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Therapeutic Evaluation of Florets of *Musa acuminate* in the Management of Rumen Lactacidosis in Goats

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ABSTRACT

Background: The present study was conducted to evaluate the efficacy of *Musa acuminate* flower floret (MAFF) extract/chopped in goats with moderate rumen lactacidosis.

Methods: Goats affected with moderate rumen lactacidosis (MRLA) were divided into three groups. TC (Control): Eight goats with moderate rumen lactacidosis were administered with magnesium oxide (@ 1g/kg PO) through stomach tube, T1: Twenty four goats with MRLA were administered with aqueous extract of MAFF (either @ 1 ml/kg, 2 ml/kg or 4 ml/kg - PO) and T2: Twenty four goats with MRLA were administered with chopped MAFF (either @1 g/kg, 2 g/kg or 4 g/kg - PO) continuously for 5 days. Proximate, mineral and phytochemical compositions of MAFF were assessed by using standard protocol. Rumen fluid examination, consisting of pH, total protozoal count and bacterial count was assessed in addition to haematology and serum biochemical examination before and after administration of MAFF.

Result: Goats with MRLA treated using chopped MAFF orally @ 4 gm/kg body weight or crude extract of the MAFF orally @ 2 ml/kg, 4 ml/kg body weight continuously for 5 days had restoration of ($P<0.05$) packed cell volume, increase in haemoglobin level, total protozoal count, gram negative bacterial count and rumen fluid pH and in serum PCO_2 level ($P<0.05$) to the levels comparable to healthy animals.

Key words: Goats, Moderate rumen lactacidosis, *Musa acuminate* flower floret.

INTRODUCTION

Goat rearing forms the backbone of the marginal farmers in India. Rumen lactacidosis or carbohydrate engorgement is one among the major problems faced by goat farmers; it causes variety of seriousness from mild changes in rumen microflora to death (Kumar *et al.,* 2007). *Musa spp* is one of the well known plants of the musaceae family that have been used in traditional medicine to alleviate various diseases and health problems (Mahmood *et al.,* 2011). Magnesium hydroxide (MgoH) (Smith and Correa, 2004) had been used as a rumen buffering agent to prevent acidosis. The interest of using available local plant sources to manipulate rumen ecology has been the main concern due to absence of chemical residue following supplements and easy availability for use by the farmers. Hence, the present study was carried out to assess the efficacy of MAFF as potential rumen buffer in the management of rumen lactacidosis in goats.

MATERIALS AND METHODS

Experimental design

The study was conducted in the Department of Veterinary Clinical Medicine, Veterinary College and Research Institute, Namakkal during the period from August 2019 to July 2020. Control group consisted of 16 goats that were divided into two sub groups and administered with MAFF @ 4 ml/kg (Control A) or MAFF chopped @ 4 gm/kg (Control B) PO for 5 days. Clinical trial group consisted of goats affected with moderate rumen lactacidosis divided into three groups *viz*, TC, T1 and T2 were administered with magnesium oxide, *Musa acuminate* floret in various proportions (Table 1). Clinical, haematobiochemical and rumen fluid examination were carried out before and after the trial.

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Preparation of extracts and chopped flower

Banana (*Musa acuminate*) flower extract was prepared by grinding freshly collected *Musa acuminate* floret (stigma, style and perianth). Chopped flower was prepared by cutting the floret into 1.5 inch pieces.

Sampling procedure and chemical analysis

Proximate composition (moisture, crude protein, crude fiber, ether extract, gross energy) for *Musa acuminate* flower floret was assessed as per AOAC, 2019. Mineral (calcium, phosphorus, magnesium, manganese, salt (AOAC, 2019), iron (Katyal and Sharma, 1980), copper (Cheng and Bray,

1953), potassium and sodium (Piper, 1966) and phytochemical parameters of MAFF were assessed (Harborne, 1998).

Collection of rumen fluid

Thirty ml of rumen fluid was collected by inserting the stomach tube through mouth with the aid of mouth gag. Physical characters like odour, colour, consistency, pH, protozoal count, bacterial count were assessed as per Constable *et al.* (2011).

Collection of blood

Venous blood sample was collected into EDTA and clot activator vials (3 ml) by jugular puncture. Haematological parameters (haemoglobin, packed cell volume, red blood cell were evaluated as per the standard procedures given by Weiss and Wardrop, (2010) serum biochemical parameters (serum calcium, phosphorus, sodium, potassium, chloride, total protein, albumin and serum PCO_2) were measured using commercially available kits as per standard methods (Kaneko *et al.*, 2008).

RESULTS AND DISCUSSION

Proximate composition, mineral elements and phytochemical analysis

Proximate composition of MAFF in the present study *viz.*, moisture, crude protein, crude fibre, ether extract, total ash and gross energy were 12.17±1.23 (%), 14.85±0.49 (%), 13.14±0.58 (%), 6.63±0.23 (%), 10.08±1.09 (%) and 3716±5.46 (K. cal/kg) respectively. Crude fibre and crude protein contents were similar to that of *Musa paradisiaca L.* (Phee kyan) as per Khin Nann Nyunt Swe, 2012 and Krishnan and Sinija, 2016. Value of moisture, ether extract and ash contents were higher than the reported values and it might be due to nature of the variant and place of cultivation.

Mineral composition of MAFF in the present study *viz.*, calcium, phosphorus, iron, copper, manganese, magnesium, salt, sodium and potassium were 0.50±0.04 (%), 0.44±0.08

Table 1: Experimental design.

Details of the study/ group	Material used	No. of animals	Level of inclusion (/kg. B. Wt - PO)
Control A	*Musa acuminate* flower floret extract	8	4 ml
Control B	*Musa acuminate* flower floret chopped	8	4 gm
T C	Magnesium hydroxide	8	1 g
T1 A	*Musa acuminate* flower floret extract	8	1 ml
T1 B		8	2 ml
T1 C		8	4 ml
T2 A	*Musa acuminate* flower floret chopped	8	1 gm
T2 B		8	2 gm
T2 C		8	4 gm

Table 2: Haematology in goats with MRLA.

Parameters	Control (MgO)		T1 (*Musa spp* flower floret crude extract - PO)						T2 (*Musa spp* flower floret chopped - PO)						F
	@ 1 gm/kg PO		@1 ml/kg		@ 2 ml/kg		@ 4 ml/kg		1 gm/kg		2 gm/kg		4 gm/kg		
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	
Hb (g/dL)	15.54^{e} ±0.82	13.35^{cde} ±0.56	14.94^{de} ±0.36	14.78^{de} ±0.69	14.08^{cde} ±0.93	10.45^{a} ±0.50	14.03^{cde} ±0.69	14.86^{a} ±0.46	15.19^{de} ±0.43	15.75^{e} ±0.48	12.94^{bc} ±0.28	14.9^{de} ±0.4	13.83^{cde} ±0.43	11.49^{ab} ±0.60	7.19**
PCV (%)	45.25^{cd} ±2.70	32.94^{b} ±1.26	44.75^{cd} ±2.51	46.13^{cd} ±2.53	42.50^{c} ±2.78	26.30^{a} ±1.10	44.88^{cd} ±1.88	24.63^{a} ±2.20	46.00^{cd} ±1.81	51.13^{d} ±2.17	43.88^{c} ±1.78	44.8^{cd} ±2.5	46.00^{cd} ±2.22	32.13^{ab} ±1.23	10.32**
RBC ($\times 10^6$/µl)	6.71^{ab} ±0.2	6.80^{ab} ±0.13	6.68^{ab} ±0.29	6.36^{ab} ±0.30	6.93^{ab} ±0.54	9.15^{c} ±0.60	6.89^{ab} ±0.22	6.53^{ab} ±0.22	7.09^{b} ±0.40	7.09^{b} ±0.40	9.79^{c} ±0.44	6.7^{ab} ±0.30	6.36^{ab} ±0.30	5.83^{a} ±0.33	8.94*
Neutrophils	40.50^{a} ±1.50	44.88^{ab} ±0.74	40.88^{a} ±1.32	43.38^{ab} ±0.92	43.88^{ab} ±2.07	45.00^{ab} ±1.98	43.63^{ab} ±1.71	47.38^{ab} ±1.75	43.88^{ab} ±2.07	43.75^{ab} ±2.23	45.00^{ab} ±1.98	40.90^{ab} ±1.3	43.38^{ab} ±0.92	43.38^{ab} ±0.92	7.01*
Lymhocytes	59.00^{b} ±1.48	54.63^{b} ±0.91	59.88^{b} ±2.72	58.75^{b} ±1.28	55.75^{b} ±1.99	45.38^{a} ±2.02	57.25^{b} ±1.86	57.63^{b} ±1.80	55.75^{b} ± 1.99	55.8^{b} ±2.24	45.38^{a} ±2.02	59.9^{b} ±2.70	58.75^{b} ±1.28	58.75^{b} ±1.28	6.26*
Monocytes	0.50^{a} ±0.27	0.50^{a} ±0.33	0.60^{a} ±0.26	0.38^{a} ±0.18	0.25^{a} ±0.16	0.63^{a} ±0.18	0.13^{a} ±0.13	0.00^{a} ±0.00	0.25^{a} ±0.16	0.13^{a} ±0.13	0.63^{a} ±0.18	0.60^{a} ±0.30	0.38^{a} ±0.18	0.38^{a} ±0.18	1.09^{NS}

Means bearing same superscript in same row do not differ significantly.
**Highly significant (P<0.01), *Significant (P<0.05) and NS- Non significant.

Table 3: Serum biochemistry in goats with MRLA.

Parameters	Control (MgO)		T1 (*Musa spp* flower floret crude extract - PO)						T2 (*Musa spp* flower floret chopped - PO)						F
	@ 1 gm/kg PO		@ 1 ml/kg		@ 2 ml/kg		@ 4 ml/kg PO		@ 1 gm/kg		@ 2 gm/kg		@ 4 gm/kg PO		
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	
Ca (mg/dL)	13.00^{abc}	15.00^{bcd}	13.00^{abc}	14.87^{bcd}	14.01^{abcd}	18.65^{e}	13.72^{abc}	17.04^{de}	10.88^{a}	11.30^{a}	16.19^{acde}	11.38^{a}	12.36^{ab}	10.66^{a}	5.46**
	±0.74	±1.20	±0.65	±1.51	±0.46	±2.16	±0.14	±1.91	±0.67	±0.40	±0.66	±0.49	±0.57	±0.48	
P (mg/dL)	6.63^{bcde}	6.26^{abcd}	7.65^{cde}	7.33^{cde}	6.08^{abc}	8.16^{e}	4.75^{a}	6.90^{bcde}	5.73^{ab}	6.30^{abcd}	8.01^{e}	7.84^{de}	5.49^{ab}	8.14^{e}	4.85**
	±0.50	±0.28	±0.43	±0.48	±0.22	±0.53	±0.51	±0.77	±0.25	±0.2	±0.45	±0.37	±0.32	±0.97	
Mg (mg/dL)	2.96^{bcd}	3.06^{cd}	3.30^{cde}	2.77^{abc}	2.27^{a}	3.22^{cde}	3.04^{cd}	3.80^{e}	2.43^{ab}	2.90^{cbd}	2.96^{bcd}	3.11^{cd}	3.40^{de}	3.36^{cde}	4.85**
	±0.08	±0.23	±0.23	±0.17	±0.05	±0.19	±0.23	±0.22	±0.18	±0.20	±0.08	±0.10	±0.17	±0.31	
Na (mEq/dL)	129.88^{ab}	132.50^{abc}	145.0^{e}	138.38^{bcde}	133.38^{abc}	144.50^{de}	125.92^{a}	139.63^{bcde}	135.38^{abcde}	136.10^{abcde}	133.38^{abc}	134.13^{abcd}	141.88^{cde}	137.50^{bcde}	4.42*
	±2.79	±3.03	±2.60	±4.49	±3.50	±2.82	±4.44	±2.76	±2.4	±3.20	±3.78	±2.46	±2.55	±2.62	
K (mEq/dL)	4.09^{b}	4.16^{bc}	4.14^{bc}	4.64^{bc}	4.45^{bc}	3.91^{b}	4.60^{bc}	4.23^{bc}	4.01^{b}	4.28^{bc}	4.09^{b}	4.16^{bc}	3.20^{a}	4.95^{c}	2.83*
	±0.21	±0.39	±0.27	±0.19	±0.29	±0.23	±0.18	±0.30	±0.31	±0.24	±0.21	±0.15	±0.20	±0.21	
Cl (mEq/dL)	97.63^{c}	87.75^{a}	95.63^{ab}	91.38^{ab}	99.38^{c}	96.96^{ab}	91.38^{ab}	98.13^{c}	95.00^{ab}	91.75^{ab}	91.13^{ab}	92.9^{ab}	91.50^{ab}	93.75^{ab}	4.46*
	±0.46	±2.30	±1.80	±2.54	±1.15	±2.00	±3.04	±1.53	±2.63	±5.45	±2.48	±2.90	±3.02	±1.25	
TP (mg/dL)	6.28^{ab}	6.53^{ab}	6.16^{a}	6.22^{ab}	6.53^{ab}	6.33^{ab}	6.30^{ab}	6.63^{ab}	6.49^{ab}	6.98^{ab}	6.69^{ab}	6.70^{ab}	6.63^{ab}	6.10^{a}	
	±0.23	±0.16	±0.30	±0.14	±0.24	±0.26	±0.20	±0.21	±0.16	±0.29	±0.37	±0.30	±0.26	±0.13	1.64^{NS}
Al (mg/dL)	3.56^{a}	4.25^{b}	3.23^{a}	3.68^{ab}	3.34^{a}	3.81^{ab}	3.46^{a}	3.49^{a}	3.38^{a}	3.58^{a}	3.66^{ab}	3.60^{a}	3.25^{a}	3.56^{a}	1.71^{NS}
	±0.14	±0.32	±0.22	±0.06	±0.14	±0.10	±0.20	±0.17	±0.17	±0.20	±0.25	±0.20	±0.25	±0.17	

Means bearing same superscript in same row do not differ significantly.

**Highly Significant (P<0.01), *Significant (P<0.05) and NS Non significant.

Table 4: PCO_2, pH and total protozoal count in the rumen fluid of goats with MRLA.

Parameters	Control (MgO)		T1 (MA flower floret crude extract - PO)						T2 (MA flower floret chopped - PO)						F
	@ 1 gm/kg PO		@ 1 ml/kg		@ 2 ml/kg		@ 4 ml/kg PO		@ 1 gm/kg		@ 2 gm/kg		@ 4 gm/kg PO		
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	
PCO_2	33.59^{d}	15.15^{a}	41.75^{e}	41.63^{e}	40.30^{e}	20.85^{b}	40.16^{e}	20.75^{b}	41.41^{e}	41.99^{e}	41.26^{e}	39.9^{e}	40.13^{e}	27.55^{c}	53.96**
	±1.61	±0.69	±1.15	±1.15	±1.65	±1.66	±1.99	±1.52	±1.04	±0.71	±0.84	±1.10	±0.84	±1.37	
pH	5.15^{ab}	6.00^{c}	5.15^{ab}	4.76^{a}	5.21^{b}	6.06^{c}	5.30^{b}	5.89^{c}	5.30^{b}	5.41^{b}	5.31^{b}	5.40^{b}	5.31^{b}	6.55^{d}	10.24**
	±0.16	±0.09	±0.16	±0.20	±0.17	±0.08	±0.11	±0.06	±0.17	±0.14	±0.12	±0.20	±0.16	±0.17	
Protozoal count	14.09^{ab}	47.72^{d}	14.04^{ab}	11.21^{a}	26.00^{bc}	68.44^{e}	32.79^{a}	24.88^{abc}	24.50^{abc}	21.78^{abc}	18.26^{ab}	18.30^{ab}	14.88^{ab}	69.69^{e}	19.13**
	±3.78	±5.67	±2.98	±2.70	±3.06	±10.31	±1.74	±2.29	±3.25	±1.70	±1.38	±1.10	±3.27	±7.76	

Means bearing same superscript in same row do not differ significantly.

**Highly Significant (P<0.01), *Significant (P<0.05) and NS Non significant.

Table 5: Bacterial count in rumen fluid of goats with MRLA.

Parameters	Control (MgO)		T1 (MA flower floret crude extract - PO)						T2 (MA flower floret chopped - PO)					
	@ 1 gm/kg PO		@ 1 ml/kg		@ 2 ml/kg		@ 4 ml/kg PO		@ 1 gm/kg		@ 2 gm/kg		@ 4 gm/kg PO	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Total bacterial count (x 10^{12})	725.77 ±484.48	28.00 ±10.83	802.57 ±431.2	920.56 ±329.15	840.30 ±324.65	22.85 ±9.66	840.16 ±245.99	25.75 ±10.52	641.41 ±243.04	741.99 ±324.71	798.26 ±298.84	339.92 ±135.10	840.13 ±339.84	32.55 ±8.37
Gram positive bacterial count (× 10^{11})	827.15 ±336.16	86.74 ±12.19	879.55 ±223.16	894.76 ±278.20	9875.21 ±712.17	116.86 ±56.08	1055.30 ±546.11	95.19 ±12.06	975.36 ±123.17	1095.41 ±543.14	1085.31 ±443.12	195.40 ±34.20	985.31 ±234.16	96.55 ±12.17
Gram negative bacterial counit (× 10^{5})	0.09 ±0.78	1447.72 ±545.67	4.04 ±2.98	1.21 ±1.70	6.00 ±2.06	680.44 ±190.31	2.79 ±1.74	249.88 ±92.29	2.50 ±1.25	21.78 ±1.70	1.26 ±0.38	18.30 ±9.10	4.88 ±2.27	6992.69 ±798.76

(%), 420±2.58 (ppm), 7.08±0.98 (ppm), 81.98±2.12 (ppm), 0.65±0.09 (%), 0.83±0.03 (%), 1.14±0.20 (%) and 6.89±0.97 (%) respectively. Calcium value of the MAFF was similar with higher values of phosphorus, magnesium and iron while Manganese and potassium values lesser than values reported by Wanapat *et al.* (2018) and Khin Nann Nyunt Swe (2012).

Phytochemical analysis of MAFF aqueous extract revealed cardiac glycosides (+++), tannin (++), hydrolysable tannins (++), glysocides (++), saponins (+), terpenoids (+), flavanoids (+), aminoacid and protein (+), carbohydrates (+) and ethanolic extract had only tannin (+), hydrolysable tannin (+), glycoside (+), cardiac glycosides (+), terpenoids (+) and flavanoids (+). These results were in accordance with Khin Nann Nyunt Swe, (2012) and Mahmood *et al.* (2011).

Banana flower has been used as a rumen enhancer, due to its high concentration of phytonutrients, protein and minerals (Kang and Wanapat, 2013; Kang *et al.* 2014 and Kang *et al.* 2016). Goats administered with MAFF chopped or extracts did not induce any untoward effect and similarly clinical signs, haematobiochemical or rumen fluid were not indicative of any deleterious effect of MAFF.

Clinical examination in goats with MRLA

Goats affected with moderate rumen lactacidosis were dull, dehydrated, anorectic or reduced feed intake with mild diarrhea, grinding of teeth, reduce heart rate, fluid thrill on the left para lumbar fossa. These were similar to the signs described by Constable *et al*. (2011). Following treatment with magnesium oxide alkalizer / MAFF the affected animal was able to stand, was hydrated and normal with clinical activity. Similar changes were reported by Smith and Correa, (2004) following administration of magnesium oxide to the RLA goats.

Haematobiochemical analysis

Haematological analysis (Table 2) in the goats with rumen lactacidosis revealed, significant ($p<0.05$) elevation in haemoglobin and packed cell volume. Gupta *et al.* (2012) explained that the significant increase in Hb, PCV and TLC values were due to dehydration. Serum biochemistry revealed significant increase in serum phosphorus, magnesium, sodium, potassium and chloride levels following treatment with *Musa acuminate* flower floret extract @ 2 ml/kg, 4 ml/kg PO and *Musa acuminate* flower floret chopped 4 gm/kg PO which might be due to presence of rich mineral elements in *Musa acuminate* flower (Table 3).

Rumen fluid analysis in clinical cases

Results of rumen fluid analysis in goats under control and treatment groups are presented in Table 4 and 5. The physical charecteristics of the rumen fluid among treatment group goats were grey to milky grey, watery to semi solid and with mild acidic odour The mean MBRT of ruminal fluid in MRLA goats were 10.69±0.42. The iodophilic activity before treatment was +. The pH of ruminal fluid in all the ruminal lactic acidotic cases was significantly lower ($P<0.05$) than the normal range. Total protozoal count was lesser than the normal range ($6.2\pm0.3 \times 10^5$). The odour, pH, iodophilic activity and protozoal count were similar to the reports of Rahima *et al*. (2012), Gupta *et al*. (2012), Kasaralikar *et al*. (2007) and Abubakr *et al*. (2013).

Following treatment, with MAFF extract, *Musa acuminate* flower chopped and magnesium oxide the characteristics of the rumen fluid returned to normal values and were comparable to that of apparently healthy animals. Addition of magnesium oxide (alkalizer) to the acidic rumen fluid would explain neutralization of acid by magnesium oxide. However, banana flower floret chopped/extract was not an alkalizer but was able to buffer the rumen fluid due to its buffering action Rogers *et al.* (1982) and Kang and Wanapat (2013).

CONCLUSION

From the present study, it may be concluded that the goats with moderate cases of rumen lactacidosis can be treated with *Musa acuminate* flower floret either in the form of chopped flower (@ 4 gm/kg - PO) or crude extract (@ 2 ml/kg, 4 ml/kg - PO) continuously for 5 days. Banana (*Musa acuminate*) flower floret extract and chopped has been used as a rumen enhancer, due to its high concentration of phytonutrients and minerals, as these could produce therapeutic effect similar to magnesium oxide in the rumen fluid.

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