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Research Article

Clinical, Haematobiochemical, Ultrasonographical, and Ruminal Alterations in Induced Lactic Acidosis with Therapeutic Evaluation in Camels in South Sinai

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Abstract | This study aimed to investigate the effect of induced lactic acidosis in camels on clinical, haemato-biochemical, ultrasonographical and ruminal examinations, and to evaluate therapeutic interference by Rumitone (herbal product). To achieve these objectives, three healthy she camel at Ras Sudr Research Station, belonging to Desert Researcher Center, aged from 8-10 years old and weighting 350- 400 kg were used. Lactic acidosis was induced with oral sucrose (14 gm/ kg BW) for 24hs after which camels were treated with oral Rumitone daily for a week. Clinical examination revealed significant increase ($P < 0.05$) in body temperature, respiratory rate, and pulse rate, and significant decrease ($P < 0.05$) in ruminal movement after lactic acid induction. Hematological examination revealed a significant increase ($P < 0.05$) in RBCs, HB, PCV%, platelets and WBCs after induction of lactic acidosis. Biochemically, the induced lactic acidosis produced significant increase ($P < 0.05$) in ALT, AST, GGT, urea, creatinine with significant decrease ($P < 0.05$) in ALP, albumin, globulin, total protein, A/G ratio, Na, Cl, Ca, P and Mg. Examination of ruminal fluid showed a significant increase ($P < 0.05$) in SAT, MBRT, and a significant decrease ($P < 0.05$) in ruminal pH, protozoal count and activity. Ultrasonographically, there was significant increase ($P < 0.05$) in ruminal wall thickness, reticular wall thickness, and small intestine diameter. The content of abomasum and small intestine appeared more echoic. Treatment with Rumitone changed the clinical, hematological, and biochemical alterations toward the reference values. It was concluded that camels are prone to induction of lactic acidosis by sucrose that induced hematobiochemical changes and the Rumitone is a useful therapy in camels affected with acidosis.

Keywords | Camels, Haemato-biochemical, Lactic acidosis, Rumitone, Ultrasonography

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INTRODUCTION

Digestive system diseases are common cause of economic losses in camels due to decrease the feed intake, dehydration and weight loss (Radostits et al., 2007).

Diseases of the gastrointestinal tract of the camel are of great importance including impaction, bloat, ulceration

and swallowed foreign bodies, enteritis, constipation, abomasal and intestinal obstruction, peritonitis, as well as abdominal hemorrhage, ascites and neoplasia (Fowler and Bravo, 2010).

Acute ruminal acidosis is one of the most dramatic form of ruminal microbial fermentative disorders and in some cases is lethal in less than 24 hours (Radostits et al., 2007).

Lactic acid causes a chemical rumenitis and its absorption results in systemic lactic acidosis. The pathophysiologic consequences are hemoconcentration, cardiovascular collapse, renal failure, muscular weakness, shock and death in late stage if left without treatment. Animals that survive may develop mycotic rumenitis in several days, hepatic necrobacillosis several weeks or months later, or chronic laminitis, as well as evidence of ruminal scars at slaughter (Allen et al., 2005).

In llamas and alpacas, specific transabdominal ultrasonographic appearance of the gastrointestinal viscera has been described in order to help in the management of New World camelids' gastrointestinal disease (Cebra et al., 2002).

In cattle, abdominal ultrasonography is an interesting diagnostic tool that can also be used as a prognostic tool in some diseases since the extension and importance of the disease are better assessed. The procedure is an ideal diagnostic tool for the investigation of gastrointestinal disorders that can also be used directly on the farm. It helps in deciding whether the animal should undergo surgical interference (rumenotomy or laparotomy) or medical treatment or be (emergency) slaughtered (Braun, 2009).

In camels, ultrasonography has been used recently in internal medicine for scanning of the healthy organs as well as evaluation and determining the diagnosis and prognosis of diseased ones. by abdominal ultrasonography, the veterinarian can scan the rumen, reticulum, omasum, abomasum, and small and large intestines and peritoneum in camels. ultrasonography supplements the clinical and laboratory examinations by providing additional information on abdominal disorders for diagnosis antemortem (Tharwat et al., 2012).

Varied efficacies of conventional medicaments against GIT disease have been reported. However, concurrently, the pernicious effects of the overuse and misuse of these chemicals, the increased prevalence of resistance and high treatment cost necessitate the development of alternative therapies for the treatment and management of GIT diseases (Rahmann and Seip, 2007).

Concerning to ruminal acidosis, there are many alternative therapies as probiotics, medicinal herbs, anise oil, garlic oil, cinnamaldehyde, gentian, oregano, eugenol, and cloves (Zeineldin et al., 2018).

Probiotics are defined as viable microorganisms in sufficient numbers are capable of altering the micro flora of the digestive tract of the host (Rook and Brunet, 2005). Probiotics have influenced the rumen ecology and thereby nutrient utilization in ruminants. Improvement in colonization of cellulolytic bacteria results in improved digestion process, enhanced nutrient utilization and growth in the small ruminants (Soren et al., 2012). Probiotics such as Lactobacillus acidophilus, Lactobacillus planterum and Bifidobacterium bifidum has very useful effect in treatment of induced lactic acidosis (Elnady et al., 2019a).

There is an increasing trend towards the use of herbal medicine in Egypt that reflects an increasing confidence in such remedies. These methods have the advantage of utilizing locally available materials which have medicinal properties (Aboelsoud, 2010).

The herbal plants extract can be used for modification of ruminal fermentation, as feed additives for improvement of animal health status and performance of liver and kidney function and used as treatment for sheep suffering from indigestion and decrease in feed intake (Wafaa, 2017).

Herbal digestive tonics and appetizer are scientifically well proven to maintain a balance between beneficial bacteria and pathogens for intestinal and general health. They also facilitate optimal absorption and utilization of nutrients and thus improves feed conversion ratio, productivity and weight gain (Tiwari et al., 2014).

Therefore, the objectives of the study were to monitor clinical, haemato-biochemical, ultrasonographic and ruminal examinations for diagnosis of digestive system alterations in response to induction of lactic acidosis in camels. Further aim was to evaluate the Rumitone in treatment of acidotic camels.

MATERIALS AND METHODS

Experimental design

Three healthy she camel aged from 8-10 years old and weighting 300-350 kg were fed alfa alfa hay supplemented with concentrate, and given access to water *ad libitum*. The camels were dewormed with anthelmintic (Ivomec super ®, (Ivermectin + Clorsulon), Merial Co) at the dose of (0.2 mg/kg B.wt S/C). They were left for 2 weeks for acclimatization before the beginning of the experiment. During this period, they were subjected to a clinical investigation to be ensured healthy and free from any clinical abnormality. Blood and ruminal samples were

collected for analysis and ultrasonographic examinations was performed before induction of acidosis.

Induction of ruminal lactic acidosis

An average dose of 14 gm sucrose/ kg body weight was estimated to produce the classical clinical picture of the lactic acidosis (Jafari et al., 2011). The three camels received sucrose after being fasted for 12 hr. The sucrose was mixed with 2–3 liters warm tap water, to make a suitable suspension, and was given in the mouth in a single dose. The camels under experiment were monitored for clinical changes for up to the 24 hrs. post induction after which blood and ruminal samples were collected for analysis and ultrasonographic examination was performed on the acidotic camels.

Treatment protocols

Camels with induced lactic acidosis were treated with Rumitone powder at a dose 1.5 gm per 50 kg Bwt (Rumitone is herbs containing natural enzymes, lactobacillus Probiotics and digestive stimulants, manufactured by Indian Herbs Specialties Pvt. Ltd (Dara Shivpuri, nawads Road, Saharanpur, 247001 (U.P.), India.). Rumitone was given in the morning according method described by Soha (2017). The treatments commenced 24h after induction and continued for a week, then blood and ruminal samples collected for analysis and ultrasonographic examination was performed on the treated camels with Rumitone.

Ethical approval

The study was reviewed and approved by the local animal care and use committee at the faculty of veterinary medicine, Benha university under the number (BUFVTM 02-12-21).

Clinical examination of the animals

Body temperature (°C), respiratory rates, pulse rates, mucous membrane, and ruminal movement of the camels were examined and recorded following the procedures described by Radostits et al. (2007).

Haemato-biochemical examination

Two sets of blood samples were obtained from each camel. The first set of samples was collected with anticoagulant for determination of hematological parameters. Complete blood counts including total erythrocytic count, hemoglobin content (mg/dl), PCV%, total leucocytic count and differential leukocytic count (lymphocytes, monocytes, and granulocytes) were done by using Hematology Analyzer (XF9080) according to the method described by Jain (1990). The second set of blood samples was taken without anticoagulant for separation of serum for the biochemical determination. Total protein was determined by colorimetric method according to the method that described by Pagana and Pagana (2016). Albumin was determined according to the method that described by Fischbach and Dunning (2009). ALT, AST, ALP, GGT, urea, and creatinine were determined according method described by Young (1990). Calcium, phosphorus, magnesium, potassium, sodium and chloride were determined spectrophotometrically by colorimetric method according to Jansen and Helbing (1991).

Ruminal juice examination

The ruminal juice was collected from all camels by using a simple ordinary stomach tube connecting with a suction syringe 50 ml capacity. Each sample (50 ml) was taken in a clean dry and sterile flask. Color, odor, and consistency of ruminal juice were evaluated according to Chakrabarti (2018). Sedimentation activity test was determined according the method described by Radostits et al. (2007). Rumen pH, protozoal activity, motility and count were determined according to method described by Abd El-Raof et al. (2007).

Ultrasonographic examination

The ultrasonography of digestive system of camels was done using a Portable ultrasound machine (sonovet R3, made in Korea) 3.5 MHZ curved linear probe using standardized scanning process (Tharwat et al., 2012).

Statistical analysis

The data were statistically analyzed using repeated measures one way analysis of variance (ANOVA) with Dunnet's as a post-hoc test as previously described by Bailey (2008). We used SPSS version 16 software to conduct this analysis. Values were presented as means ± standard error (SE). All differences were considered significantly different when $P<0.05$.

RESULTS AND DISCUSSION

Clinical examination

The clinical signs of camels 24 hours after acidosis induction with sucrose showed anorexia, dullness, depression, semisolid feces with diarrhea in some cases, isolated away from the herd, and tend to sternal recumbency with their head lowered with slightly distended abdomen. There was significant increase ($p<0.05$) in, temperature, respiratory and pulse rates, while ruminal movements were significantly decreased and completely absent in some cases (Figures 1 and 2). Clinical symptoms improved after therapy with medicinal herbs (Rumitone). The clinical parameters were significantly changed after Rumitone therapy as demonstrated in Table 1.

Haematological examination

There was a significant increase ($P < 0.05$) in Hb content, PCV%, RBCs, WBCs, neutrophils, lymphocytes,

monocytes, eosinophils, and basophils 24 hours after acidosis induction. The hematological parameters were significantly changed after treatment with medicinal herbs (Rumitone) (Table 2).

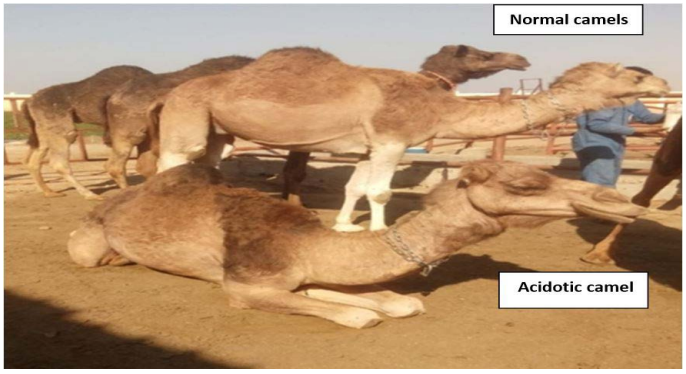

Figure 1: She-camel after induction of acidosis showing signs of dullness, depression and sternal recumbency compared to normal healthy standing she camels.

Biochemical analysis

There was a significant increase ($P < 0.05$) in ALT, AST, GGT, Urea, BUN, Creatinine, and Potassium on the other hand there was significant decrease ($P < 0.05$) in ALP, albumin, globulin, total protein, A/G ratio, Sodium, Chloride, Calcium, Phosphorus, and Magnesium after 24 hours of acidosis induction. The biochemical parameters were significantly changed after treatment with medicinal herbs (Rumitone) (Table 3).

Figure 2: She-camel after induction of lactic acidosis showing soiling of anal area, tail and hind quarters indicating diarrhea. Notice the sticky nature of fecal martials.

Table 1: Clinical parameters in camels before and after induction of acidosis and after treatment with Rumitone.

Parameter	Before induction of acidosis (n=3)	After induction of acidosis (n=3)	After treatment with Rumitone (n=3)	Reference range
Temperature	37.60±0.17 ^{b}	38.47± 0.12 ^{a}	37.57±0.16 ^{b}	34-40
Respiratory rate/ minute	12.00±0.58 ^{b}	17.33± 0.88 ^{a}	11.67±0.33 ^{b}	5-12
Pulse rate/ minute	35.67±1.2 ^{b}	49.67±0.88 ^{a}	34.33±0.88 ^{b}	24-48
Ruminal movement/3 minutes	2.67± 0.33 ^{a}	0.33± 0.33 ^{b}	2.00± 0.58 ^{a}	2-3

Values with different superscript letters within the same row differed significantly at $p<0.05$.

Table 2: Haematological examination in camels before and after induction of lactic acidosis and after treatment with Rumitone.

Parameter	Before induction of acidosis (n=3)	After induction of acidosis (n=3)	After treatment with rumitone (n=3)	Reference range
Hb (gm/dl)	12.78±0.38 ^{b}	15.12±0.82 ^{a}	13.22±0.45 ^{ab}	8-17
PCV%	38.07±1.32 ^{b}	45.33±2.32 ^{a}	39.93±1.32 ^{ab}	24.0 - 50
RBCs (106/ul)	5.17±0.15 ^{b}	6.03±0.13 ^{a}	5.20±0.17 ^{b}	4.25-12.9
MCV (fl)	73.67±4.4 ^{a}	75.67±5.2 ^{a}	77.00±5.3 ^{a}	26-103
MCH (pg)	24.67±1.2 ^{a}	25.00±1.73 ^{a}	25.67±1.76 ^{a}	7-35
MCHC%	33.67±0.33 ^{a}	33.33±0.33 ^{a}	33.00±0.00 ^{a}	27-42
WBCs (103/ul)	4.72±0.35 ^{b}	9.43±0.43 ^{a}	5.57±0.43 ^{b}	4.2 – 20.9
Neutrophils%	59.67±2.84 ^{a}	59.00±2.1 ^{a}	59.33±2.9 ^{a}	41-65
Lymphocytes%	33.67±2.33 ^{a}	34.00±1.76 ^{a}	33.67±2.6 ^{a}	43-63
Monocytes%	3.67±0.88 ^{a}	3.67±0.33 ^{a}	4.00±0.57 ^{a}	0 – 7
Eosinophils%	2.00±0.00 ^{a}	2.33±0.33 ^{a}	2.00±0.00 ^{a}	0 – 4
basophils%	1.00±0.00 ^{a}	1.00±0.33 ^{a}	1.00±0.00 ^{a}	0 – 3
Neutrophils(thousand/liter)	2.82±0.33b	5.56±0.49 ^{a}	3.30±0.71 ^{b}	
Lymphocytes(thousand/liter)	1.59±0.22 ^{b}	3.21±0.19 ^{a}	1.88±0.04 ^{b}	
Monocytes(thousand/liter)	0.17±0.47 ^{b}	0.35±0.66 ^{a}	0.22±0.53 ^{b}	
Eosinophils(thousand/liter)	0.09±0.094 ^{b}	0.22±0.236 ^{a}	0.11±0.33 ^{b}	
basophils(thousand/liter)	0.05±0.00 ^{b}	0.09±0.048 ^{a}	0.06±0.00 ^{b}	
platelets(103/ul)	149±29 ^{b}	239±35 ^{a}	160±24 ^{b}	230 – 360

Values with different superscript letters within the same row differed significantly at $p<0.05$.

Table 3: Biochemical analysis of serum in camels before, after induction of acidosis and after treatment with Rumitone.

Parameter	Before induction of acidosis (n=3)	After induction of acidosis (n=3)	After treatment with rumitone (n=3)	Reference range
ALT(U/L)	24.33±2.6 ^{b}	39.00±4.72 ^{a}	22.00±0.6 ^{b}	8.8-14.5
AST(U/L)	34.60±4.74 ^{ab}	53.4±12.19 ^{a}	24.8±9.99 ^{b}	24.1-35.1
ALP(U/L)	79.00±6.6 ^{a}	40.67±0.7 ^{b}	51.67±3.76 ^{b}	33-196
GGT(U/L)	11.67±0.33 ^{b}	18.00±0.57 ^{a}	12.00±0.57 ^{b}	13-20
Total protein(g/dl)	9.23±0.39 ^{a}	5.40±1.15 ^{b}	8.73±1.63 ^{a}	6.3-8.7
Albumin(g/dl)	3.33±0.33 ^{a}	1.80±0.00 ^{b}	3.00±0.57 ^{a}	3-4.4
Globulin(g/dl)	5.90±0.59 ^{a}	4.00±1.15 ^{b}	5.73±1.16 ^{a}	2.7-3.7
AG_Ratio	0.56±0.11 ^{a}	0.45±0.2 ^{b}	0.52±0.09 ^{a}	
Creatinine(mg/dl)	1.32±0.12 ^{b}	2.02±0.16 ^{a}	1.01±0.06 ^{b}	0.16 - 0.53
Urea(mg/dl)	50.00±8 ^{b}	81.77±32 ^{a}	38.90±6 ^{b}	17.6-44.9
BUN (mg/dl)	23.36±3.6 ^{b}	38.21±15 ^{a}	18.18±2.7 ^{b}	8.2-21
Sodium (mEq/l)	150.67±0.66 ^{a}	140.33±2.4 ^{b}	152.33±1.4 ^{a}	129-160.7
Potassium(mEq/l)	4.70±0.32 ^{b}	5.40±0.36 ^{a}	4.80±0.75 ^{b}	3.6-6.1
Chloride (mEq/l)	103.33±1.2 ^{a}	97.67±1.5 ^{b}	102.00±0.6 ^{a}	107-115
Calcium (mg/dl)	9.27±0.07 ^{a}	6.90±0.35 ^{b}	7.70±0.70 ^{ab}	1.58-2.75
Phosphorus(mg/dl)	7.03±0.35 ^{a}	4.87±0.03 ^{b}	7.23±0.37 ^{a}	1.26-2.19
Magnesium(mg/dl)	3.10±0.06 ^{a}	1.10±0.06 ^{c}	1.37±0.07 ^{b}	0.74-1.19

Values with different superscript letters within the same row differed significantly at $p<0.05$

Ruminal parameters

The physical properties of ruminal juice including color, odor and consistency of ruminal juice were changed 24 hours after acidosis induction in camels. Sedimentation activity time (SAT) in minutes showed a highly significant increase. Microscopical examination of ruminal juice revealed significant decreases in the activity and the count of protozoa (Figure 3). Biochemically, there was a highly significant decrease in ruminal pH and Methylene blue reduction test (MBRT) in camels after 24 hours of acidosis induction. All the ruminal parameters returned toward control value after treatment with medicinal herbs (Rumitone) (Table 4).

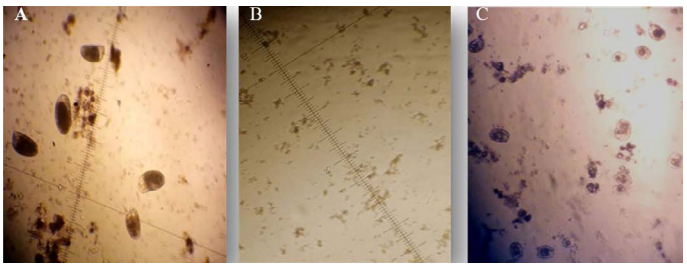

Figure 3: Protozoal changes of ruminal juice in camels. (A) Before induction of acidosis (normal protozoal count). (B) After induction of acidosis (decrease the number of protozoa). (C) After treatment with Rumitone (increase the protozoal count).

Ultrasonographic examination

The ultrasonographic measures of different parts gastrointestinal tract in camels (Table 5, Figures 4, 5 and 6) showed a significant increase in the dorsal ruminal sac wall, reticulum wall and small intestine diameter in camels 24 hours after acidosis induction. These measures were significantly reduced after treatment with Rumitone. On the other hand, there were no significant changes in abomasal wall, abomasal diameter, caudle glandular sac, cranial blind sac, cecal wall, cecal diameter, and colon wall before and after acidosis induction, and after treatment with Rumitone. Ultrasonographic examination showed increase in abomasal contents echogenicity, increased the contents echogenicity and diameter of small intestine 24 hours after acidosis induction. These changes returned toward pre-acidosis values after treatment with Rumitone. In view of the liver, there were no significant changes in portal vein, hepatic veins, and caudle vena cava before, after acidosis induction, and after treatment with Rumitone. Moreover, the spleen wall and size were not significantly changed before, after acidosis induction and after treatment with Rumitone.

Because camel diseases are very important nowadays due to their economic importance as being a useful addition to the food supply chain in terms of milk, meat and other products (Mochabo et al., 2006). Camel is an important domestic animal well adapted to extremely harsh environments of the desert (Faraz et al., 2021). Because of this importance, it was crucial to study diseases affecting the health problem of camels. Digestive troubles in camel are rarely investigated probably because of the unique structure of digestive organs (Radostits et al., 2007).

Table 4: Ruminal parameters in camels before, after induction of acidosis and after treatment with Rumitone.

Parameter	Before induction of acidosis (n=3)	After induction of acidosis (n=3)	After treatment with rumitone (n=3)
Color	-Olive green -Yellowish Brown	-yellowish - Milky grey	-Olive green -Yellowish Brown
Consistency	Slightly viscous	Watery	Slightly viscous
Odor	Aromatic	Soured	Aromatic
SAT (minutes)	6.67±0.33 ^{b}	38.33±0.58 ^{a}	7.23±0.12 ^{b}
Protozoal count (105/ml)	3.64±0.25 ^{b}	0.73±0.08 ^{c}	5.47±0.52 ^{a}
Ph	7.03±0.12 ^{a}	4.87±0.13 ^{b}	7.23±0.12 ^{a}
MBRT (minutes)	1.50±0.17 ^{b}	15.90±0.52 ^{a}	1.73±0.17 ^{b}

Values with different superscript letters within the same row differed significantly at p<0.05. +++ = highly motile and overcrowded. ++ =motile and crowded. + = sluggish motile and low number. 0 = no live protozoa.

Table 5: Changes in digestive system measures in control camels before, after induction of acidosis and after treatment with Rumitone.

Parameter	Before induction of acidosis (n=3)	After induction of acidosis (n=3)	After treatment with rumitone (n=3)
Dorsal ruminal sac wall(cm)	0.58±0.08 ^{b}	0.88±0.04 ^{a}	0.48±0.06 ^{b}
Reticular wall(cm)	1.40±0.035 ^{b}	1.93±0.065 ^{a}	1.31±0.067 ^{b}
Abomasal wall(cm)	0.64±0.104 ^{a}	0.59±0.042 ^{a}	0.55±0.099 ^{a}
Small intestine diameter(cm)	0.80±0.057 ^{b}	4.93±1.46 ^{a}	3.24±1.2 ^{ab}
Cecal wall(cm)	0.47±0.074 ^{a}	0.44±0.055 ^{a}	0.37±0.031 ^{a}
Cecal diameter(cm)	7.60±0.21 ^{a}	8.14±1.38 ^{a}	7.75±0.25 ^{a}
Colon wall(cm)	0.62±0.15 ^{a}	0.53±0.06 ^{a}	0.40±0.04 ^{a}
Caudle glandular sac wall(cm)	6.03±0.09 ^{a}	5.77±0.18 ^{a}	6.03±0.15 ^{a}
Portal vein(cm)	1.91±0.21 ^{a}	1.84±0.04 ^{a}	1.82±0.25 ^{a}
Caudle vena cava(cm)	2.60±0.38 ^{a}	2.91±0.42 ^{a}	2.14±0.14 ^{a}
Spleen wall(cm)	0.50±0.05 ^{a}	0.53±0.04 ^{a}	0.49±0.06 ^{a}
Spleen diameter(cm)	5.59±0.25 ^{a}	6.10±0.28 ^{a}	5.55±0.32 ^{a}

Values with different superscript letters within the same row differed significantly at p<0.05.

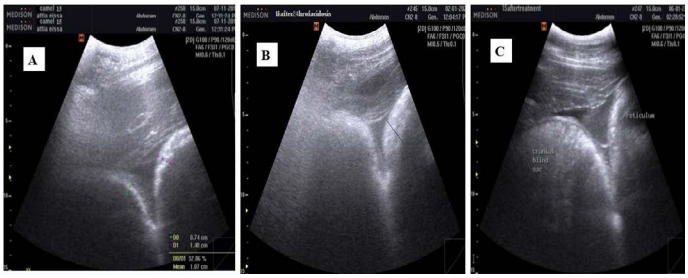

Figure 4: Ultrasonographic images of the camel reticulum visualized from the right paramedian region just behind the sternal pad using 3.5 MHz convex probe (transverse). (A) Before induction of acidosis: The wall of the dorsal ruminal sac wall appeared echogenic line and the reticulum appeared as a half-moon-shaped echogenic structure with an even contour and the contents of dorsal ruminal sac and reticulum appeared hypoechoic and homogenous. (B) After induction of acidosis: The reticulum wall thickness increased. (C) After treatment with Rumitone: The reticular wall thickness decreased compared to pre-acidosis.

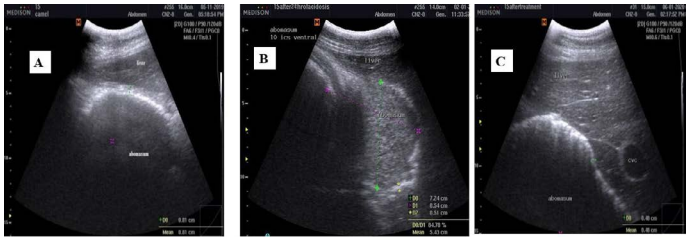

Figure 5: Ultrasonographic images of camel abomasum visualized from the right side from 8th-9th intercostal space using 3.5 MHz convex probe (longitudinal). (A) Before induction of acidosis, the abomasal wall appeared as distinct echogenic white line and the abomasal contents appeared hypoechoic and homogeneous. (B) After induction of acidosis, the wall appeared thicker than before induction of acidosis and the content appeared heterogenous in echogenicity and more echoic than before induction. (C) After treatment with Rumitone, the abomasal wall returned to distinct echogenic line and the content appeared hypoechoic and homogeneous.

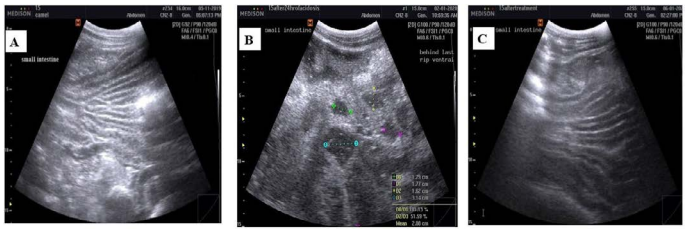

Figure 6: Ultrasonographic images of camel small intestine visualized low in the right paralumbar fossa using 3.5 MHz convex probe (longitudinal). (A) Before induction of acidosis: The intestinal contents were almost very hypoechoic and homogenous. (B) After induction of acidosis: Small intestine diameter is increased, the contents appeared heterogenous and more echoic compared to pre-acidosis induction. (C) After treatment with Rumitone: the intestinal contents returned to hypoechoic and homogenous.

In the present study the camels after induction of acidosis with sucrose showed anorexia, dullness, depression, semisolid feces with diarrhea in some cases, isolation from the herd, and tendency for sternal recumbency with the head lowered with slightly distended abdomen. There was significant increase in temperature, respiratory and pulse rates, while ruminal movement were significantly decreased and completely absent in some cases. this result was nearly similar to that obtained result by Elbehiry (2005), Owing to the negative relationship between ruminal pH and temperature, the elevated body temperature was attributed to a rise in ruminal temperature caused by the high pH of ruminal juice (Alzahal et al., 2008) and (Antanaitis et al., 2016). there was significant increase in pulse and respiratory rate, this result agreed to result obtained by Baraka et al. (2000). The increase in pulse and respiratory rate were attributed to the decrease of ruminal pH and excessive production of lactic acid, histamine and methanol which affects on vital organs and nerve centers (Radostits et al., 2007). On the other hand, there was a significant decrease in ruminal motility, this result was similar to result obtained by Baraka et al. (2000) and (Elbehiry, 2005). Ruminal motility can be diminished as a result of rumen atony caused by low pH (Elbehiry, 2005). After one week of Rumitone therapy, all clinical parameters returned to normal, confirming the findings of Soha (2017). This can be attributed to Rumitone's stomachic properties, which inhibit gastric juice secretion and facilitate viscous liquid secretion while increasing ruminal motility (Kohlein, 1990).

In terms of blood indices, there was a significant increase in RBCs, PCV% and Hb concentration. This could be explained on the basis that lactic acidosis produced dehydration and hemoconcentration (Radostits et al., 2007). All blood parameters returned to reference value after treatment with Rumitone, a close result to that obtained by Asopa et al. (2021).

In view of biochemical parameters there were significant increase in ALT, AST, GGT these results are in accordance to result obtained by Asopa et al. (2021), The increased activity of ALT reflects the hepato cellular damage which may be sub lethal degeneration or necrosis and the increased activity of AST may be due to hepato cellular damage or degenerated skeletal muscles. On the other hand, there was a significant decrease in ALP, this result was similar to result obtained by Minuti et al. (2014), the decrease in ALP can be attributed to the excretion of ALP in feces that was 50-fold in acidotic sheep than control sheep (Minuti et al., 2014). The significant decrease in total proteins, albumin, globulin and A/G ratio, is comparable to the findings of (Asopa et al., 2021)and could be attributed to the excretion of these parameters in the intestinal lumen with diarrhea (Cao et al., 1987) or damage of the hepatic cells responsible for synthesis of these proteins (Schreiber, 1988). There was a highly significant rise in urea, BUN, and creatinine levels, which corresponded to the results obtained by Elnady et al. (2019). The increased kidney function parameters could be attributed to could be attributed to decreased glomerular filtration rate, renal damage or reduction in effective renal flow and drop in the arterial blood pressure in camels after induction of acidosis which results in subnormal function as stated by Xu and Ding (2011). Others reported that elevated serum urea and creatinine levels were caused by dehydration and oliguria, which occurs to compensate for the body's fluid losses (Owens et al., 1998).

Regarding serum minerals and electrolytes, there was a highly significant decrease in serum levels of calcium, phosphorus, magnesium, sodium and chloride while potassium level was significantly increased. These results agreed with that obtained by Kamr et al. (2017). The decrease in serum sodium and chloride may be attributed to the shift of these electrolytes by osmolarity from the blood to hyper tonic rumen (due to high lactic acid increase hypertonicity in rumen) or due to their losses (Cl and Na) in lactic acidosis associated with diarrhea (Enemark, 2008). The hyperkalemia observed in acidotic camels could be attributed to haemoconcentration and the metabolic acidosis where the K is reabsorbed from kidneys and H ions are excreted to maintain the pH as a compensatory mechanism (Sabes et al., 2017). The drop in calcium levels could be attributed to a temporary malabsorption triggered by weakened intestinal mucosa (Radostits et al., 2007) and the decrease in phosphorus could be caused by recycling large amounts of phosphorus by saliva and the rumen, resulting in variations in its level. Phosphorus presence in the rumen is necessary to maintain the activity of ruminal flora and consequently a proper digestion of food (Schwegler et al., 2014). After treatment with Rumitone

all biochemical parameters returned to the normal, this result was similar to result obtained by Soha (2017).

Regarding to ruminal juice examination of camels after induction of acidosis revealed variation in color from yellowish to milky grey, soured odor, watery consistency and SAT showed a highly significant increase. These results agreed with Baraka et al. (2000). these changes caused by excessive production of lactic acid (Radostits et al., 2000). Since SAT is used to determine microflora activity, the increased SAT time was attributed to decreased ruminal microflora activity (Kimberling, 1988). The microscopical examination of ruminal juice of camels after induction of lactic acidosis showed marked reduction in the activity and count of ruminal protozoa. These results agreed with Elnady et al. (2019). Death of microflora may be due to decrease of ruminal pH and increase level of lactic acid as the microflora accustoms the life in neutral media 6.2-7.2 (Steen, 2001). The Biochemical analysis of ruminal juice showed significant decrease in ruminal pH and significant increase in time of MBRT, The decreased rumen pH was due to increase production of lactic acid, Methylene blue reduction test used as guide to evaluate the activity of microflora (Elnady et al., 2019b). These results agreed with Baraka et al. (2000) and (Azza, 2008). All ruminal juice parameters returned to the normal after treatment with Rumitone, this result was agreed with result obtained by Soha (2017).

The ultrasonographic examination of camels have been used to evaluate changes in the GIT of camel as being one of the non-invasive diagnostic techniques. After induction of acidosis, the sickness of rumen and reticulum wall suggesting an inflammatory process. The increased in sickness could be attributed to chemical rumenitis caused by increase of lactic acid and its absorption that results in lactic acidosis (Allen et al., 2005). Additional ultrasonographic findings included an increase in small intestine diameter which may be attributed to change of consistency of ruminal fluid to permit passing of undigested food to the small intestine (Pagana et al., 2017). In addition, there was increase in abomasal contents echogenicity, that become more heterogenic. These changes could be attributed to change of consistency of ruminal and reticular fluid due to increase the amount of fluids withdrawn from the extracellular fluid space into the rumen and consequently permit passing of ruminal liquor to abomasum and the small intestine (Radostits et al., 2007). this Ultrasonogram returned toward the normal after treatment with Rumitone.

There is an increasing trend towards the use of herbal medicine in Egypt that reflects an increasing confidence in such remedies (Aboelsoud, 2010). Rumitone containing natural enzymes, lactobacillus probiotics and digestive stimulants help maintain proper secretion of saliva and gastric juices and optimum rumeno-reticular and intestinal movements optimizes the population and activity of ruminal and intestinal microflora as well as enzymic activity for efficient cellulose break-down and optimum digestion, absorption and utilization of carbohydrates, proteins and lipids leading to improved feed conversion and farm productivity. Rumitone also helps maintain right balance between beneficial bacteria and pathogens in the intestines for better gut health. This explain the changes that happened after treatment, there was improvement in feed intake, as the animal began to eat 24 hour after treatment, also there was increase in ruminal movement, as the pH returned back to the control level, there was increase in the protozoal count and the microscopic field was crowded with motile protozoa (Soha, 2017).

CONCLUSIONS AND RECOMMENDATIONS

It is concluded that induced lactic acidosis can produce haematobiochemical, ruminal and ultrasonographical changes in camels and these changes returned to normal after treatment with Rumitone. Therefore, Rumitone should be included in the prescription of therapy for rumen acidosis in camels.

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NOVELTY STATEMENT

Induction of ruminal acidosis with sucrose in group of camels and Using of ultrasonographic examination in diagnosis of ruminal acidosis in camels.

AUTHOR'S CONTRIBUTION

All authors designed the experiment; GMM, EAAE and EAA conducted the research; AYM, AHA, AAR and EAA analyzed the data; GMM, EAAE, AAR and EAA wrote the manuscript; all authors reviewed the manuscript and approved the final version.

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Conflict of interest

The authors have declared no conflict of interest.

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