. S. Diurnal variation in pH reduces digestion and synthesis of microbial protein when pasture is fermented in continuous culture. J. Dairy Sci. 2001. Vol. 84. P. 2066-2072.
10. Dougherty R. W., Riley J. L., Cook H. M. Chnages in motility and ph in the digestive tract of experimentally overfed sheep. Am. J. Vet. Res. 1975. Vol. 36. P.827-829.
11. Dougherty R. W., Couburn K. S., Cook H. M. Preliminary study of appearance of endotoxin in circulatiory system of sheep and cattle after induced grain engorgement. Am. J. Vet. Res. 1975.Vol. 36. P.831-832.
12. Eades S.C. Endotoxaemia in dairy cattle: mechanism of reticulorumen stasis. Vet. J. 1997. Vol. 153. P.321-327.
13. Fujii K., Okajima M., Kawahori K.et al. Effect of alpha2-adrenergic receptor antaonist (midaglizole) on gastrointestinal motility in conscious dogs. Jpn. Smooth Muscle Res. 1989. Vol. 25. P.125-135.
14. Galfi P., Neogrady S., Sakata T. Effects of volatile fatty acids on the epitherial cell proliferation of the digestive tract and its hormonal mediation. In: T. Tsuda, Y. Sasaki, R. Kawashima (eds): Physiological aspects of digestion and metabolism in ruminants. San Diego: Academic Press, 1991. P.49-59.
15. Galyean M. L., Lee R.W. Hubbert M.E. Influence of fasting and transit on ruminal and blood metabolites in beef steers. J. Anim. Sci. 1981. Vol. 53. P.7-18.
16. Gross M. E., Tranquilli W. J. Use of alpha 2-adrenergic receptor antagonists. J Am Vet Med Assoc. 1989. Vol. 195. P. 378-381.
17. Hara S., Tamura T., Takahashi T. et al. Treatment of left displaced abomasum in dairy cows by the combined use of alpha2-adrenergic drugs and rolling. Abstracts of The 19th World Buiatrics Congress. Edinburgh. 1996. P. 182-183
18. Hara S. Effect of herb medicine on the motility of gastrointestinal tract. 11th Congress of the Federation of Asian Veterinary Asociation. Taipei. 2000. Proceeding, P.226-228.
19. Kakinuma C., Hara S., Asai N. Effects of xylazzine on gastrointestinal motility in goats and dogs. Jpn. J. Vet. Anesth. 1986. Vol 17. 19-29 (in Japanese with English summary).
20. Klopfenstein T. J., Purser D. B., Tyznik W. J. Effects of defaunation on feed digestibility rumen metabolism and blood metabolites. J. Anim. Sci. 1966. Vol. 25. P. 765-772
21. Matsumoto, T., Sarna, SK., Condon RE. et al. Canine gallbladder cyclic motor activity. Am. J. Physiol. 1988. Vol.255 (Gastrointest. Liver Physiol. 18). P. G409-G419.
22. Mortensen K.M., Binder M. The limulus amoebocyte lysate test: detection of endotoxin in plasma of swine and cattle. I. In vitro investigations. Acta vet. Scand. 1985. Vol. 26. P. 231-245
23. Mullenax C. H., Keeler R. F., Allison M. J. Physiologic

responses of ruminants to toxic factors extracted from rumen bacteria and rumen fluid. Am. J. Vet. Res. 1966. Vol. 27. P. 857-868

24. Nakashima, Y.: Studies on enhancement of the nutritive value of rice straw by soodium hydroxide spraying treatment as a dry process method. J. Fac. Agr. Iwate Univ. 1979. Vol. 14. P. 187-276(in Japanese with English summary).

25. Nagaraja T. G., Bartkey E. E., Fina L. R. et al. Relationship of rumen gram-negative bacteria and free endotoxin to lactic acidosis in cattle. J. Anim. Sci. 1978. Vol. 47. P.1329-1336

26. Plumb D.C. Veterinary Drug Handbook. 2nd ed. Ames: 1995. Iowa State University Press, P.636-638.

27. Roger, T. & Ruckebusch Y. Colonic alpha2-adrenocepyor mediated responses in pony. J. vet. Pharmacol. Therap. 1987. Vol. 10. P. 310-318.

28. Ruckebusch Y., Allal C. Depression of reticulo-ruminal motor functions through the stimulation of alpa 2-adrenoceptors. J, Vet. Phamacol. Therap. 1987. Vol. 10. P1-10.

29. Svendsen P. E. Experimental studies of gastro-intestinal atony in ruminant. In: McDonald I. W. & Warner A. C. I. (eds): Digestion and metabolism in the ruminant. Australia: The University of New England publishing Unit, 1975. P. 363-575.

30. Toutain P. L., Zingoni M. R., Ruckebusch Y. Assessment of alpha2-adrenergic antagonists on the central nervous system using reticular contraction in sheep as model. J. pharmacol. Exp.Ther. 1982. Vol. 223 P. 215-223.

31. Turner A S. and Mcilwraith C. W. Techniques in Large Anmal Surgery. Philadelphia: 1982. Lea & Febiger, P.7-27.

32. Yoder R. D., Trenkle A., Burroughs W. Influence of rumen protozoa and bacteria upon cellulose digestion in vitro .J. Anim Sci. 1966. Vol. 25. P. 609-612.

2002 09 19