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Occurrence, etiological studies and clinical findings in ruminal alkalosis in cattle of Parbhani and adjoining areas

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Abstract

The present investigation was carried out to record the occurrence, causes and clinical findings in cattle affected with alkaline indigestion in and around Parbhani district of Maharashtra state. The overall hospital occurrence of alkaline indigestion in cattle was 16.98% (27/159). The sex wise occurrence was found to be highest in male (55.56%) than in females (44.44%). Study indicated that highest occurrence was in December 2017 (23.08%) followed by January 2018 (20.00%) and lowest in June 2018 (12.50%). In 27 affected animals, there was history of exclusive feeding of soyabean husk / Toor husk / soyabean husk along with Jowar kadbi while in 3 animals there was history of accidental feeding of urea. Affected cattle exhibited clinical signs as complete anorexia, dry muzzle, dullness and depression, ruminal atony, constipated pasty faeces, grinding of teeth, salivation and twitching of ears and facial muscles. Some cases showed nervous disturbances. The parameters like rectal temperature, heart rate, respiration rate, hydration status and ruminal motility was found to be altered in alkaline indigestion which improved after treatment towards normalcy.

Keywords: Ruminal ammonia, occurrence, cellulose digestion, urea

Introduction

Indigestion resulting from change in pH of ruminal fluid exceeding 7.5 is referred to as alkaline indigestion or ruminal alkalosis (Vijayakumar *et al.*, 2010) ^[1]. Alkaline indigestion occurs usually due to excess and sudden intake of protein rich feed, urea feeding, abrupt change of ration, drinking of contaminated and sewage water and excessive feeding of straw over a prolonged period of time (Misra and Tripathy, 1963) ^[2]. Most of the times Soyabean meal is commonly fed to dairy cows and growing cattle due to its high energy and nitrogen content leading to alkalosis (Sauvant *et al.*, 2002) ^[3].

In rumen, when there is excess production of ammonia, the microbes cannot utilize it. But ammonia which is not utilized for microbial synthesis is absorbed beyond the gastrointestinal tract. The increased level of ruminal ammonia results into increased rate of absorption (Huntington, 1986) ^[4]. The excess ammonia reaches the portal circulation, transported to liver and converted to urea. The urea is then excreted via kidney through urine or recycled into the rumen by way of saliva or through blood. As a result of an enormous intake of protein, there will be excessive accumulation of ruminal ammonia, nitrogen and decrease in VFA leading to an alkaline pH of ruminal fluid. Excessive alkaline pH will inhibit ruminal contractions which can cause paresis of rumen musculature. The range of pH in alkaline indigestion remains between 7.5 to 9.5. When pH exceeds to 7.5, there is decrease in the number of ruminal microflora and rumen fluid appears watery and dark brown in colour. It may become slimy and having putrid odour. The paresis of rumen musculature and high ruminal fluid pH bring about inappetence and interfere with cellulose digestion (Chakrabarti, 2014) ^[5].

The principal signs of alkaline indigestion include anorexia, moderate decrease in milk yield, depression, increased pulse and respiratory rate and passage of semi-solid or pasty faeces, atony of rumen along with hepatic, renal, circulatory and nervous disturbances along with leucocytosis (Stocker *et al.*, 1999 ^[6]; Mode *et al.*, 2006 ^[7]; Radostits *et al.* 2006 ^[8]). As compared to other forms of indigestion, very less information is available on alkaline indigestion in cattle (Radostits *et al.*, 2006 ^[8]). Hence, the present investigation was carried out to study occurrence, etiological study and clinical findings in ruminal alkalosis in cattle.

Materials and methods

Selection of animals

Cattle suffering from digestive problems were screened for the occurrence of alkaline indigestion irrespective of age, breed, sex and those with ruminal fluid pH more than 7.5 were used for present investigation. Amongst 27 cattle affected with alkaline indigestion 20 cases were randomly selected and distributed in two different groups (Group I and Group II) of ten each for clinico-therapeutic studies. Ten apparently healthy cattle of similar age group and managemental practices were kept as healthy control (Group III).

Clinical examination of animals

The clinical examination of cattle suffering from alkaline indigestion included anamnesis, recording of clinical parameters viz., rectal temperature (RT), heart rate (HR), respiration rate (RR), ruminal motility and hydration status of animals (Kelly, 1984^[9]).

All the physiological parameters of affected cattle were recorded on day '0' i.e. before therapy (BT) and 24 hours after clinical recovery. All the twenty clinical cases of ruminal alkalosis were kept under observation for a period of one week. Similar clinical parameters were recorded in 10 healthy control cattle (Group III) for comparison.

Results and Discussion

In the present study, 159 clinical cases of digestive disorders were reported and out of these, 27 (16.98%) were diagnosed as cases of alkaline indigestion based on high ruminal fluid pH (≥ 7.5), history of ingestion of protein-rich but low carbohydrate feed such as soya bean, Bengal gram, ground maize floor, oil cakes, legumes and urea with characteristic clinical manifestations. Out of 27 alkaline indigestion affected cattle, 15 were male indicating overall occurrence as 55.56% in them, while occurrence in females was 44.44% (12 out of 27 cases). The details of sex wise occurrence is illustrated in Table 1 and Fig. 2.

Table 1: Occurrence of clinical cases of alkaline indigestion amongst digestive disorders in cattle.

Month/Year	Clinical cases of digestive disorders	Clinical cases of Alkaline indigestion			Percent occurrence
		Male	Female	Total	
Dec-2017	26	4	2	6	23.08%
Jan-2018	25	2	3	5	20.00%
Feb-2018	27	1	3	4	14.81%
March-2018	24	3	1	4	16.67%
April-2018	22	2	1	3	13.64%
May-2018	19	2	1	3	15.19%
June-2018	16	1	1	2	12.50%
Total	159	15	12	27	16.98%

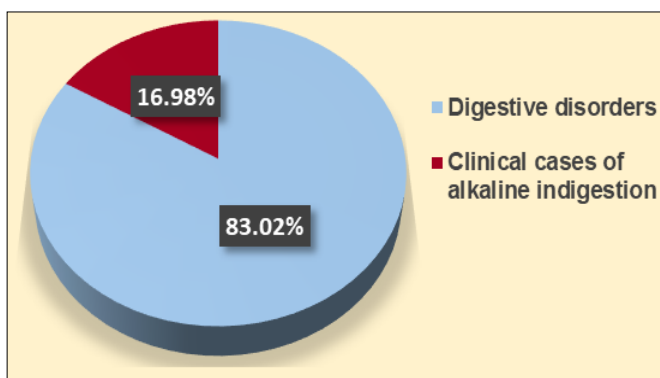


Fig 1: Occurrence of alkaline indigestion in cattle

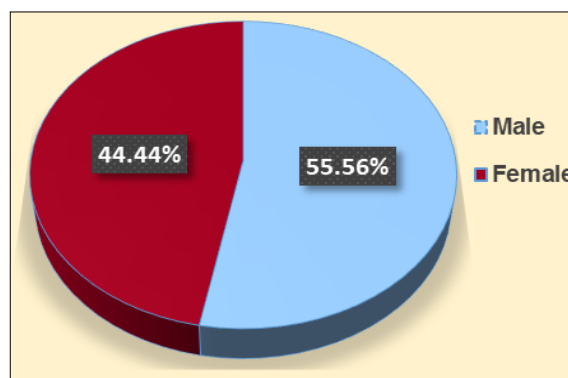


Fig 2: Sex-wise occurrence of alkaline indigestion in cattle

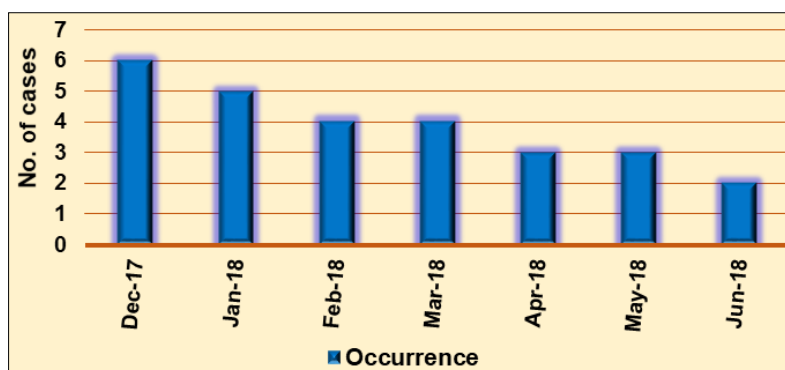


Fig 3: Month-wise occurrence of alkaline indigestion in cattle

Table 2: Frequency of clinical signs observed in cattle affected with alkaline indigestion

S. No.	Clinical manifestations	Number of cases (n = 27)	Percent (%)
1	Complete anorexia	12	44.44
2	Gradual inappetence	14	51.85
3	Dullness and depression	23	85.19
4	Dry muzzle	18	66.66
5	Suspended ruminal motility	24	88.88
6	Constipated pasty faeces	21	77.77
7	Diarrhoea	5	18.52
8	Dehydration	27	100
9	Frothy salivation	6	22.22
10	Grinding of teeth	9	33.33
11	Twitching of ears and facial muscles	7	26.92

A perusal of Table 1 and Fig. 3 indicates that there were total 26, 25, 27, 24, 22, 19 and 16 clinical cases of digestive disorders in December 2017, January, February, March, April, May and June 2018 respectively. Amongst them, total numbers of clinical cases of alkaline indigestion were 6 (23.08%), 5 (20.00%), 4 (14.81%), 4 (16.67%), 3 (13.64%), 3 (15.79%) and 2 (12.50%) in the month of December 2017, January, February, March, April, May and June 2018 respectively. It can be observed from Table 1 and Fig. 3 that the occurrence of alkaline indigestion, in the present study was highest in December 2017 followed by January 2018, while it was lowest in June 2018. Anamnesis revealed that the animals were solely fed with Jawar kadbi, soyabean husk and Toor husk in the month of December 2017 and January 2018 since this was only the cheapest animal feed available with farmers during these two months. This appears to be the major reason for the highest occurrence of alkaline indigestion in these two months.

In the present study it was observed that the overall occurrence of alkaline indigestion in cattle was 16.98% with higher rate of occurrence in male animals. These observations on occurrence of alkaline indigestion corroborate to the finding of Prasad *et al.* (1972) [10] who found alkaline indigestion in 15.85% cases, while Ortolani *et al.* (2000) [11] found 30% cases suffering from alkaline indigestion. This difference could be attributed to the variations in the period of study, feeding schedule, ecological conditions and method of study. Ahuja *et al.* (1989) [12], Randhawa *et al.* (1989) [13], Gaikwad *et al.* (1993) [14], Sahu *et al.* (1994) [15], Gurumoorthy *et al.* (2002) [16] and Srinivasan *et al.* (2008) [17] found similar observations on occurrence of alkaline indigestion.

Anamnesis of all 27 cases of alkaline indigestion revealed that 24 animals were fed solely on soyabean husk / Toor husk /

soyabean husk along with Jawar kadbi having low carbohydrate content while in 3 animals, there was history of accidental ingestion of urea. Similar etiological factors causing alkaline indigestion were observed by Srinivasan (2004) [18], Vijayakumar *et al.* (2010) [1] and Shaikat *et al.* (2012) [19].

The clinical manifestations recorded in affected cattle included complete anorexia, dehydration, dry muzzle, dullness and depression, hypomotility to atony of the rumen musculature, constipated pasty faeces, grinding of teeth, salivation and twitching of ears and facial muscles. In some cases there were nervous disturbances. The clinical cases of alkaline indigestion were presented after 3-5 days of ailment. The frequency of various clinical signs observed in the present study is depicted in Table 2.

The average rectal temperature ($^{\circ}\text{F}$) in affected cattle of Group-I and Group-II at '0' hour (before therapy) was 100.88 ± 0.14 and 100.74 ± 0.11 respectively. The healthy control (Group-III) cattle had a mean rectal temperature ($^{\circ}\text{F}$) of 100.86 ± 0.08 . The mean heart rate (beats/min) in affected cattle of Group I and Group II at '0' hours (before therapy) was 76.40 ± 1.22 and 77.40 ± 0.94 as against 68.80 ± 1.17 of healthy control animals (Group III) respectively. The average respiration rate (breaths/min) was 25.00 ± 0.80 and 25.40 ± 0.94 in alkaline indigestion affected cattle of Group I and Group II while it was 20.20 ± 0.86 in healthy control. The average time of skin fold test (sec) in affected cattle of Group I and II was 2.12 ± 0.08 and 2.16 ± 0.09 at '0' hours (before therapy) as against 0.70 ± 0.04 of healthy cattle (Group III). The average ruminal motility (motility/5 min) in affected cattle of Group I and Group II was 2.20 ± 0.24 and 1.90 ± 0.23 at '0' hours (before therapy) while the healthy cattle of Group III had ruminal motility as 7.30 ± 0.30 .

There was non-significant variation in rectal temperature in affected cattle of Groups I, II and III as healthy controls. Similar observation was recorded by Shah *et al.* (2013) [20], Mohan *et al.* (2015) [21] and Biswal *et al.* (2016) [22], while some workers (Kulkarni and Kulkarni, 2002 [23]; Sharma *et al.*, 2017 [24]) found subnormal rectal temperature in clinical cases of alkaline indigestion.

Significant ($p < 0.01$) increase in heart rate and respiration rate in all the groups of alkaline indigestion have been observed in affected cattle as compared to their corresponding healthy control values. The present findings of significant increase in heart rate and respiration rate in alkaline indigestion corroborates with the observations of Mathew (1989) [25], Biswal *et al.* (2016) [22] and Sharma *et al.* (2017) [24]. Increased heart rate might be due to compensatory mechanism of fall in plasma volume and effects of ammonia on central nervous system (Randhawa *et al.*, 1989) [13].

Table 3: Clinical observations in healthy and in different groups of alkaline indigestion affected cattle before (BT) and after therapy (AT) (Values are Mean \pm SE of ten individual observations of each group)

S. No.	Clinical parameter	Group-I (5% Acetic acid)		Group-II (5% Lactic acid)		Group-III (Healthy control)
		BT	AT	BT	AT	
1	Rectal temperature ($^{\circ}\text{F}$)	$100.88\pm 0.14^{\text{NS}}$	$100.48\pm 0.09^{\text{NS}}$	$100.74\pm 0.11^{\text{NS}}$	$100.59\pm 0.11^{\text{NS}}$	$100.86\pm 0.08^{\text{NS}}$
2	Heart rate (beats/min)	$76.40\pm 1.22^{\text{a}}$	$70.20\pm 1.17^{\text{bc}}$	$77.40\pm 0.94^{\text{a}}$	$71.60\pm 0.97^{\text{b}}$	$68.80\pm 1.17^{\text{c}}$
3	Respiration rate (breaths/min)	$25.00\pm 0.80^{\text{a}}$	$22.40\pm 0.83^{\text{bc}}$	$25.40\pm 0.94^{\text{a}}$	$23.00\pm 1.00^{\text{ab}}$	$20.20\pm 0.86^{\text{c}}$
4	Skin fold test (Sec)	$2.12\pm 0.08^{\text{a}}$	$1.24\pm 0.08^{\text{b}}$	$2.16\pm 0.09^{\text{a}}$	$1.41\pm 0.06^{\text{b}}$	$0.70\pm 0.04^{\text{c}}$
5	Ruminal motility (motility/5minutes)	$2.20\pm 0.24^{\text{d}}$	$5.90\pm 0.31^{\text{b}}$	$1.90\pm 0.23^{\text{d}}$	$5.00\pm 0.33^{\text{c}}$	$7.30\pm 0.30^{\text{a}}$

a, b, c, d, ab, bc superscripts indicate statistical significance at $p < 0.05$ and $p < 0.01$ within the rows

NS = Non-significant difference at $p < 0.05$ and $p < 0.01$ within the row

The average values of rectal temperature ($^{\circ}\text{F}$) in cattle suffering from alkaline indigestion of Group I and Group II at '24' hours after complete recovery were 100.48 ± 0.09 and 100.59 ± 0.11 respectively. There was no any significant difference in the rectal temperature of the animals after therapy (Table 3). The mean heart rate (beats/min) and respiration rate (breaths/min) in affected cattle of Group I and II at '24' hours after complete recovery were 70.20 ± 1.17 , 71.60 ± 0.97 , 22.00 ± 0.83 and 23.00 ± 1.00 respectively. Decrease in heart rate and respiration rate in both the treatment groups were statistically significant as compared to their pre-treatment values (Table 3).

Similar to the present findings Mode *et al.* (2006)^[7], Shah *et al.* (2013)^[20], Mohan *et al.* (2015)^[21] and Sharma *et al.* (2017)^[24] found significant decrease in heart and respiration rate after therapy. The average values of skin fold test (sec) in cattle affected with alkaline indigestion of Group I and II at '24' hours after complete clinical recovery were found to be improved to 1.24 ± 0.08 and 1.41 ± 0.06 respectively. There was significant ($p < 0.01$) improvement in hydration status in all the two groups (Table 3) after clinical recovery. Similar findings were observed by Hazarika *et al.* (2002)^[26].

Conclusions

Ruminal alkalosis occurred in cattle commonly in the period of December to June when soyabean husk / Toor husk / soyabean husk along with Jowar kadbi was the only source of animal feed available with the farmer which is high protein and less carbohydrate containing feed. Generally the affected animals showed gradual development of clinical signs over prolonged period of feeding of such feed. Due planning about balanced feeding with available source of feed along with a good source of carbohydrates in the period of scarcity is necessary to reduce the occurrence of alkaline indigestion in cattle.

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