

Research Article

Cassia fistula as a curative strategy for lactic acidosis in goats

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Abstract

Ruminal acidosis is a metabolic disorder occurs in ruminants due to feeding errors. It represents a significant economic loss due to direct as well as indirect effects on the affected animals. In present study a total of twenty four goats were focused to observe the efficacy of *Cassia fistula* against induced lactic acidosis. Goats were divided into two groups viz A and B. Group A were induced lactic acidosis by offering the ingested crushed wheat grains, while group B was kept as control and provided normal diet. Following clinical signs goats were treated with the *Cassia fistula* and examined for the changes in physiological parameters like body temperature, respiration rate, heart rate, rumen motility, rumen pH, blood pH, and liver function test at the interval of 24, 48 and 72 hours after the treatment. Body temperature, ruminal and intestinal movement, ruminal pH, blood pH, respiration rate and heart rate in goats affected with lactic acidosis were found $98.1 \pm 0.89^{\circ}\text{F}$, $0.23 \pm 0.48/\text{m}$, 4.8 ± 0.07 , 7.1 ± 0.08 , $56.14 \pm 7.15/\text{m}$ $136.28 \pm 4.71/\text{m}$ respectively, however they became normal after treatment with *Cassia fistula*. Further, glucose level (190.14 ± 36.49 mg/dl), total bilirubin (0.75 ± 0.04 mg/dl), direct bilirubin (0.27 ± 0.03 mg/dl), indirect bilirubin (0.40 ± 0.03 mg/dl), alanine aminotransferase ALT or serum glutamic-pyruvic transaminase (SGPT) (36.42 ± 3.04 U/L) and alkaline phosphatase (420 ± 3.65 U/l) were significantly ($P < 0.05$) increased, goats showed increased rumen and intestinal motility, hemo-concentration and increased Hb% (15.02 ± 1.30), however after treatment with *Cassia fistula* all serum biochemical changes were significantly ($P < 0.05$) returned to the normal. Study concluded that the *Cassia fistula* is highly effective against lactic acidosis. It supports the ruminal and intestinal motility and rapidly restore all physiological changes.

Keywords: *Cassia fistula*; Clinical examination; Lactic acidosis; Sign

Introduction

Goat farming is a valuable assets for the poor man and villagers who depend on a single goat to large scale goat farming for their source of income. It is also called as the cow of poor peoples. About 90% world's goat population is found in the under developing countries such as Africa,

Nigeria, India, Bangladesh, Pakistan and Sudan [1]. The total goat population in Pakistan is estimated as 63.3 billion heads which makes it a third largest goat rearing country in the world after India and China [2]. Goats are raised mainly for the meat and milk purpose [3].

The growing concern in animal welfare has ignited intensive attention about the living situations of production animals. Production diseases appear due to over production or mismanagement of the feed intake and relatively primary or secondary disturbances in metabolism [4]. Among all nutritional disorders particular interest is being levied on lactic acidosis or ruminal acidosis nowadays. Ruminal acidosis is a metabolic disorder caused by feeding errors in ruminants that may be manifested in acute or sub-acute form. It represents a significant economic problem due to direct effects caused by alterations in the ruminal metabolism that could lead to death and indirect effects which could lead to rumenitis, liver abscesses and laminitis [5, 6]. To promote the efficient growth or to achieve fast weight gain in goat, the wheat grain or its byproducts are used in pure or mixed in feed, they are highly fermentable in the ruminant's compound stomach [7]. Fermentable grains over feed lead to the development of metabolic disorder, particularly lactic acidosis. Lactic acidosis develops with excessive intake of highly fermentable diet [8]. Many ruminal bacteria, particularly *Lactobacillus* and *Streptococcus bovis* (acid resistant bacteria) cause rapid fermentation of carbohydrates and changes the ruminal function through proliferation and an increased lactate and volatile fatty acids production which cause the fall in ruminal pH less than to (< 5.00) [9, 10]. Clinical signs observed in goat lactic acidosis are increased in respiration, heart rate and decrease in body temperature, rumen motility and intestinal motility, characterized by sudden increase in respiratory rate, heart rate, decrease body temperature, distension of abdomen, pain, anorexia, constipation or pastry diarrhea, depression, weakness, dehydration and death if not treated [11]. Lactic acidosis causes the changes in hematological parameters like increased hemoglobin percentage, increase erythrocytes count, leukocytes and packed cell values due to dehydration [12]. Lactic acidosis causes

systemic changes in normal biochemical levels such as hypocalcaemia, increase aspartate aminotransferase (AST), acute hyperglycemia, decreased total protein, hypernatremia, hyperkalemia, alanine aminotransferase (ALT) activity, increase urea nitrogen, creatinine level and blood lactic acid [13].

Treatment of lactic acidosis is difficult and recovery depends on the severity of the condition [14]. Clinical acidosis recovery chances depend on the neutralization of the acids, reducing the acid absorption from intestine, increasing motility of the rumen. *Cassia fistula* is native to Pakistan but it is found in the all tropical countries of Southeast Asia. It's all parts are used in traditional medicine [15]. *Cassia fistula* has been traditionally used to reduce the swelling of throat, fever, cold, reduces acidity and work as gentle laxative. It also used as antibacterial, anti-oxidant and anti-viral [16, 17]. *Cassia fistula* contains a large numbers of chemical compounds like, rhein I, emodin II, kaem ferol III, Tannin, anthraquinone derivatives, Proanthocynadins, steroids, phlobaphenes, volatile oil, gum (Glactomannans), waxes, and the alkaloid chaksine. The fruit pulp contains the anthraquinone and a glycoside fistuline which has a significant purgative action. It is also used in human practice to relieve the constipation [18]. We hypothesize that the *Cassia fistula* being a medicinal plant could also possess curative activity against the lactic acidosis in goats. Thus current study was planned in order to determine the effectiveness of this medical plant against the lactic acidosis in goats.

Materials and methods

Location of study and experimental design

Current research project was conducted at the livestock experimental station, Sindh Agriculture University, Tandojam. For confirmative diagnosis some part of study was conducted at the department Veterinary Medicine, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam. Trial was conducted

on total of twenty four (n=24) goats of same age. Goats were clinically examined, selected and distributed into two groups viz A and B. Goats in group A were induced lactic acidosis by over feeding of grains, while group B was kept as control and normal diet was provided to the goat.

Experimental procedures

Experimental animals were kept in clean disinfected pens and fed on green fodder up to Ten days to acclimatization to green fodder. Goats were dewormed with albendazole 10% and vaccinated against enterotoxaemia. Animals were divided into two groups like A and B. Goats in group A were fasted for 12 hours and then wheat grains at the dose rate of 50g/kg body weight were provided to develop the lactic acidosis. However, group B was kept as control and normal diet was provided to the goats. After induction of lactic acidosis, goats were treated with oral administration of *Cassia fistula*. *Cassia fistula* (powdered form) was mixed with 500ml water and given to the animals at the dose rate of 30g/Kg body weight at the interval of 24, 48 and 72 hours. All goats were regularly observed for the clinical manifestations like body temperature, heart rate, respiration rate, appetite, regurgitations, behavior, urination, feces, gait, rumen motility, rumen pH, rumen ingesta color and odor and consistency, before and after induction of lactic acidosis. Moreover, blood samples were collected from goats of group A and B by puncturing the jugular vein with the help of 5cc disposable syringe. Blood was transferred into anticoagulant containing (EDTA) screw capped test tubes. Samples were analyzed for blood glucose level, blood and ruminal fluid pH level, hemoglobin (Hb%) and liver function test (LFT). Blood glucose level was analyzed by digital blood glucometer monitoring system (Accusign, Germany), pH level was determined by digital pH meter (RoHS, China), hemoglobin (Hb%) was measured by Sahli method using haemometer (Marienfeld laboratory glassware Germany). Further, for liver function test the blood

serum samples were analyzed at Latif diagnostic and research laboratory, Tandojam. Blood sampling was performed at the interval of 12hrs, 48hrs and 72hrs post-treatment. In addition to that ruminal juices were collected using sterile plastic stomach tube in order to observe ruminal pH. Stomach tube was connected plastic syringe (50cc) fluid was sucked. All rumen fluid material was passed through the sieve of sterile gauze and examined for rumen pH by electronic pH meter.

Statistical analysis

The data were collected and statistically analyzed by two-way analysis of variance (ANOVA) in the statistical software SPSS (Version 22.0; 2013. IBM, USA). Values (means \pm SD) were considered significantly different at ($P \leq 0.05$).

Results

The study was carried out on 24 goats in order to determine the efficacy of *Cassia fistula* against the lactic acidosis. All affected goats of group A were examined physically as well as clinically before and after the induction of lactic acidosis and findings are presented in the (Table 1). Goats affected with lactic acidosis possessed distended rumen, fluctuating with doughy consistency. Goats were anorexic, dull, depressed, lethargic and standing with their head down. The rectal temperature was subnormal, whereas heart rate and respiration rate were increased. The hematological examination of goats after induction of lactic acidosis revealed changes within few hours after administration of wheat grains. Liver enzymes, blood glucose level and blood Hb% were increased while blood pH and ruminal pH level were decreased. Urine and feces were not passing as shown in Table 1. Comparatively goat in group B possessed no clinical manifestation of lactic acidosis. All physiological parameters were found normal (Table 1).

***Cassia fistula* and clinical signs of lactic acidosis**

Goats affected with lactic acidosis were treated with *Cassia fistula*. *Cassia fistula* was mixed in the 500ml water and given to

the goats at the dose rate of 30g/ Kg body weight. In addition to that supportive treatment was applied like Dextrose 5% 500ml I/V, B complex 5cc I/V, Avil and Dexamethasone. Clinical examination revealed significant improvement in the goats treated with *Cassia fistula*. Clinical signs were improved suddenly and after the 2-3 hours the diarrhea was started and signs were returned to the normal, such as rectal temperature (98.3 ± 0.57) (101.36 ± 0.72) and (103.1 ± 0.28), heart rate (139.12 ± 4.96) (100.62 ± 6.32) and (82.12 ± 6.22), respiration rate (57.87 ± 7.95) (41.75 ± 3.95) and (23.75 ± 3.01) and rumen motility (1.87 ± 0.58) (2.06 ± 0.41) and (3.15 ± 0.51) at the interval of 24, 48 and 72hrs, respectively. Two way ANOVA showed significant difference among the means of different time periods in treated group A ($P<0.05$) compared to B (Table 2).

Blood analysis

Blood is the main component which is considerably affected by the lactic acidosis. Blood samples of all goats were examined for pH, Hb% and blood glucose level. Goats treated with *Cassia fistula* showed significant increase in the blood pH from 7.02 ± 0.11 to 7.35 ± 0.08 level within 72hrs, while Hb% which was prominently increased (14.37 ± 0.93 g/dl) returned to normal level (10.2 ± 0.8 g/dl) within 72hrs of the treatment. Two way ANOVA data analysis showed significant difference ($P<0.05$) among the means of 24, 48 and 72hrs intervals at as shown in (Table 3).

Liver function test and glucose level

The serum profile of goats treated with *Cassia fistula* was analyzed and results are presented in the (Table 4). Liver enzyme analysis showed prominent increase in total bilirubin, indirect bilirubin, direct bilirubin, ALT (SGPT) and alkaline phosphatase level. While total bilirubin (0.79 ± 0.03 mg/dL) and alkaline phosphatase that was highly increased (438.87 ± 14.74 U/L) at 24hrs, returned to normal level within 72hrs following the *Cassia fistula* treatment. Two way ANOVA analysis of data revealed significant difference

($P<0.05$) among the means of 24hrs, 48hrs and 72hrs (Table 4).

Ruminal juice

The ruminal juice examination of goats treated with *Cassia fistula* showed considerable change in the color, odor, and consistency from yellowish, soured and watery, respectively. The pH level which was subnormal (5.02 ± 0.07) became normal (6.63 ± 0.15) within 72hrs following the treatment with *Cassia fistula*. Statistical analysis showed significant difference ($P<0.05$) among the means of 24hrs and 72hrs (Table 5).

Discussion

In the present study, goats affected with lactic acidosis were focused and *Cassia fistula* was assessed as a curative therapy. All the goats studied in the current study showed similar clinical signs of lactic acidosis as reported by [19]. Further, the decrease in body temperature, ruminal motility, pH and increase in heart rate, respiration rate and Hb% were observed which are in accordance with [20]. It has also been reported that the lactic acidosis leads to dehydration, ruminal motility, increase in ruminal pH and blood pH [12]. However, these findings also possessed strong connection with the results of current study. The decrease in blood pH of lactic acidotic goats was also seen in close agreement with [21]. In the present study anorexia, apathy, teeth grinding, ruminal stasis and increased respiration rate were the predominant signs of lactic acidosis, which are supported by findings of [22].

Moreover, goats showed significant decrease in blood circulating volume, hemoconcentration and severe dehydration and these results are in agreements to the earlier reports of [23]. All goats after the ingestion of grain showed anorexia, dehydration, increase in ruminal fluid and decreased ruminal pH, these physiological changes lead to decrease in gram negative bacteria and increase in gram positive bacteria in the rumen resulting decrease in appetite, further these changes favor the lactobacilli to utilize more carbohydrates

and to produce excessive amount of lactic acids and its isomers with lactate salt. These all caused increase in osmotic pressure significantly which result the movement of excessive quantities of fluid in to the rumen and dehydration, these results are in close agreement with previously reports [11]. Treatment of Lactic acidosis is always focused on the correction of ruminal and systemic acidosis and to inhibit the further production of lactic acid [24], however in the present investigation the clinical symptoms were returned to the normal using *Cassia fistula* as treatment strategy. All goats after the treatment with *Cassia fistula* passed the feces within 3hrs, and started feeding within 12hrs of treatment, pH increased sharply. Goats with lactic acidosis containing ruminal fluid with watery consistency and souring odor, these findings

were found to be in close connection with [25]. Further, the blood glucose level was found increased after the ingestion of grains this indicated that the grain feed was converted into highly fermentable action of the rumen microbial flora, these results are similar to [26].

Liver function test indicated increased level of total bilirubin, direct bilirubin, indirect bilirubin, ALT (SGPT) and alkaline phosphatase in all goats affected with lactic acidosis, these reported findings are in strong relation with [11]. Valmik [27] reported that the clinical signs disappeared after treatment in all acidotic goats as relevant treatment was advocated by many researchers [8, 28, 29], similarly when *Cassia fistula* was applied on goats affected with lactic acidosis, clinical signs disappeared significantly.

Table 1. Clinical and biochemical examination of experimental goats

Parameters	Group A (goats affected with lactic acidosis)	Group B (Normal goats)
Body temperature	98.1±0.89 ⁰ F	103°F
Heart rate/min	136.28±4.71/m	80/m
Respiration rate/min	56.14±7.15/m	20/m
Ruminal motility/min	0.23±0.48/m	3/m
Rumen pH	4.8±0.07	6.6±1.07
Rumen ingesta color	Yellowish	Olive green
Rumen ingesta odor	Soured	Aromatic
Rumen ingesta consistency	Watery	Viscous
Appetite	Anorexic	Normal
Regurgitation	Absent	Normal
Behavior	Dull	Normal
Urination	Absent	Normal
Feces	Absent	Normal
Gait	Staggering	Normal
Blood pH	7.1±0.08	7.4±0.08
Hb%	15.02±1.30	11.02±1.30
Glucose (mg/dL)	190.14±36.49	70.14±5.89
Total bilirubin (mg/dL)	0.75±0.04	0.55±0.02
Direct bilirubin (mg/dL)	0.27±0.03	0.19±0.03
Indirect bilirubin (mg/dL)	0.40±0.03	0.35±0.03
ALT (SGPT) (U/L)	36.42±3.04	27.42±2.58
Alkaline phosphatase (U/L)	420±3.65	300±7.21

Table 2. Mean values of the clinical signs in goats treated with *Cassia fistula*

Variables	<i>Cassia fistula</i>		
	24h** Mean \pm SD	48h** Mean \pm SD	72h** Mean \pm SD
Rectal Temperature / min	98.35 \pm 0.57 ^c	101.36 \pm 0.72 ^b	103.1 \pm 0.28 ^a
Heart rate/min	139.12 \pm 4.96 ^a	100.62 \pm 6.32 ^b	82.12 \pm 6.22 ^c
Respiration rate/min	57.87 \pm 7.95 ^a	41.75 \pm 3.95 ^b	23.75 \pm 3.01 ^c
Rumen motility/min	1.87 \pm 0.58 ^c	2.06 \pm 0.41 ^b	3.15 \pm 0.51 ^a

Superscripts ^{a-c} show significant difference

Table 3. Blood pH and hemoglobin percentage (Hb) of goats treated by *Cassia fistula*

Variables	<i>Cassia fistula</i>		
	24h** Mean \pm SD	48h** Mean \pm SD	72h** Mean \pm SD
Blood pH	7.02 \pm 0.11 ^c	7.15 \pm 0.08 ^b	7.35 \pm 0.08 ^a
Blood Hb% (g/dl)	14.37 \pm 0.93 ^a	12.91 \pm 0.92 ^b	10.2 \pm 0.8 ^c

Superscripts ^{a-c} indicate significant difference

Table 4. Blood glucose and liver function test in goats treated with *Cassia fistula*

Variables	<i>Cassia fistula</i>		
	24h** Mean \pm SD	48h** Mean \pm SD	72h** Mean \pm SD
Glucose (mg/dl)	132.87 \pm 37.91 ^a	99.87 \pm 11.63 ^b	81 \pm 5.60 ^{bc}
Total Bilirubin (mg/dl)	0.79 \pm 0.03 ^a	0.72 \pm 0.03 ^b	0.60 \pm 0.04 ^c
Direct Bilirubin (mg/dl)	0.29 \pm 0.03 ^a	0.27 \pm 0.02 ^a	0.20 \pm 0.02 ^b
Indirect Bilirubin (mg/dl)	0.45 \pm 0.03 ^a	0.41 \pm 0.02 ^b	0.39 \pm 0.02 ^b
ALT (SGPT) (U/L)	38.5 \pm 2.56 ^a	35.25 \pm 3.28 ^b	30.62 \pm 1.92 ^c
Alkaline Phosphatase (U/l)	438.87 \pm 14.74 ^a	411.25 \pm 12.90 ^b	326 \pm 17.82 ^c

Superscripts ^{a-c} shows significant difference

Table 5. Ruminal juice analysis of goats treated with *Cassia fistula*

Variables	<i>Cassia fistula</i>		
	24h** Mean \pm SD	48h** Mean \pm SD	72h** Mean \pm SD
Color	Yellowish	Yellow green	Olive green
Odor	Soured	Mild Soured	Aromatic
Consistency	Watery	Mild watery	Viscous
Ruminal juice pH	5.02 \pm 0.07 ^c	5.48 \pm 0.33 ^b	6.63 \pm 0.15 ^a

Superscripts ^{a-c} shows indicate significant difference

Conclusion

Present study concludes that the *Cassia fistula* administration in induced lactic acidosis remained highly effective. It increases the ruminal and intestinal motility and rapidly restore all physiological parameters to their normal range. It was further identified that the *Cassia fistula* is very effective laxative to expel the ruminal ingesta containing grains and supports in protecting the liver.

Authors' contributions

Conceived and designed the experiments: MQ Koonthar, RA Leghari & AA Khaskheli, Performed the experiments: MQ Koonthar, Analyzed the data: MI Memon, Contributed reagents/ materials/ analysis tools: M Malhi, Wrote the paper: AA Khaskheli.

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