"EFFECT OF NON-PENETRATING FOREIGN BODY ON CLINICAL, BIOCHEMICAL AND RUMEN FUNCTION WITH SPECIAL REFERENCE TO HISTOPATHOLOGY OF RUMINAL MUCOSA

THESIS

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MASTER OF VETERINARY SCIENCE
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BY

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University Enrolment No. : V/02/133 **Year : 2004**

DECLARATION OF STUDENT

I hereby declare that the experimental research work and interpretation of the thesis entitled **"EFFECT OF NON-PENETRATING FOREIGN BODY ON CLINICAL, BIOCHEMICAL AND RUMEN FUNCTION WITH SPECIAL REFERENCE TO HISTOPATHOLOGY OF RUMINAL MUCOSA"** or part thereof has not been submitted for any other degree or diploma of any University, nor the data have been derived from any thesis/ publication of any University or scientific organization. The sources of materials used and all assistance received during the course of investigation have been duly acknowledged.

R. B. Patil

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Date 9-11-/2004. **Enrolment No – V/02/133**

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Mr. RAHUL BHANUDAS PATIL has satisfactorily prosecuted his course of research for a period of not less than one semester and that the thesis entitled **"EFFECT OF NON-PENETRATING FOREIGN BODY ON CLINICAL, BIOCHEMICAL AND RUMEN FUNCTION WITH SPECIAL REFERENCE TO HISTOPATHOLOGY OF RUMINAL MUCOSA"** submitted by him is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination in the subject of **Veterinary Surgery and Radiology** for the award of **Master of Veterinary Science** degree by the Maharashtra Animal and Fishery Sciences University, Nagpur.

I also certify that the thesis or part thereof has not been previously submitted by him for a degree of any other University.

Place : Akola.
Date : 9-11-2004.

(Dr. S. P. Mehesare)
Chairman
Advisory Committee

CERTIFICATE - II

This is to certify that the thesis entitled **"EFFECT OF NON-PENETRATING FOREIGN BODY ON CLINICAL, BIOCHEMICAL AND RUMEN FUNCTION WITH SPECIAL REFERENCE TO HISTOPATHOLOGY OF RUMINAL MUCOSA"** submitted by **Mr. RAHUL BHANUDAS PATIL** to the Maharashtra Animal and Fishery Sciences University in partial fulfillment of the requirement for the degree of **"Master of Veterinary Science"** has been approved by the Student's Advisory Committee after oral examination in collaboration with the External Examiner.

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R.B. Patil

(Rahul B. Patil)

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ABBREVIATIONS

%	-	Per cent
@	-	at the dose rate of
^{0}F	-	Degree Fahrenheit
b. wt.	-	Body weight
BUN	-	Blood urea nitrogen
CD	-	Critical difference
dl	-	Decilitre
EDTA	-	Ethylene Diamine Tetra Acetate
et al.	-	et alia (and others)
Fcal	-	Calculated F value
fig.	-	Figure
g	-	Gram
gm/dl	-	Gram per decilitre
i.e.	-	that is
I/M	-	Intramuscular
kg.	-	Kilogram
l	-	Litre
m	-	Mili
mEq/l	-	Milli equivalent per litre
mg	-	Mlligram
mg/dl	-	Milli gram per decilitre
ml	-	Milliliter
MSS	-	Mean sum of square
NH_3-N	-	Ammonia nitrogen
NPFB	-	Non penetrating foreign body
NS	-	Non significant
pH	-	Hydrogen ion concentration
SRL	-	Strained rumen liquor
SV	-	Source of variation
TVFA	-	Total volatile fatty acid
viz.,	-	Namely

CHAPTER - I

Introduction

CHAPTER I

INTRODUCTION

This era of modern civilization and industrialization has been affected by excessive human population growth. To fulfill their residential needs they are occupying more and more land. Lot of attention is being paid to provide them the residential area and food. This has resulted tremendous reduction in the agricultural, green and grazing land. Before independence 80 per cent of land was covered with greenery and today it has sadly depleted to a mere 30 per cent of total land, leaving minimum of agriculture land for fodder and grazing.

Several estimates over the past five decades have variously quantified the availability and requirement of feed of fodder for livestock. The latest among's these estimates is the report of policy advisory group on the integrated grazing policy by Ministry of Forest and Environment, which highlighted that Indian Livestock, had a deficit of 31 per cent dry fodder, 23 per cent green fodder and 47 per cent concentrate. The total area of the CPRS has shrunk to 130 million hectare between 1950 to 1990 i.e. to the tune of 30 per cent. They are now nothing but open assess regimes with little users obligations on user participation in management in the advanced state of denudation, degradation scanty biomass cover which is almost at the point of no return. They no longer can support any meaning full livestock production. (Kurup, 2004)

Hence, whole scenario of the agriculture and animal feeding is totally affected and due to excessive industrialization there are increase in pockets of waste dump area. All these definetely affect the plane of nutrition for the animals. Due to scarcity of green productive land the basic food material is

not available, this ultimately leads to development of nutritional deficiencies thus they divert their attention towards urban land especially the waste dump areas and at the time of eating animals ingest undigestible things such as plastics, leather, clothing material, wood and stones along with the food material to complete their satiety. As the use of plastics by human population has became wide spread, a large quantity of different plastic material are often found scattered in and around the animal habitation, which also predispose the deprived appetite animals towards the syndrome termed as "non-penetrating foreign body syndrome". This condition is noticed commonly in adult cow (Kohli *et al.*, 1998), buffaloes (Singh and Sobti, 1998) and sporadically in adult ewe (Eshoue *et al.*, 1989).

Bovines are fore-stomach animals and possess indiscriminate type of feeding behaviour. They ingest food without selection as they are not having sensitive prehensile organs and sense of taste (Udall, 1964). Due to the poor economic condition of livestock owner, they are unable to adopt the scientific managemental and feeding practices, thus the animals are seen grazing in the slums and waste dump areas of city. When this is coupled with the scarcity and increased cost of good quality green fodder during lean period make the animal prone the ingestion of these foreign material especially when the polytheline bags are used for disposal of edible garbage such as kitchen wastes. Incidentally the local house hold almost vigorously use plastic bags for disposal of aforesaid type of kitchen garbage mainly consisting of leftover organic food peeling of fruits and vegetables.

Subsequently all these foreign material being indigestible, get lodged into rumen and reticulum (Jubb and Kennedy, 1970) resulting into various

digestive disorders like recurrent tympany, indigestion, impaction, traumatic reticulitis, diaphragmatic hernia and peritonitis, due to which digestive process is partially disturbed and ultimately lower the production potential of animals.

This "non-penetrating foreign body syndrome" is usually chronic in nature with sharp drop in milk yield and complete loss of appetite as they do not produce alarming symptoms. Such cases are always neglected by owner hence the careful diagnosis is of importance to the field veterinarians during their treatment. The vogue presentation and unavailability of specific diagnostic procedures. Many times it creates difficulty in diagnosis as well as treatment. The only remedy for the treatment of these cases of non-penetrating foreign body syndrome is laparoruminotomy operation. The more accurate and easily available diagnostic tests will make the prognosis of such malady more easy and the veterinarian will be able to give an immediate surgical treatment for relieving the animal of such ailment before any fatal symptom can invade death. Besides the production capacity of the animal can be enhanced

Keeping in view the major economical importance of dairy cattle in an agricultural nation, like India and the financial status of poor farmer's, an effort has been made in the present study to create awareness and to provide diagnostic aid using various tests for confirmative diagnosis and also efficient treatment of "non-penetrating foreign body syndrome" with the following objectives.

1. To study the effect of varying quantity of non-penetrating foreign body on clinical parameters.
2. To study the effect of varying quantity of non-penetrating foreign body on biochemical parameters.
3. To establish an early diagnostic test based on rumen liquor profile.

4. To study effect of varying quantity of non-penetrating foreign body on histopathology of ruminal mucosa.
5. To ascertain and establish early diagnosis based on above studies.

To meet the above mentioned objectives the following parameter's have to be studied.

A) Clinical observation
B) Serum biochemical observation of serum
C) Rumen liquor profile
D) Histopathological examination of ruminal mucosa.

CHAPTER - II

Review of Literature

CHAPTER II

REVIEW OF LITERATURE

Non-penetrating foreign body syndrome has been many a times confused with simple digestive disturbance in bovine forestomach usually associated with ingestion of abnormal feed such as Polyethylene bag's, cloth's and rexine materials. Incidence of penetrating foreign body in ruminent has widely been accepted during last four decades, but evidence of non-penetrating foreign body syndrome is an entirely new emerging disease entity which has created havoc among field veterinarians and livestock owner. On such commonly occurring clinical condition very few references and literature are available. An attempt is being made to review this clinical condition on the basis of available literature in present study.

2.1 Etiology

Kushali *et al.* (1981) studied 11 cases of foreign body syndrome in the Iraqi cattle out of which in two cases they observed the presence of entwined nylon ropes in the rumen which could be palpated on left paralumbar fossa.

Ramji and Soni (1981) reported post-mortem findings in a cow where the cause of death was foreign bodies which included seven military caps, two polythene bags (30 x 45 cm), two banyans, two woolen socks, bunch of nylon rope and leather belts.

Diwan and Mulay (1982) recovered 10 kg of non-penetrating foreign material like ropes, plastic bags, cloth pieces, stone, etc. in the rumen, and

in reticulum two inch large loose bale wire which was removed from a clinical case of 6 yr. old Gir cross cow.

Jit Singh *et al.* (1983) observed that in bovine foreign bodies will chiefly located in antero-ventral region of reticulum. In their study they recovered object like leather, cloth, polythene bags, nylon from rumen and nuts, coins, nails, hair pins, spoon, keys, wires, pens, clips screw from reticulum.

Prasad *et al.* (1984) reported a case of chronic recurrent tympany due to obstruction caused by foreign body. During laparoruminotomy the presence of non-penetrating foreign material like shoes, tyre, nylon cord and cloth were removed from rumen.

Chakrabharti (1988) coined the term 'licking disease' to the indiscriminate feeding habit of cattle where in, they ingest paper, cloth, leather, plastic, wood and metallic objects.

Eshouse *et al.* (1989) stated that due to poor condition of grazing land and indiscriminate feeding habit, cattle usually ingest foreign bodies because variety of nutritional deficiencies like phosphorus leading to pica and pose these animal to seek out metallic and hard object to satisfy their cravings thus predisposing them to foreign body syndrome.

Garry (1990) reported the presence of foreign bodies such as trichobenzer, plastic bags, ingested placenta as a cause of ruminal obstruction leading to accumulation of fluid in abomasum and gross distension of abdomen and disturbance in ruminal motility in bovine species.

Khachane (1993) reported that presence of light and heavy non-penetrating foreign bodies in rumen and reticulum causing reduction in ruminal movement, increase in pH of rumen liquor and biphasic contraction time.

Chug (1994) noted the incidence of recurrent bloat and tense abdomen with rapid breathing in animal having non-penetrating foreign body and stated that trichobezor were formed by constant licking and ingestion of hair by animal.

Sheldon (1995) recovered two pfizer boli, stone, nuts and bolts each weighing of 750 gm from cow by laparoruminotomy operation.

Thorat (1997) studied 8 clinical cases of non-penetrating foreign bodies, where in 4-5 kg non-penetrating foreign bodies were recovered from forestomach of bovine.

Singh and Sobti (1998) reported death of about 30 buffaloes with similar clinical signs from herd of buffalo and the owner of herd suspected ingestion of bales of plastic ropes about 3 year back. On post-mortem examination of one buffalo revealed a lump of plastic ropes in the reticulum.

Madhav Rao *et al.* (1999) recovered lump of plastic ropes (20-25 kg) from rumen and reticulum of buffalo where as in another animal bolts, nails, hair pins, wire of 6 cm and stones were recovered from rumen and reticulum.

Patil *et al.* (1999) collected the gold ornaments that were packed in the cloth and stuffed inside on AMUL-DAN gunny bag which were removed from reticulum of a 8 yr. old Mehsani buffalo.

Ramesh Kumar (2000) reported a case of severe impaction in goat. After laparoruminotomy, plastic sheets, carry bags, plastic wires and twisted ropes weighing about 3 kg were recovered.

Wawre (2002) operated 12 cases of non-penetrating foreign body in bovine and remove 6-37 kg. of plastic material including ropes and wires on laparoruminotomy.

Satish Kumar (2003) treated a case of foreign material obstruction in punganur bull. Laproruminotomy revealed the presence of polyethylene bags, casting rope and few glass bangle pieces with little ingesta in rumen. All these materials were entangled together forming a single solid mass. The complete material recovered from rumen was 2 bucket and weighing 16.4 kg.

2.2 Incidence

Advances in modern civilization and industrialization is being achieved at alarming pace, leaving a minimum of agriculture land for fodder production and grazing to animal, increasing the incidence of foreign body syndrome in last decade. The occurrence of the malady is mostly seen in animal which roam freely for grazing near the urban, periurban areas, where in there is scarcity of grazing land.

Jamkhedkar and Kulkarni (1965) observed the presence of nails in 37 cases, hair pins in 12 cases, coin in 9 cases, bailing wire in 23 cases, 2 feet large electric insulated wire in 2 cases, horse-shoe pieces in one case and metal pieces of irregular shape in nine cases during the operation of 39 cases of bovine.

Narasimha Murthy *et al.* (1967) reported a case of Abomasal impaction in a dairy cow on laparoruminotomy operation, the reticular content showed small and round pebbles and naya paisa coin in forestemach.

Crisolog (1973) found that out of 691 cows 51 had presence of foreign bodies like abaca ropes, plastic sheet and hair ball in forestomach.

Singh and Rathod (1977) recorded presence of foreign bodies of various description in nine out of 19 cases of diaphragmatic hernia in buffaloes.

Kushali *et al.* (1981) reported the foreign body syndrome in 11 cases in Iraqi cattle presented for clinical examination of which 2 cases had a presence lumps of hard mass which was palpated from left paralumbar fossa. Which was later discovered to be nylon ropes.

Ramje and Soni (1981) conducted post-mortem examination of an eight year old cow. The following material were recovered such as military caps (7), polyethylene bags (2), banyan (2), woolen socks (2), canvas belt (4), bunch of thin nylon ropes (6 m long) and two nails from the reticulum.

Jit Singh *et al.* (1983) performed 220 laparoruminotomy in bovine showing symptom of complete anorexia, retarded or suspended rumination and reduce milk yield. They noted that 164 animals had presence of foreign bodies like nuts, coins and nails. In anteroventral region of reticulum where as polythene ropes, leather were recovered from rumen.

Venkataravanappa *et al.* (1984) studied 863 cases of bovine out of which 460 were positive for the foreign body syndrome in bovine species (cow, buffaloes and bullocks).

Muslih *et al.* (1987) studied 2341 cases in cattle out of which 233 were positive for non-penetrating foreign bodies, the laparoruminotomy revealed presence of gunny bags, socks, rags, polyethylene bags etc in rumen and reticulum.

Eshoue *et al.* (1989) recorded foreign bodies in the rumen and reticulum of ewe. They removed about 2.5 to 4.5 kg. of non-metallic material from 3 ewes. The foreign bodies included polyethylene bags, nylon ropes, cloth, leather, socks and rags.

Garry (1990) observed the incidence of foreign bodies like trichobezor, plastic bags, ingested placenta leading to obstruction at abomasum and distention of abdomen in bovine species.

Thorat (1997) recovered non-penetrating foreign bodies like plastic bags, rexin, rubber, stones from rumen and reticulum of 6 animals after ruminotomy operation.

Kohli *et al.* (1998) reported 54 cases of Iraqi cattle having presence of large quantity of plastic accompanied by non-digestible material like jute cotton twines, ropes and cloths in fore stomach.

Mehendale *et al.* (1998) recovered 19.68 kg. plastic material and polythene bags from rumen of 22 cow after ruminotomy operation.

Singh and Sobti (1998) reported in a herd of buffaloes about 100 animals, out of these 30 buffaloes expired due to ingestion of bales of plastic ropes. Necropsy examination showed lump of the plastic rope in reticulum, remaining 70 buffaloes were operated for ruminotomy, where in numerous interwoven plastic ropes were recovered from rumen and reticulum. They concluded that the plastic ropes due to churning motion in rumen made into balls which obstructed the reticulo-omasal orifice of the affected buffaloes.

Saini *et al.* (2001) on survey of 205 cases of buffaloes between 5-8 year age group revealed the presence of foreign bodies in 41.5 per cent cases.

2.3 Symptoms

The animal suffering from the non- penetrating foreign body syndrome are not presented to the hospital in early stages of disease as the symptoms are vague and not noticeable. Under such circumstances it becomes a

challenging task for the veterinarian to diagnose and treat such confusing cases. The symptoms indicative for presence of non-penetrating foreign body in bovine are rare however symptoms observed by some veterinarian are stated below.

Singh *et al.* (1959) studied 10 cases of buffaloes showing symptom, like dullness, arched back, increased heart rate and pulse rate, decreased ruminal movement and complete anorexia. On laparoruminotomy they observed the presence of 79.6 per cent foreign body in reticulum and 12.9 per cent in rumen.

Narasimha *et al.* (1967) recorded non- penetrating foreign body in a case of 6 year old cow with the history of off feed, suspended rumination, passing small quantity of faeces, anorexia and mucous coated faeces.

Dash *et al.* (1972) reported that in case of acute indigestion animal showed symptom of mild tympany, abdominal pain and dehydration. The pulse rate and respiration rate also increased in these cases of cattle.

'O' Corner (1980) observed signs of indigestion, tympany and colic in cattle for variable period after swallowing foreign bodies.

Diwan and Mulay (1982) recorded a case of non- penetrating foreign body in cow where the affected animal shown symptoms of intermittent tympany, anorexia, emaciation, arching of back, lethargic movement and abduction of limbs.

Jit singh *et al.* (1983) noted common clinical symptoms comprising of suspended rumination, agalactia, recurrent tympany, dyspnoea, constipation, brisket odema and increased body temperature after ingestion of foreign bodies.

Eshoue *et al.* (1984) noted symptoms like chronic indigestion, dullness, distension of abdomen, engorgement of jugular vein increased heart rate and pulse rate in ewes due to presence of foreign bodies in the rumen and reticulum.

Misk *et al.* (1984) reported symptoms of chronic indigestion, distention of the abdomen, rough body hair coat, sunken eye ball, dehydration and engorgement of jugular vein in cattle with presence of foreign body in rumen and reticulum.

Prasad *et al.* (1984) reported a case of chronic recurrent tympany due to obstruction caused by ingestion of foreign bodies in buffaloes. The affected animal showed increased heart rate up to 100/min, systolic murmers, mild dysponoea, moderate to severe distension of rumen with hypomotility (1 movement/2 min.).

Aher *et al.* (1992) reported moderate tympany, absence of rumination, increased heart rate, pulse rate and complete anorexia in goat suffering from foreign body syndrome.

Dandge (1993) recorded reduced appetite, increased heart rate, decreased ruminal movements and increased reticular biphasic contraction time (20.5 to 21.75 sec.) in non-penetrating foreign body syndrome.

Bawane (1994) conducted experimental study on non-penetrating foreign body in bovine and noted decreased appetite in advanced condition, decreased ruminal movements and increased reticular biphasic contraction time.

Gadakh (1996) reported anorexia, inappetance, constipation, increased respiration rate, increased reticular biphasic contraction time and

decreased ruminal movement on experimental study conducted on male buffaloes with non-penetrating foreign body.

Singh *et al.* (1996) recorded 48 cases of the tympanitis and alkaline indigestion in buffaloes and noted normal rectal temperature, increased heart rate, pulse rate and respiration rate in affected animals.

Singh *et al.* (1997) found symptom of anorexia, dullness, depression and reduced water intake associated with cases of indigestion and impaction in buffaloes.

Thorat (1997) noted hypothermia, distended abdomen, engorgement of jugular vein, recurrent tempany, increased heart rate, suspended rumination and increased reticular biphasic contraction time in clinical cases of non-penetrating foreign body syndrome in buffalo.

Kohli *et al.* (1998) reported 97 cases in bovine suffering from the ruminal engorgement caused due to ingestion of plastic material, the affected animal showed symptom as abducted limb, arched back, inappetance, decreased production, progressive loss of condition, weight loss and hypomotility (1/3 min.) of the rumen.

Venu *et al.* (2001) observed symptom of the inappetence, dullness, passing reduced quantity of faeces. Where ruminal movement (0/3 min). Rumen was doughy and firm in consistency in 6 yr. old Ongole cow from whom Trichobezor were removed after laparoruminotomy.

Wawre (2002) noted signs of dullness, abducted elbows, anorexia, bilateral tympany, suspended rumination, engorged jugular vein, increased heart rate and respiration rate in 12 clinical cases of non-penetrating foreign body.

Kohli (2003) reported ruminal engorgment due to ingestion of plastic in 54 bovine with history of lack of appetite, decreased production and progressive loss of condition and weight, ruminal motility was 1/3 min. The consistency of rumen was heard to doughy.

Satish Kumar *et al.* (2003) reported symptom of off feed, recurrent bloat, passing small quantity of faeces in 5 yr. old bull and they observed that rumen was doughy in consistency with zero motility for 3 min. the bull was weak and dehydrated.

2.4 Rumen liquor profile

Rumen liquor analysis is an important diagnostic aid for digestive disorders. The presence of foreign bodies in the forestomach of ruminants may leads to alternation in the physiology of forestomach as regards the biochemical status.

Dash *et al.* (1972) noted alkaline pH (7.4) in case of acute indigestion and observed diplodinium group of protozoa survived in case of alkalosis.

Prasad and Joshi (1973) noted that in clinical cases at traumatic pericarditis there was a low ruminal movement associated with higher value of total volatile fatty acids, decrease in the ruminal pH and increased ammonia nitrogen level in rumen liquor.

Joshi and Mishra (1975) reported the rumen dysfunction in 40 zebu cattle. There was rise in rumen pH, up to 7.5 in alkaline indigestion. There was reduction in total volatile fatty acid concentration. The difference in levels of

ammonia nitrogen concentration in the rumen fluid was observed significant in disease condition.

Prasad *et al.* (1977) studied 74 cases of indigestion in cattle and buffaloes and reported a negative correlation of total volatile fatty acids with pH and ammonia nitrogen concentration in rumen liquor.

Vihan and Rai (1985) reported the pH of rumen fluid between 4.5 to 7.2 in animals suffering from rumen dysfunction.

Sopori and Prasad (1986) conducted experimental study on ten cow calves ageing 1½ years in which the rumen was engorged with wheat straw and found that the pH and ammonia level of rumen liquor were significantly increased in affected calves. They stated that there was decreased total volatile fatty acids concentration due to high rumen liquor pH and low microbial population in the rumen liquor leading poor fermentation and digestion.

Ahuja *et al.* (1989) studied experimentally induced acute rumen alkalosis by feeding urea in buffalo calves, the average total rumen protozoal count was estimated to be $2.92 \pm 0.16 \times 10^5$ /ml. which was significantly decreased to $1.36 \pm 0.18 \times 10^5$ /ml. The mean ammonia nitrogen concentration of rumen liquor showed significant increase from base value of 5.57 ± 0.79 to 45.44 ± 0.06 mg per cent. The mean total volatile fatty acid concentration decreased from 72.50 ± 3 to 53.33 ± 4.50 m. Eq/l.

Sen *et al.* (1989) reported the pH of rumen liquor of healthy animal kept in extensive condition to be 7.01 ± 0.14 whereas the total protozoal count was $6.5 \pm 0.76 \times 10^5$/ml and stated that in mild alkaline pH there was a decrease in total protozoal count.

Randhwa *et al.* (1992) reported that in case of induced alkaline indigestion in buffalo calves that there was deterioration in protozoal activity. They observed that there was significant increase in rumen liquor pH and decline in ammonia nitrogen and total volatile fatty acid concentration.

Nambi and Ghanaprkasam (1993) reported mean pH value of 7.55 ± 0.16 in the sick animal against 6.98 ± 0.15 in normal cattle. They found that the total protozoal count in sick animal to be $2.46 \pm 0.95 \times 10^5$ as compared to $4.43 \pm 1.28 \times 10^5$ in healthy animals cattle and stated that there was decreased in protozoal count.

Khachne (1993) observed alkaline pH of rumen liquor in case of light non-penetrating foreign body syndrome in male buffalo calves.

Sahu *et al.* (1993) revealed significant increase in pH of rumen liquor from normal value of 6.8 ± 0.09 upto 9.58 ± 0.257 after oral administration of urea in goat. There was decrease in total volatile fatty acid value from 61.66 ± 0.98 m Eq/l to 30.75 ± 0.75 m Eq/l. The ammonia nitrogen concentration in rumen liquor showed a significant increase from 16.67 ± 1.032 mg/100 ml. to 78.96 ± 2.086 mg/100 ml., which rose upto 176.97 ± 2.92.

Bawane (1994) reported significant reduction in total volatile fatty acid and ammonia nitrogen with increase in pH of rumen liquor in experimentally induced non-penetrating foreign body syndrome in bovine.

Karunanidhi *et al.* (1995) reported the pH of rumen fluid in cow calves upto 7.15 ± 0.99 whereas the mean total protozoal count was 0.0826×10^5/ml which is lower that normal protozoal count.

Rani *et al.* (1995) reported the increase in pH of rumen fluid up to 8.42 ± 0.08 in experimentally induced ruminal alkolosis (urea treated) in buffaloes.

Singh *et al.* (1996) reported that the rumen liquor pH was higher in cases of alkaline indigestion. The total volatile fatty acids and total protozoal count were significantly ($P<0.01$) low.

Venkateswarlu *et al.* (1998) reported significant increase in the mean rumen ammonia nitrogen values in case of alkaline indigestion (28.22 ± 2.12 mg %) as compared to (9.6 ± 0.95 mg %) in healthy group of buffalo and the rumen pH was reported to be 7.5 in case of alkaline indigestion in buffalo.

Hawasingh *et al.* (2001) recorded decrease in total volatile fatty acid to 46 ± 2.16 m mole Eq/l in goats as compared to control group with 69.50 ± 3.15 m mole Eq/l.

Wawre (2002) reported moderate alkaline pH, decreased ammonia nitrogen and total volatile fatty acid concentration and total protozoal count in cattle suffering with non-penetrating foreign body syndrome.

2.5 Biochemical profile

Sevendsen (1969) recorded rapid onset of dehydration, hypochloraemia, hypokalaemia and alkolosis in the clinical cases of vegal indigestion and right abomasal displacement in buffalo, which might be due to large volume of fluid, ingested or secreted and accumulated in forestomach which could not therefore absorbed from the small intestine leading to fluid or electrolyte imbalance.

Pearson and Smith (1973) noted the disturbances in fluid and electrolyte balance in a cow with bowel stasis or obstruction. They recorded hypokalaemia, hypochloraemia, alkolosis and rapid onset of dehydration.

Jagdish Prasad and Joshi (1973) reported that serum calcium and inorganic phosphorous level within normal range in traumatic pericarditis in buffaloes and total serum protein were higher (9.9% gm.). The normal albumin globulin ratio was also found to be disturbed.

Prasad and Joshi (1975) reported that serum calcium and inorganic phosphorus level were with in normal physiological range in 21 cases of ruminal impaction in zebu cattle and buffaloes.

Pandiya *et al.* (1977) reported significant ($P<0.01$) fall in serum calcium level in age group 0-12 month 10.06 ± 0.096 mg/100 ml in cattle and noted that decreased as animal advanced in age as 9.06 ± 0.096 mg/100 ml. The phosphorous level tended to decrease from 7.63 ± 0.22 to 4.92 ± 0.26 mg/100 ml and the decline was found to be significant ($P<0.01$). The serum alkaline phosphatase activity in cattle had wider range 3.15 ± 0.22 to 4.82 ± 0.14 Bodansky units. It was also observed that alkaline phosphate activity increased with the increase in age and variation was highly significant.

Randhawa *et al.* (1980) studied experimentally induced acidosis in buffalo calves and observed the significant rise in blood glucose concentration which might have been either due to increased glycogenolysis, gluconeogenesis or due to decreased utilization of glucose by peripheral tissue in the advance stage of rumen acidosis.

Vihan and Rai (1985) reported in their study that the blood glucose concentration varied between 52.4 ± 5.03 to 58.2 ± 3.69 mg/dl in sheep

and 58.33 ± 5.92 to 91.82 ± 8.57 mg/dl in goat in various rumen disorders. Inorganic phosphorus showed highly significant ($P<0.01$) differences in disease conditions.

Sivaiah (1986) studied serum calcium and inorganic phosphorous levels in Ongole cross breed cows and observed serum calcium levels were slightly lower 7.04 ± 2.07 to 8.15 ± 2.48 mg per cent than normal value of serum calcium which is 8-12 mg per cent. The analysis of variance showed non-significant difference in the level of calcium. The serum inorganic phosphorus levels ranged from 5.73 ± 0.92 to 7.18 ± 0.90 mg per cent while normal value ranged from 4-12 mg per cent. The low calcium phosphorous ratio was due to inhibition of dietary calcium absorption.

Hanumanthaia *et al.* (1991) experimentally induced ruminal acidosis in 15 buffalo calves and reported the value of plasma chloride, potassium and sodium to be between 84.75 ± 3.40 to 89.00 ± 4.58, 5.55 ± 0.45 to 5.75 ± 0.29 and 155.50 ± 3.00 to 169.60 ± 1.67 m.eq/l, respectively. Significantly decrease serum sodium level was reported in the investigation.

Gaikwad *et al.* (1992) estimated blood glucose and serum protein in Jersey and Red kandhari cattle and reported significantly ($P<0.01$) low blood glucose level in calves and significantly ($P<0.05$) less serum total proteins than in adult cows. Serum albumin ratio ranged from 2.27 ± 0.066 and 2.44 ± 0.07 per cent in young female and male calves. Whereas adult cow had significantly ($P<0.01$) more serum globulin than young female calves. Serum globulin and albumin ratio ranged from 0.70 ± 0.04 to 0.42 ± 0.02 gm/dl.

Radostits *et al.* (1994) found increased in haematocrit values, neutrophilia with shift to the left and dehydration associated with hypokalaemia

and hypochloraemia in the disorders of digestive system like traumatic reticulo pericarditis.

Thorat (1997) observed the effect of non-penetrating foreign body in buffalo calves, where the serum calcium and phosphorous level were not altered. The serum sodium level were found significantly decreased without significant alteration in the serum potassium levels in experimental animal.

Hawasingh *et al.* (2001) studied 24 cases of primary simple indigestion in goat. They found that serum calcium and inorganic phosphorous values fluctuated within normal range. The mean glucose levels were significantly higher ($P<0.05$) in simple indigestion cases. The increase in glucose values were due to stress of the digestive disorders leading to the adreno corticoids release causing hyper glycemia.

Wawre (2002) reported that the serum total protein levels in 12 clinical cases of non-penetrating foreign body were significantly decreased which resulted in marked hypoproteinemia.

2.6 Histopathology of ruminal wall

The presence of non-penetrating foreign body in the rumen for longer duration will alter the ruminal environment by damaging the ruminal mucosa. The common changes observed in the ruminal mucosa were alterations in the structure of ruminal papillae and ruminal epithelium, there by affecting the normal function of ruminal mucosa which ultimately lead to digestive disturbance. Therefore to study the extent of damage to ruminal mucosa histopathological examination of ruminal wall is one of the important aspect in the non-penetrating foreign body syndrome in ruminants.

Rao (1968) observed normal histological structure of ruminal wall and noted the papillae of different size and shape, absence of a distinct muscularis muscosae, Tunica mucosa - submucosa, stratified squamous cornified epidermis - like lining epithelium; Lamina propria tunica submucosa of areolar - reticular connective tissue forming the core of the papillae. The deeper portion of loose areolar connective tissue. In the taller papillae smooth muscle cell clusters representing the muscularis mucosae, Tunica muscularis of smooth muscle arranged in an inner circular and outer longitudinal layers and Tunica serosa of coarse areolar connective tissue with elastic fibres and adipose cells.

Dellmann (1971) stated that the normal ruminal papillae are important for absorption process by increasing the absorbing surface and providing heat to the ruminal content like heating rod action. They further reported that the presence of large number of mitochondria in the stratum granulosum layer of ruminal wall were responsible for transport of sodium and calcium ions.

Dellmann and Brown (1976) noted that the epithelium of rumen was stratified squamous keratinised type and performed three important function as protection, metabolism and absorption. The upper keratinized layer forms a protective shield against the rough fibrous ingesta, where as the deeper layer metabolize the short chain volatile fatty acid (Butyric, acetic and propionic acid). which are the chief product of fermentation. In addition to the volatile fatty acids, sodium potassium, urea and many other products were also observed from the ruminal content.

Randhawa *et al.* (1981) studied the effect of experimently induced acute ruminal acidosis on ruminal mucosa in buffalo calves and observed the neutrophil infiltration in the laminapropria with abscess formation over the mucous membrane of rumen and reticulum along with complete necrosis and

exfoliation of straitified squamous keratinized epithelium lining of mucous membrane leading to ulceration. They observed increased mast cell count particularly in the preivascular location in the ruminal mucous of affected animals.

Piercy and Kemp (1990) studied the effect of eosinophilic rumenitis in intensively reared lambs. The histological examination of ruminal mucosa revealed the papillary hypertrophy, swelling and vacuolation of epithelial cells, ulceration of the stratum corneum and nentrophil infiltration; Inflammatory changes were seen through out all layers of rumen by presence large number of eosinophils especially in the thickened submucosa, lamina propria and tumica muscularis in the ruminal acidosis which resulted due to ingestion of excess carbohydrate.

Hailat *et al.* (1997) observed effect of foreign bodies (Plastics) over the gross and microscopic changes of ruminal wall, 130 sheep having rumen impaction with plastic and treated by rumenotomy. In these animals they revealed presence of plastic bags (78%), rope and leather (7 %) in the rumen also presence of pins and nails (18.5%) in both rumen and reticulum. The gross examination at rumen with plastic shows the area of sloughing, haemorrhages, congestion and stunting of the papillae. Histopathological examination revealed area of coagulative necrosis, hyperemia, inflammatory process, focal hyperplasia, and presence of several mitotic figures and cell with more than one nucleolus.

Randhawa *et al.* (1998) studied the effect of experimentally induced subacute ruminal acidosis on ruminal mucosa. Histopathological examination revealed formation of microabscess in the mucosa in buffalo calves and purulent ruminitis, which was characterized by marked infiltration of the neutrophils in the ruminal mucosa.

CHAPTER - III

Material and Methods

CHAPTER III

MATERIALS AND METHODS

The present research work was carried out at Department of surgery and Radiology, PGIVAS, Akola.

The animals were presented to veterinary hospital with the symptoms of rough hair coat, anorexia, inappetance and impaction with the history of being let loose for grazing in the urban areas were selected for study. The laboratory investigations for rumen liquor analysis, serum biochemical analysis and histopathological observation of rumen were carried out on these animals simultaneously.

The animals suspected for presence of non-penetrating foreign body were subjected to laproruminotomy described by Oehme and Prier (1976). These foreign bodies were weighed and its presence was evaluated as per cent body weight of animals. The various observations were recorded on 'o' day, 5^{th} day 10^{th} day and 15^{th} day post-operatively.

The animals of the control group were selected randomly from DBT-TVOR, IVF, Project, Department of Gynaecology, PGIVAS, Akola.

3.1 Grouping of animals

The animals were divided in 3 groups viz., A, B and C each of this comprising of 6 animals.

Group A : This was the control group where in, the animals were selected at random from DBR-TVOR, IVF, Project, Department of Gynaecology, P.G.I.V.A.S., Akola.

Group B : Comprised of animals having presence of 5 - 10 per cent (per 100 kg of body weight)of non-penetrating foreign body.

Group C : Comprised animals having presence of non-penetrating foreign body of 10 per cent (per 100 kg body weight) and above.

3.2 Preparation of animal for surgery

3.2.1 Preoperative consideration

The animals those are to be suspected from group 'B' and 'C' were fasted for 18 hours and deprived of water 10 hours prior to surgical intervention. The animals were restrained and sedated with inj. Triflupromazine hydrochloride* @ 1 mg/10 kg body weight deep intramuscularly. The left paralumbor fossa was prepared aseptically for operation by washing, shaving, cleaning and applying spirit over operative site.

3.2.2 Anesthesia

Local infiltration was carried out by performing 'T' block using the inj. lighocaine hydrochloride**.

3.2.3 Surgical technique

Laparurumenotemy was performed in all affected animals using conventional method described by Oehme and Prier (1976). Anterior side of rumen and reticulum as well as posterior side of diaphragm were palpated for presence of any traumatic foreign body or any abnormality.

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* Inj. Siquil. : Trifluopromazine Sarabhai Chem. Vikram Sarabhai Road, Vadodara, Gujarat.

** Inj. Xylocain : Asira IDL Ltd., 12th Mile, Ballegey Road, Bangalore.

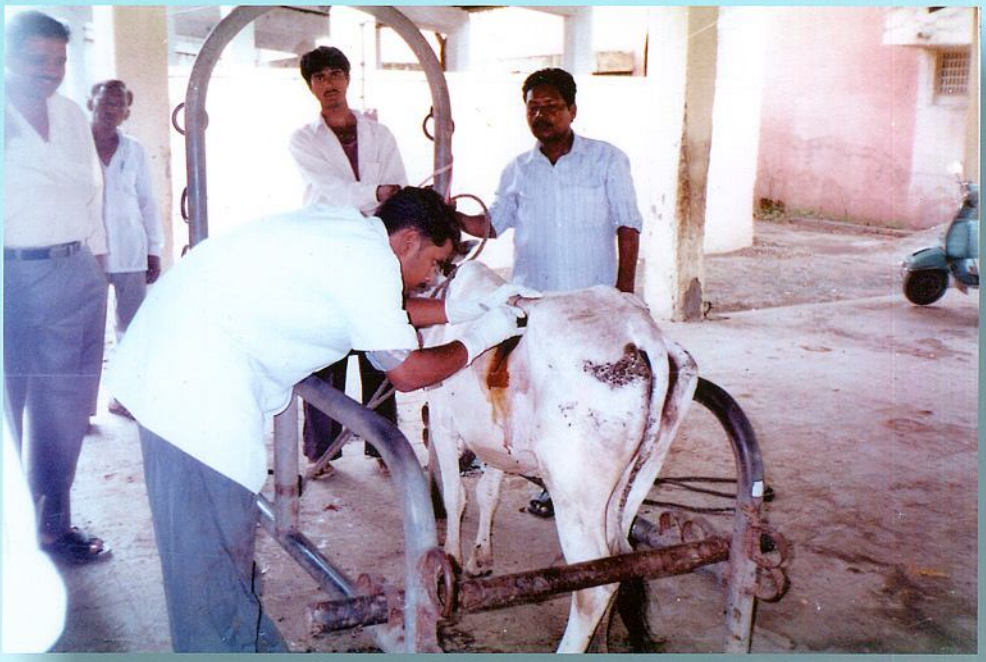

Plate 1 : Operative treatment for removal of non-penetrating foreign body

About '2' below the levels at the lumber transverse process, approximately 8-10" long incision was made on the skin. The muscles were incised and peritoneum was cut to expose rumen. An incision at 6-7 inches was given on rumen and non penetrating foreign bodies accumulated inside the rumen and reticulum were removed. The small piece of the ruminal wall was taken from the incised rumen where blackish or brownish coloured papille are visible. This small piece of the rumen was collected for histopathological study of ruminal wall. Then the rumen wall was closed by double row of Lambert suture using ethic absorbable surgical chromic catgut No. 2*. The peritoneum and abdominal muscle were sutured by simple interrupted suture using chromic catgut No. 2. The skin was sutured using coarse nylon by the interrupted sutures.

Inj. dicrysticin** 2.5 gm powder was sprinkled into the peritoneal cavity.

3.2.4 Post-operative treatment

Dressing of laparotomy wound was carried out daily using the Himax*** ointment upto 6 days and a course of antibiotic therapy using the inj. Dicrysticin (5 gm) was given I/M for 5 day along with inj. Belamyl**** 10 ml, inj. Cadistin**** 10 ml and inj. Zobid***** 15 ml for 3 days Bol. Bioboost****** @ 2 bol. BID for 5 days, Pow. Himalayan Battisa******* 60 gm BID and fresh rumen cud from different animal @ 5-10 lit/day for 5 days, 3 % dil. acetic acid was given for correction of rumen liquor pH, and skin sutures were removed on 10^{th} post operative day.

All the animals of group 'A', 'B', 'C' were subjected to following studies upto 15^{th} day.

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* Johnson and Johnson Ltd., 30 Forgreet Street, Bombay
** Sarabhai Chemicals Ltd., Wadi Road, Baroda
*** Natural Remidies, Bangalore
**** Sarabhai Chemicals Ltd., Wadi Road, Gujrat
***** Sarabhai Chemicals Ltd., Wadi Road, Bangalore
****** Lyka Exports Ltd., Mumbai-99.
******* Natural Remidies, Bangalore

3.3 Clinical findings

a) **General appearance** : Whether dull or alert, general look and skin coat condition etc. were studied.

b) **Appetite** : The feed intake quality of individual animal was studied.

c) **Posture** : Change in posture of animals was observed.

d) **Temperature** : Body temperature was recorded in degree Fahrenheit.

e) **Heart rate** : Heart rate/min was recorded with stethoscope.

f) **Pulse rate** : Pulse rate/min was recorded from coccygeal artery.

g) **Respiration rate** : Respiration rate per minute was observed.

h) **Ruminal movement** : Ruminal movement per 5 minute was recorded.

i) **Reticular biphasic contraction time** : Time required for the biphasic contraction of reticulum was recorded.

3.4 Rumen liquar profile

Rumen liquar was collected by abdominal parenthesis from the left paralumber fossa using 6" long 18 gauge spinal needle as per method described by Joshi (1967).

The following observations were determined.

1) **pH of Rumen liquar**

10 ml SRL was collected and immediately the pH was determined using systronic digital pH meter 335*

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* Systonic Digital pH meter - 335.

2) **Total protozoal count (1 x 10^5/ml)**

Total protozoal count from the rumen liquor was estimated by the method described by Shankarnarayan and Nambiar (1992).

3) **Determination of ammonia nitrogen (mg/100 ml SRL)**

The estimation of ammonia nitrogen of strained rumen liquar was carried out as per the microdiffusion technique of Conway (1957).

4) **Determination of total volatile fatty acid (m. mol/100 ml SRL)**

Total volatile fatty acid was estimated by using standard method (Annison, 1956).

3.5 Biochemical profile

10 ml blood was collected in a sterile test tube and kept in slanting position from which 5 ml serum was collected for biochemical studies. The following observations were recorded in all experimental animals on 0, 5^{th}, 10^{th}, 15^{th} day post operative day.

3.5.1 Estimation of blood glucose (mg/dl)

The blood glucose levels were estimated using Folins and Wu method (1920) with the help of autoanalyzer and the values are expressed in mg/dl.

3.5.2 Estimation of serum calcium (mg/dl)

The serum calcium levels were estimated by using O.C.P.C. method suggested by Lorentz (1982) and the values are expressed in mg/dl.

3.5.3 Estimation of serum phosphrous (mg/dl)

Serum phosphorus levels were estimated by using U.V. molybdate method suggested by Munoz (1983) and the values were expressed in mg/dl.

3.5.4 Estimation of serum sodium level (m.Eq/litre)

The serum sodium levels was estimated on flame photometer method as per the Oser (1965).

3.5.5 Estimation of serum potassium level (m.Eq/litre)

The serum potassium level was also estimated on flame photometer method as per the Oser (1965).

3.5.6 Estimation of total protein (gm/dl)

The total protein was estimated using Biuret, modified method suggested by Vatzidis (1977). The values are expressed in gm/dl.

3.6 Statistical analysis

Statistical analysis for clinical observations and biochemical studies was carried out by applying Factorial Completely Randomized Design (FCRD) Snedecor and Cochran (1968).

3.7 Histopathological study

The sample of the rumen tissue was collected at the time of laparo-rumentomy operation from group 'B' and 'C' to observe histopathological changes. The sample was thoroughly washed with normal saline fixed in 10 per cent formalin and followed the procedure which is shown in flow chart (Fig. 1 and Fig. 2) for the processing and staning of tissue as per Luna (1968).

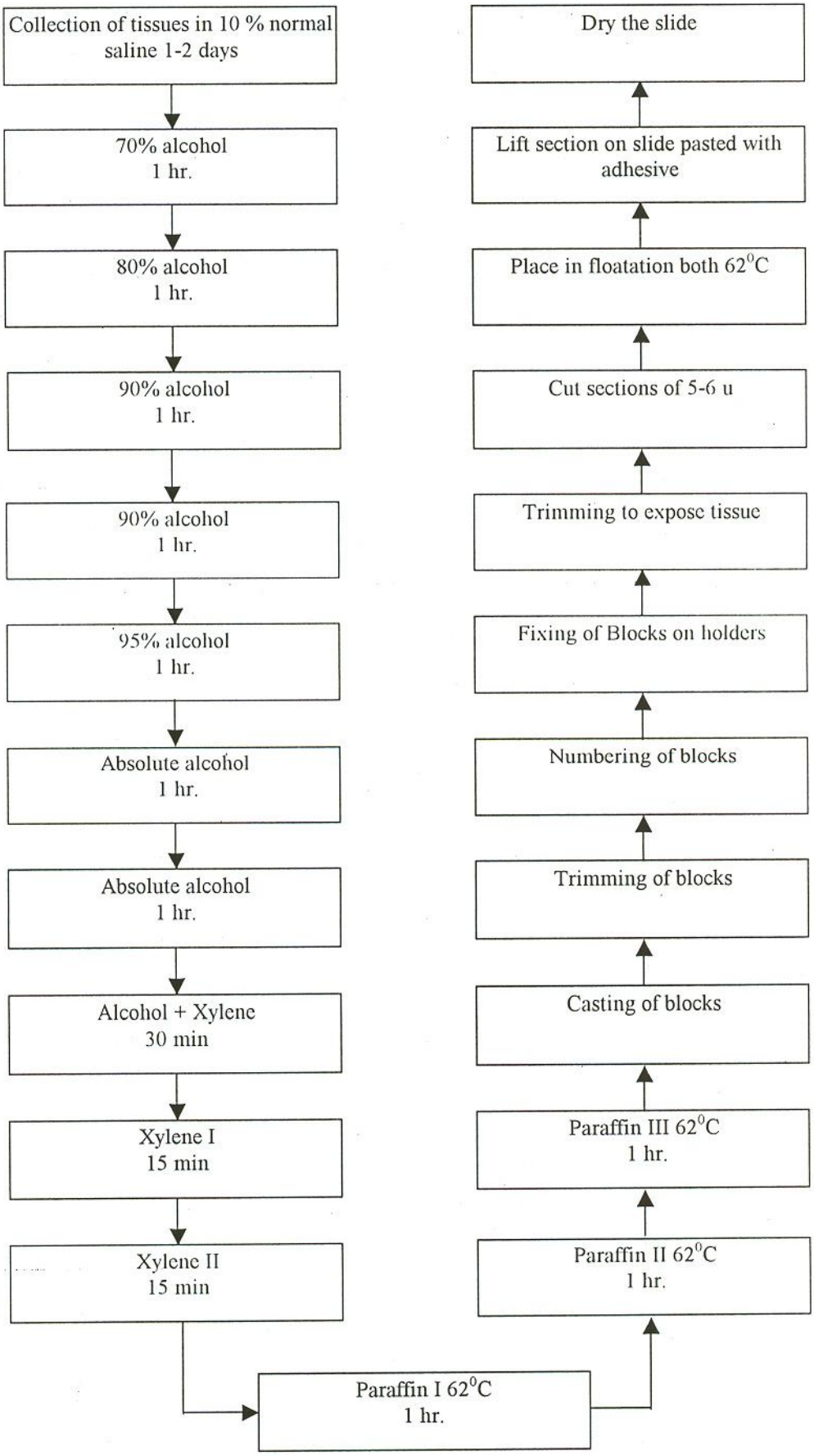


Fig. 1 : Flowchart showing procedure for processing of tissue

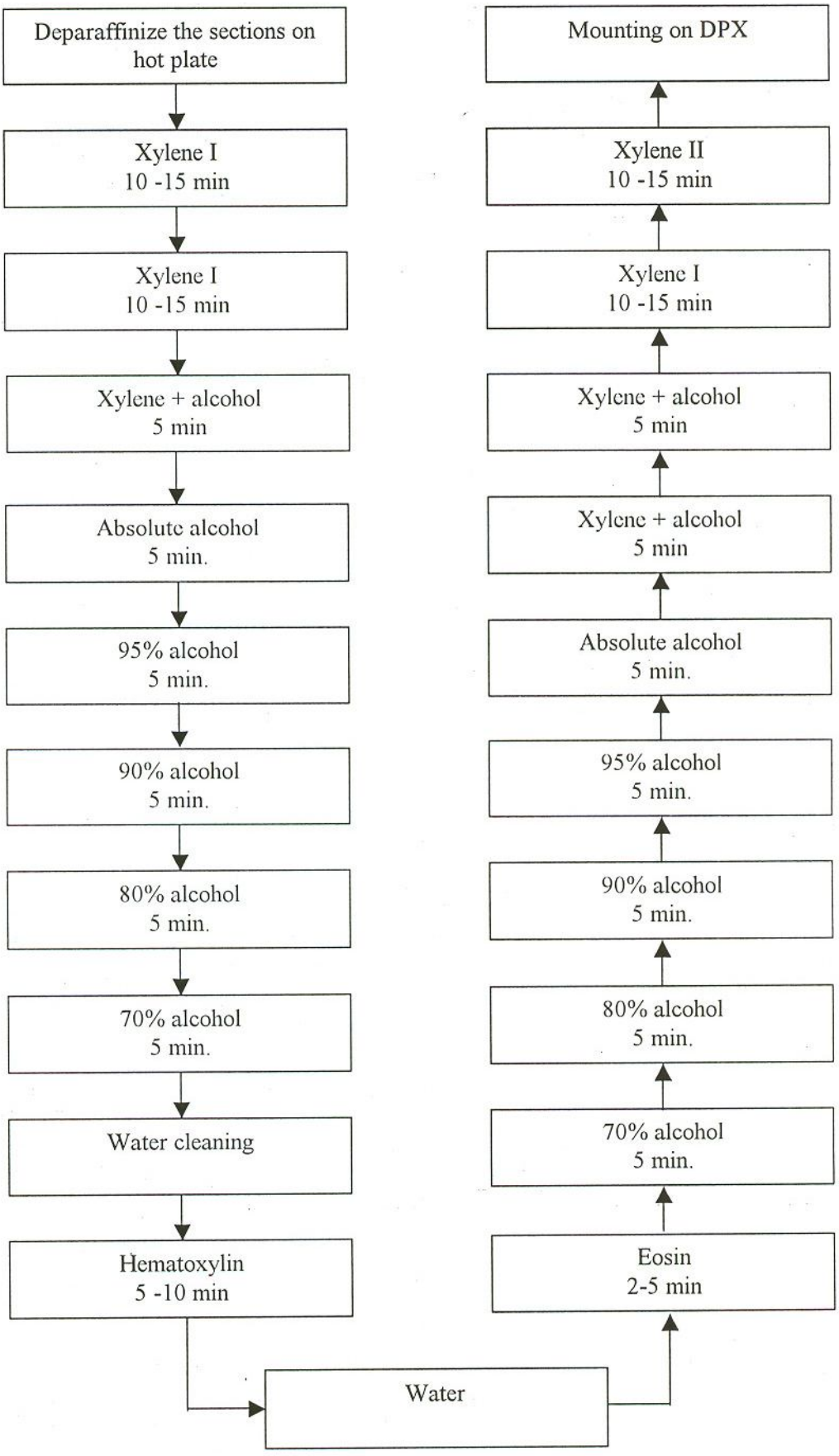


Fig. 2 : Flowchart showing procedure for staining of tissue

CHAPTER - IV

Results and Discussion

CHAPTER IV

RESULTS AND DISCUSSION

Now a days many of the cases come across in the field with the complaint of inappetance, chronic anorexia, deterioration of health and loss of production day by day with out any other systemic involvement. They are usually diagnosed for the digestive system disturbances and when symptomatic treatment is given to the animal, it does not show response to treatment. Hence exploratory laparoruminotomy is usually performed in such cases either for diagnostic purpose or for surgical correction. In many of these cases there was a presence of non-penetrating foreign material such as plastic bags, rexin, synthetic clothes, nylon ropes, turkish towel in huge quantity were recovered from rumen and reticulum of the bovine. These non-penetrating foreign bodies accumulate in the rumen and reticulum and disturb the rumino reticular activities by altering the function of digestive process, through altering pH and ruminal microflora. It also damages the wall of rumen by damaging the ruminal papillae and ruminal epithelium, which ultimately leads to digestive disturbances exhibiting various symptoms.

The scientific managemental practices are not followed in India as that of other developed countries, which make animals prone to develop such non-penetrating foreign body syndrome. In India the animals are allowed to roam freely in slum, waste dump and industrial area in search for feed material which lead to ingestion of non-penetrating foreign bodies along with food material due to nutritional deficiencies Chakrabarti (1988), coined the term 'Licking disease' to the indiscriminate habit of cattle where in they ingest paper, cloth, leather,

Plate 2 : Photograph showing ingestion of non-penetrating foreign body along with the residual material

plastic, wood and metallic objects which are present in large quantities in waste dump area or in the pocket of west dump.

The non-penetrating foreign body syndrome is a common condition in today's clinical practice and it is difficult to differentiate it from other digestive disorders. Hence in order to ascertain the exact ruminal environment and a prognostic tool of affected animals the histopathological examination ruminal mucosa can serve of great importance hence an efforts have been made on 12 clinical cases in the present study with regards to rumen liquor profile, blood biochemical profile and histopathological lesion to have a confirmative diagnosis. The results of entire research work is presented and discussed in this chapter.

4.1 Clinical Observation

4.1.1 General appearance

History of animal and overall changes in general appearance of group 'B' and 'C' revealed loss of appetite, dullness, dehydration with loss of health status and lethargic movements. Their general appearance was dull, depressed and inactive with hide bone condition. Animals of group 'C' showed higher degree of dehydration, ruminal impaction, lusterless rough hair body coat, bilateral distension of abdomen and persistent tympany which may be due to occluding the eructation of gases due to obstruction of the passage in the rumen by polyethylene bags. Similar findings were reported by Garry (1990), Narsimha Rao *et al.* (2001), Veena *et al.* (2001) and Satishkumar *et al.* (2003).

Dehydration and dullness was due to loss of appetite and anorexia. Similar findings were also reported by Diwan and Mulay (1982), Jit Singh *et al.* (1983), Misk *et al.* (1984) and Gadakh (1996).

4.1.2 Appetite

The animals in group 'B' showed partial loss of appetite whereas animals in group 'C' showed complete anorexia on zero day. The inappetance was reduced significantly in group 'B' as compared to group 'C' after five days post-operatively.

The loss of appetite was more intense in the animals of group 'C' as compared to group 'B'. It may be due to mechanical obstruction, which depends on amount of non-penetrating foreign bodies present in the rumen and reticulum. Also due to presence of huge quantity of non-penetrating foreign bodies in the rumen leading to non-availability of space in the rumen resulted into improper mixing of ruminal contents due to which there is disturbance of normal function of forestomach of animal i.e. disturbance in the ruminoreticular motility, loss of appetite, and reduced secretion of saliva. All these consequence results into impaction of rumen, which leads to atony of rumen and deterioration of health status of animals. Similar findings have also been reported by Kushali *et al.* (1981), Jit Singh *et al.* (1983), Dandge (1993) and Thorat (1997). Chronic indigestion, anorexia, suspended rumination in foreign body syndrome has also been reported (Diwan and Mulay 1982, Jit Singh *et al.* 1983, Misk *et al.* 1984).

After removing the etiology the appetite of all the animals of group 'B' and 'C' returned to normal within a period of 15 day post operatively.

4.1.3 Posture

The posture of animals was normal in group 'B' where as animals of group 'C' presented to clinic showed abnormal posture. Out of six animals in group 'C' two animals were in recumbent position. The animal C_3, C_5 showed bilateral distension of abdomen and two animals showed arched back. The above said posture of animals might be due to weight of large quality of non-penetrating foreign body which accumulated in forestomach. Similar findings have been reported by Singh *et al.* (1959), Dandge (1993) and Thorat (1997).

After surgical removal of the etiology, the animal returned to normal posture. These result are also in agreement with Singh *et al.* (1959), Dandge (1993), Thorat (1997) and Wawre (2002).

4.1.4 Body temperature (°F)

The mean value of body temperature (°F) for pre and post operative treatment were recorded and their overall mean value at different periodic interval for all the three different treatment groups presented in Table 1. and depicted in Fig. 3.

It is observed from Table 1, that in control group 'A' the average body temperature was in the range of 100.7 ± 0.28 to 101.4 ± 0.27 with overall mean of 101.9 ± 0.27 °F which was within the normal range reported by Radostitis (1994).

The mean temperature recorded for treatment 'A', 'B' and 'C' was 101.00 ± 0.12, 101.50 ± 0.05 and 101.62 ± 0.11, respectively with the significant variation. However, the difference for period found to be non significant. It was

Plate 3 : Animal showing bilateral distension of abdomen

Plate 4 : Animal showing vacant look and distended abdomen

Table 1 : Mean values for body temperature (^{0}F) of three different groups of animals during pre and post operative periods

Group	Periods				Pooled mean for group
	0th day	5th day	10th day	15th day	
A	101 ± 0.22	100.7 ± 0.28	101.4 ± 0.27	100.9 ± 0.27	101.9^{b} ± 0.12
B	101.7 ± 0.15	101.6 ± 0.15	101.5 ± 0.15	101.3 ± 0.14	101.5^{a} ± 0.05
C	101.9 ± 0.33	101.8 ± 0.25	101.51 ± 0.15	101.3 ± 0.16	101.62^{ab} ± 0.11
Pooled mean of period	101.5 ± 0.23	101.3 ± 0.2	101.47 ± 0.18	101.2 ± 0.19	

Common superscript within the column indicates non significant differences

Analysis of variance for body temperature

S.V.	D.F.	S.S.	M.S.S.	F. cal.
Treat	11	8.25	0.75	2.44898
A	2	5.0625	2.53125	8.265306**
B	3	0.875	0.2916667	0.9523809^{NS}
A x B	6	2.3125	.3854167	1.258503^{NS}
Error	60	18.375	0.30625	
Total	71	26.625		

** - Significant 0.1 % level

CD for treatment = 0.32

NS - Non-significant

observed that body temperature was slightly higher at pre operative period i.e. 0^{th} day in group 'B' and group 'C' as compared to control group 'A'.

Similar observation was reported by Diwan and Mulay (1982), Jit Singh *et al.* (1983) Dandge (1993), Gadakh (1996), Thorat (1997) and Wawre (2002).

4.1.5 Pulse rate/ min

The mean values of pulse rate observed in 3 different groups of animals during pre-operative and 5^{th}, 10^{th} and 15^{th} day post-operative period have been given in Table 2 and depicted in Fig. 4.

The mean values of pulse rate per minute for different period varied significantly ($P<0.01$) where as the mean pulse rate per minute for different group found to be non-significant.

The pulse rate in control group 'A' was in the range of 64.00 ± 3.18/ min. to 64.66 ± 1.97/ min. with over all average mean of 64.28 ± 0.12/ min. which was within the normal range reported by Radostitis (1994). The mean values of pulse rate of '0' day were comparatively ($P<0.01$) higher in group 'B' and group 'C' than control group 'A' as 81.83 ± 4.05/ min. and 75.66 ± 8.34/ min in group 'B' and group 'C', respectively. A decreasing trend in the pulse rate was observed from 0^{th} day to 15^{th} day post-operatively in group 'B' and 'C'. The mean values of pulse rate per minute on 5^{th}, 10^{th} and 15^{th} day were 72.00 ± 2.79, 63.00 ± 4.84 and 58.00 ± 3.54 per minute in group 'B', and 71.00 ± 4.85, 65.66 ± 3.55 and 59.00 ± 2.17 per minute in group 'C', respectively.

The increase in pulse rate at zero day in the treatment group might be due to the presence of hard and large amount of foreign bodies in the rumen

Table 2 : Mean values for pulse rate (per min) of three different groups of animals during pre and post operative periods

Group	Periods				Pooled mean for group
	0^{th} day	5^{th} day	10^{th} day	15^{th} day	
A	64.33^{a} ± 2.31	64.66^{a} ± 1.97	64.16^{a} ± 1.47	64.00^{a} ± 3.18	64.288 ± 0.12
B	81.83^{c} ± 4.05	72.00^{b} ± 2.79	63.00^{a} ± 4.84	58.00^{a} ± 3.54	68.70 ± 4.54
C	75.66^{c} ± 2.31	71.00^{bc} ± 4.85	65.66^{b} ± 3.55	59.00^{a} ± 2.17	67.83 ± 3.10
Pooled mean of period	73.94^{c} ± 4.18	69.22^{bc} ± 1.87	64.27^{ab} ± 0.62	60.33^{a} ± 1.51	

The values bearing the common superscript within the respective row indicates non-significant differences

Analysis of variance for pulse rate

S.V.	D.F.	S.S.	M.S.S.	F. cal.
Treat	11	3170.781	288.2529	2.994835
A	2	262.5313	131.2656	1.363799^{NS}
B	3	1890.125	630.0417	6.545888**
A x B	6	1018.125	169.6875	1.762987^{NS}
Error	60	5775	96.25	
Total	71	8945.781		

** - Significant 0.1 % level CD for period = 6.56

NS - Non-significant

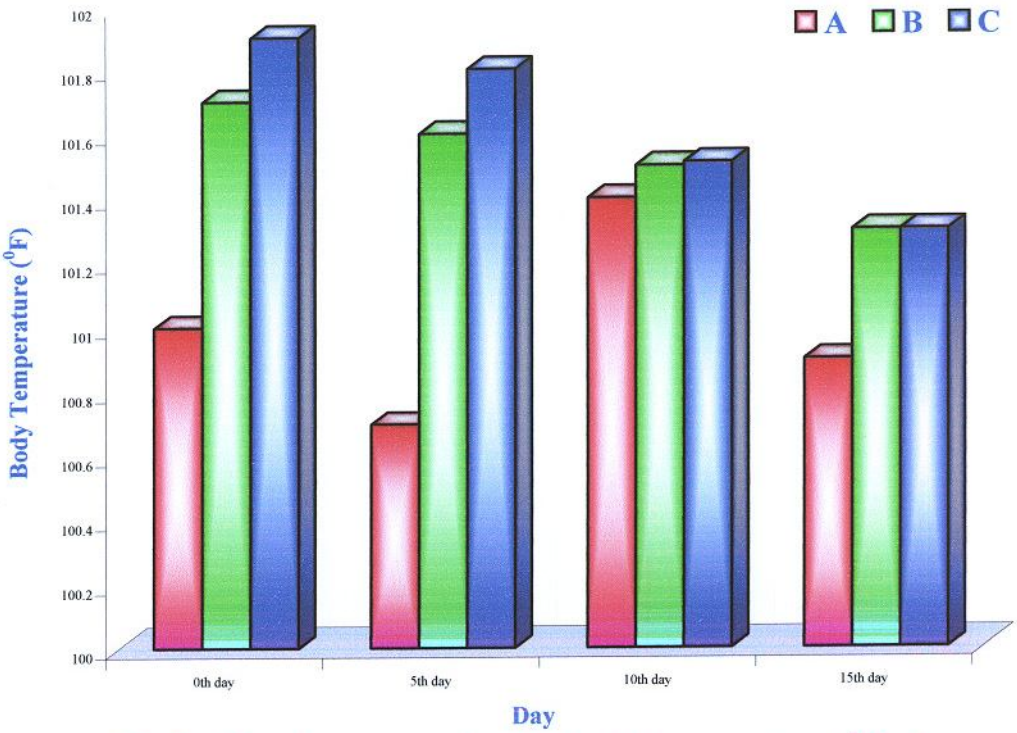


Fig. 3 : Showing mean values for body temperature (^{0}F) of three different groups of animals during pre and post operative periods

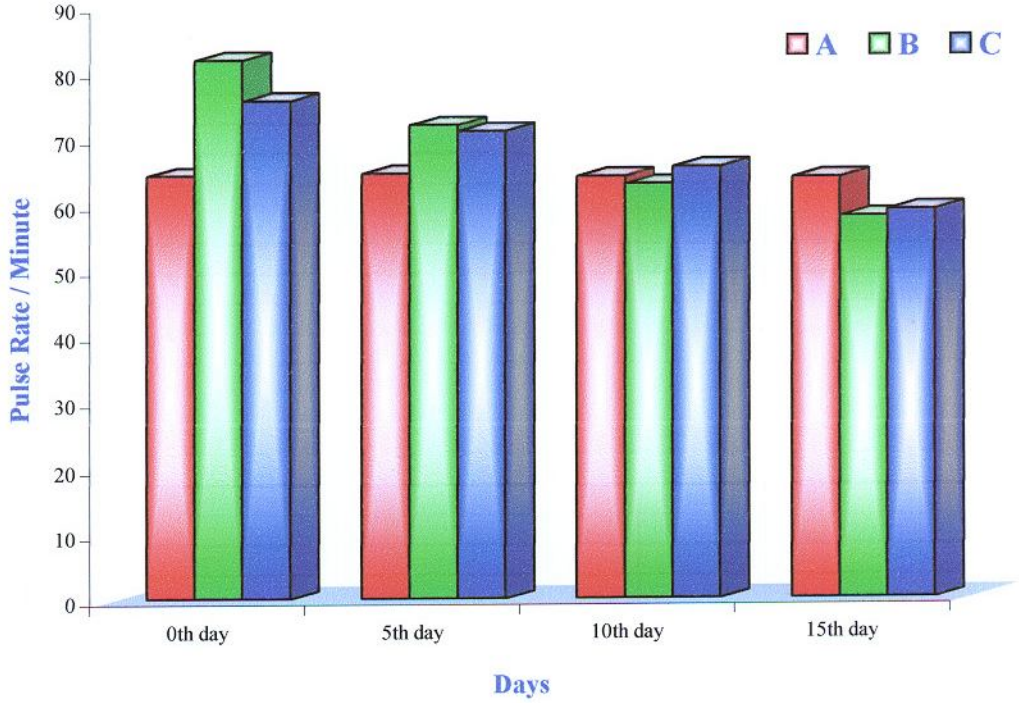


Fig. 4 : Showing mean values for pulse rate (per minute) of three different groups of animals during pre and post operative periods

and reticulum. Similar findings were reported by Singh *et al.* (1959), Singh *et al.* (1996) and Wawre (2002) in their clinical study.

4.1.6 Heart Rate/ minute

The mean values of heart rate observed in three different groups of animals before operation and 5th, 10th and 15th day after operation have been given in Table 3, depicted in Fig. 5.

Non significant difference were noticed for heart rate within the groups, however significant differences were noticed for heart rate recorded during the various periods.

The mean heart rate in control group 'A' was 68.57 ± 0.76/min, which was within the normal range reported by Radostitis (1994). The mean values of heart rate within period were apparently higher on '0' day which were 75.83 ± 2.89/ min and 80.00 ± 6.79/ min in group 'B' and group 'C', respectively as compared to control group 'A'. The significantly decreasing trend was recorded after operative treatment. The heart rate on 5th, 10th, 15th day was 70.83 ± 3.48, 74.16 ± 4.19, 67.16 ± 2.16, 65.83 ± 2.45 and 68.33 ± 2.07, 65.33 ± 3.21 per minute in group 'B' and group 'C', respectively which was almost similar to normal range.

The increase in heart rate in treatment groups on 0th day might be due to presence of large quantity of plastic material present in rumen and reticulum, which may produce chronic irritation to rumen and reticular wall and produce inflammatory reaction. Similar observation have been reported by Singh *et al.* (1959), Prasad *et al.* (1984), Aher *et al.* (1992) and Wawre (2002).

Normal heart rate was achieved on 10th day post operatively due to removal of non penetrating foreign body from the forestomach of animal.

Plate 5 : Removing the non-penetrating foreign bodies from the animal

Plate 6 : Non-penetrating foreign material recovered from the animal in group 'C'

Table 3 : Mean values for heart rate (per min.) of three different groups of animals during pre and post operative periods

Group	Periods				Pooled mean for group
	0^{th} day	5^{th} day	10^{th} day	15^{th} day	
A	71.16^{a} ± 1.77	67.16^{a} ± 1.79	68.16^{a} ± 2.31	67.83^{a} ± 1.51	68.57 ± 0.76
B	75.83^{c} ± 2.89	70.83^{abc} ± 3.48	67.16^{a} ± 2.16	68.33^{ab} ± 2.07	70.53 ± 1.66
C	80.00^{c} ± 6.79	74.16^{b} ± 4.19	65.83^{a} ± 2.45	65.33^{a} ± 3.21	71.33 ± 3.05
Pooled mean of period	75.66^{c} ± 2.08	70.71^{abc} ± 1.65	67.05^{a} ± 0.55	67.16^{ab} ± 0.75	

The values bearing the common superscript within the respective row indicates non-significant differences

Analysis of variance for heart rate

S.V.	D.F.	S.S.	M.S.S.	F. cal.
Treat	11	1315.1887	119.5625	1.941918
A	2	96.2187	48.10938	$.7813861^{NS}$
B	3	886.2812	295.4271	4.798288**
A x B	6	332.6875	55.4479	$.9005778^{NS}$
Error	60	3694.156	61.56927	
Total	71	5009.344		

** - Significant 0.1 % level CD for period = 5.25

NS - Non-significant

4.1.7 Respiration rate/ min.

The mean values of respiration rate per minute, at pre and post operative treatments and their overall mean values in all the animals of all the groups of different periodic interval for all the treatment groups are presented in Table 4 and depicted in Fig. 6.

It was observed from Table 4, that their was significant ($P<00.1$) difference between all the group i.e. A, B and C. The mean value of respiration rate/ min in group 'A' varied between 17.83 ± 0.90 to 18.33 ± 0.76 from 0^{th} day to 15^{th} day with an overall average of 18.08 ± 0.09.

In group 'B' the respiration rate was significantly higher (25.16 ± 0.70) at '0' day which gradually decreased to 21.33 ± 0.95 on 5^{th} day, 19.5 ± 0.56 on 10^{th} day and 20.00 ± 1.00 on 15^{th} day with overall mean value of 21.49 ± 1.10. Similarly, in group 'C' respiration rate was significantly higher than group 'A' and group B on '0' day, it was 33.16 ± 3.30 on 0^{th} day which gradually decreased to 24.33 ± 2.02, 21.66 ± 1.33 and 18.16 ± 0.94 at 5^{th}, 10^{th} and 15^{th} day, respectively with overall mean value of 24.32 ± 2.71.

The mean value of the respiration rate/ min for different period under various treatments were 25.49 ± 1.53, 21.22 ± 1.13, 19.66 ± 2.79, 18.83 ± 0.9 at 0^{th}, 5^{th}, 10^{th} and 15^{th} day, respectively. The respiration rate decreased post-operatively on 5^{th}, 10^{th} and 15^{th} day and returned to the normal. The result showed significant difference between pre-operative and post-operative period.

The increase in the respiration rate at zero day might be due to the increased intra abdominal pressure and subsequent decrease in respiration rate after operative treatment could be attributed to the removal of cause. Similar,

Table 4 : Mean values for respiration rate (per min.) of three different groups of animals during pre and post operative periods

Group	Periods				Pooled mean for group
	0th day	5th day	10th day	15th day	
A	18.16^{Aa} ± 0.60	18.00^{Aa} ± 0.44	17.83^{Aa} ± 0.90	18.33^{Aa} ± 0.76	18.08a ± 0.09
B	25.16^{Bb} ± 0.70	21.33^{Ab} ± 0.95	19.5^{Aa} ± 0.56	20.00^{Aa} ± 1.00	21.49^{b} ± 1.10
C	33.16^{Dc} ± 3.30	24.33^{Cc} ± 2.02	21.66^{Bb} ± 1.33	18.16^{Aa} ± 0.94	24.32^{c} ± 2.71
Pooled mean of period	25.49^{D} ± 3.53	21.22^{BC} ± 1.49	19.66^{AB} ± 0.90	18.83^{A} ± 0.42	

The values bearing the common capital alphabets within the respective row and common small alphabets within the respective coloumn indicate non-significant differences

Analysis of variance for respiration rate

S.V.	D.F.	S.S.	M.S.S.	F. cal.
Treatment	11	1328.277	120.7525	10.7975
A	2	470.1094	235.0547	21.0183**
B	3	475.168	158.3893	14.1629**
A x B	6	383	63.8333	5.707899**
Error	60	671	11.18333	
Total	71	1999.277		

** - Significant 0.1 % level

CD for treatment = 1.93

CD for period = 2.23

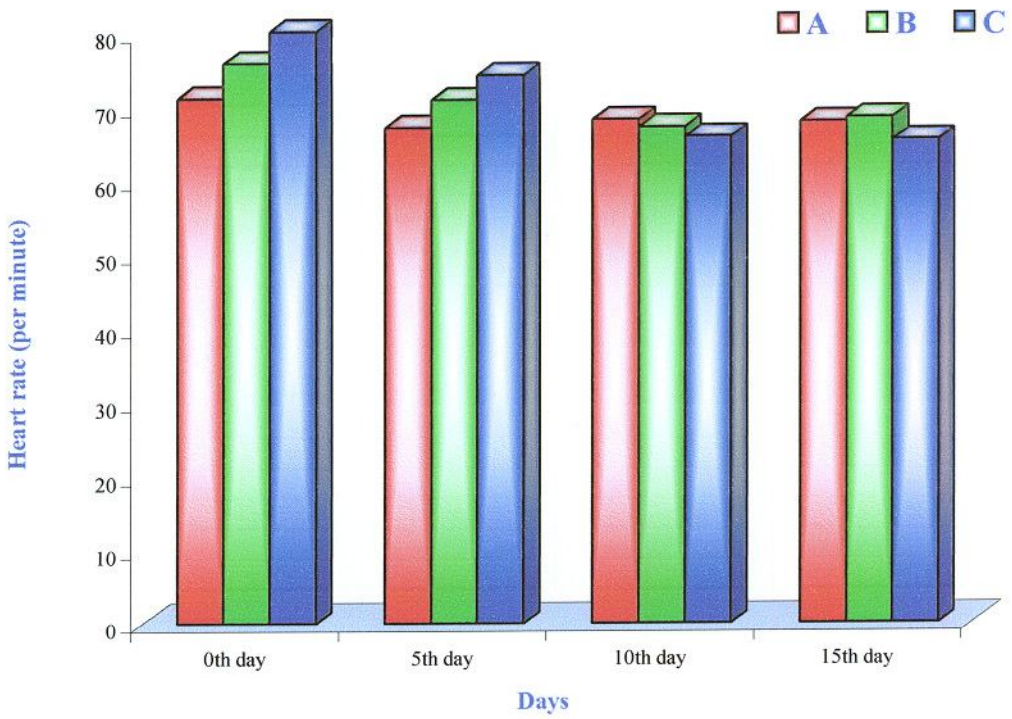


Fig. 5 : Showing mean values for heart rate (per min.) of three different groups of animals during pre and post operative periods

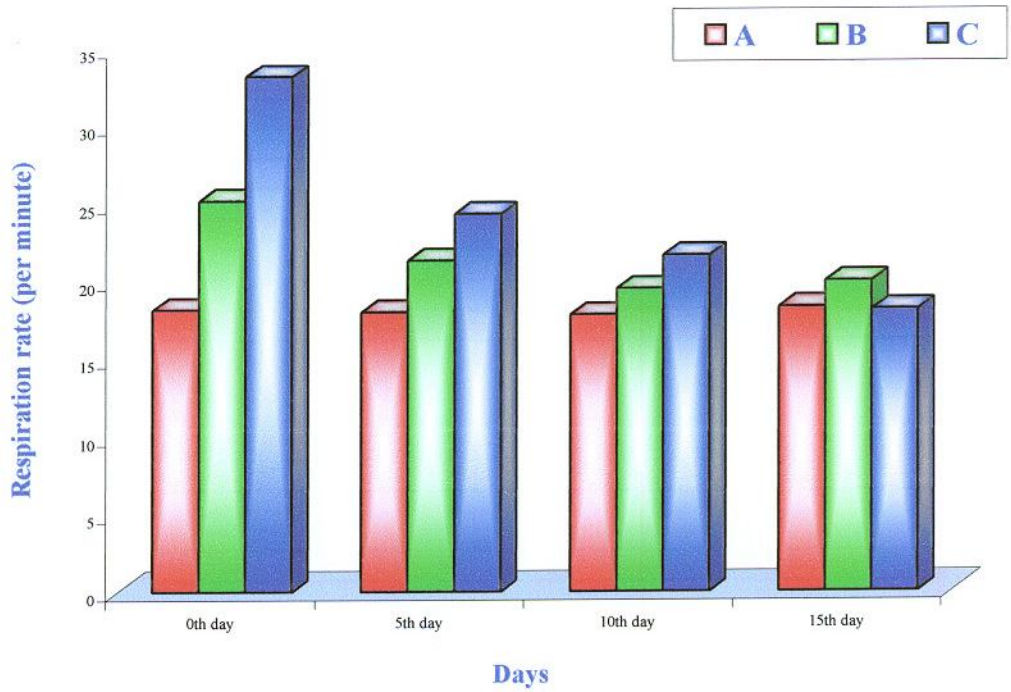


Fig. 6 : Showing mean values for respiration rate (per minute) of three different groups of animals during pre and post operative periods

findings were reported by Singh (1959), Dandge (1993) Gadakh (1996) and Wawre (2002).

4.1.8 Ruminal movement/ 5 min

The mean values of ruminal movement per 5 min. observed in all groups of animals at different intervals have been given in Table 5 and depicted Fig. 7.

The mean values of ruminal movement for different groups at various intervals were found to be highly significant ($P<0.01$) and the ruminal movements were found to be severely affected in the study.

The ruminal movement in control group 'A' were in range of 7.16 ± 0.83 to 7.5 ± 0.42 per 5 minute. Which was with in normal physiological range. During the pre operative period i.e. at '0' day the mean values of the ruminal movements in group 'B' and group 'C' were 3.66 ± 0.42 and 1.83 ± 0.30 per 5 minute, respectively which were significantly ($P<0.01$) lower than normal. Further the pre-operative value of ruminal motility in group 'C' was significantly lower than the value of group 'B' indicating poor ruminal motility in group 'C'. The pre-operative values of the ruminal movement 3.66 ± 0.42/ 5min and 1.83 ± 0.30/ 5 min. in group 'B' and 'C' were raised to 5.00 ± 0.77/5 min and 5.16 ± 0.47/ 5 min. on 5^{th} day, 5.83 ± 0.70 and 5.66 ± 0.21 per 5 minute on 10^{th} day and 6.50 ± 0.22 and 7.5 ± 0.42 per 5 minute on 15^{th} day post operative treatment, respectively. These changes indicated significant increase in ruminal movement during post operative period.

It was observed that ruminal movements per 5 min. were significantly reduced in group 'B' and 'C' according to percentage of non-penetrating foreign bodies in forestomach as compared to 'A' group. At zero day

Table 5 : Mean values for ruminal movement (per 5 min.) of three different groups of animals during pre and post operative periods

Group	Periods				Pooled mean for group
	0th day	5th day	10th day	15th day	
A	7.16^{Ac} ± 0.83	7.33^{Ab} ± 0.80	7.33^{Ab} ± 0.55	7.50^{Ab} ± 0.42	7.33^{b} ± 0.06
B	3.66^{Ab} ± 0.42	5.00^{Ba} ± 0.77	5.83^{Ca} ± 0.70	6.50^{Ca} ± 0.22	5.24^{a} ± 0.52
C	1.83^{Aa} ± 0.30	5.16^{Ba} ± 0.47	5.66^{Ba} ± 0.21	7.5^{Cb} ± 0.42	5.03^{a} ± 1.02
Pooled mean of period	4.21^{A} ± 1.27	5.83^{B} ± 0.61	6.27^{BC} ± 0.43	7.16^{C} ± 0.27	

The values bearing the common capital alphabets within the respective row and common small alphabets within the respective coloumn indicate non-significant differences

Analysis of variance for ruminal movement

S.V.	D.F.	S.S.	M.S.S.	F. cal.
Treatment	11	204.7083	18.60984	10.04428
A	2	77.08325	38.54163	20.80206**
B	3	82.15283	27.38428	14.78011**
A x B	6	45.47217	7.578695	4.090447**
Error	60	111.1668	1.852779	
Total	71	315.875		

** - Significant 0.1 % level

CD for treatment = 0.78

CD for period = 0.91

i.e. prior to surgical operation the ruminal motility was found to be clinically important in the present study. It was significantly reduced in group 'C' as compared to 'B', probably associated with the presence of huge amount of non-penetrating foreign bodies in the rumen and reticulum. The contractions of reticulum are basically initiated from the biphasic contraction (Blood and Handerson, 1979 and Garry, 1990). Presence of huge amount of foreign bodies in forestomach probably hampered the initiation of biphasic contraction of reticulum through the vagus nerve to produce subsequent hypomotility and atony of rumen. The results are in agreement with Dandge (1993), Khachane (1993), and Thorat (1997).

Increase in the ruminal movement for successive period of 0 to 15 day in animals of group 'B' and group 'C' could be attricuted due to the removal of non-penetrating foreign bodies from forestomach, stimulation of vagus nerve during ruminotomy operation and correction of pH and subsequent stabilization of rumen microflora which lead to improvement in digestion and motility of rumen. (Wawre, 2002).

4.1.9 Reticular biphasic contraction time (second)

The mean values of reticular biphasic contraction time in seconds, observed in three different groups of animal during pre-operative '0' day, 5th day, 10th day and 15th day post operative period have been given in Table 6 and depicted in Fig. 8.

It was observed from the Table 6. that the mean values for reticular biphasic contraction time (second) varied significantly ($P<0.01$) between the various treatment and period. In control group 'A', the mean values of reticular biphasic contraction time were in range of 7.83 ± 0.47 sec. to 11.00 ±

Plate 7 : Animal in Group B along with recovered foreign material

Plate 8 : Animal showing sign of recovery

0.89 sec. with over all average mean of 9.29 ± 0.57 sec., which was within normal physiological range. During the pre-operative period ('0' day) the reticular biphasic contraction time was significantly ($P<0.01$) higher in group 'B' and group 'C' as compard to control group 'A'. The mean values of reticular biphasic contractions time on zero day in group 'B' was 22.00 ± 2.08 sec. and in group 'C' 27.16 ± 3.40 sec. It indicated that reticular biphasic contraction time was increased in animals which had consumed large amount foreign material .

A decreasing trend in reticular biphasic contraction time was observed on 5^{th}, 10^{th} and 15^{th} day post operatively in group 'B' and 'C' and the values returns to normal physiological range on 10^{th} day.

The mean reticular biphasic contraction time in group 'B' and 'C' was comparable, however significant differences were noticed on 0^{th} day among these two groups. It is observed that in animals of group 'C' consuming large amount of plastic i.e. 10 per cent and above per 100 kg body weight required more time for reticular biphasic contractions as compared to group 'B' in which amount of plastic was 5-10 per cent. Prasad (1979) reported that increase biphasic contraction time was due to presence of foreign body which blocked the reticulo ruminal orifice. Hence, increase in reticular biphasic contraction time was observed, and it was towards normal range post operatively after removal of non-penetrating foreign bodies from ruminoreticular passage. In the present investigation similar findings were observed in group 'B' and 'C'. Which are in agreement with Dandge (1993), Khachane (1993) and Thorat (1997).

Table 6 : Mean values for reticular biphasic contraction time (second) of three different groups of animals during pre and post operative periods

Group	Periods				Pooled mean for group
	0th day	5th day	10th day	15th day	
A	11.00^{Ba} ± 0.89	9.50^{ABa} ± 0.42	8.83^{ABab} ± 0.47	7.83^{Aa} ± 0.47	9.29^{a} ± 0.57
B	22.00^{Cb} ± 2.08	16.33^{Bb} ± 1.64	8.33^{Aa} ± 0.91	7.66^{Aa} ± 0.49	13.58^{b} ± 2.96
C	27.16^{Cc} ± 3.40	16.66^{Bb} ± 1.60	10.50^{Ab} ± 1.54	8.33^{Aa} ± 0.55	15.66^{b} ± 3.65
Pooled mean of period	20.05^{C} ± 3.89	14.16^{B} ± 1.90	9.22^{A} ± 0.53	7.94^{A} ± 0.16	

The values bearing the common capital alphabets within the respective row and common small alphabets within the respective coloumn indicate non-significant differences

Analysis of variance for reticular biphasic contraction time

S.V.	D.F.	S.S.	M.S.S.	F. cal.
Treatment	11	2667.152	242.4684	18.3187
A	2	507.1944	253.5972	19.15949**
B	3	1635.819	545.2731	41.19586**
A x B	6	524.167	87.35644	6.599855**
Error	60	794.167	13.23612	
Total	71	3461.319		

** - Significant 0.1 % level

CD for treatment = 2.10

CD for period = 2.43

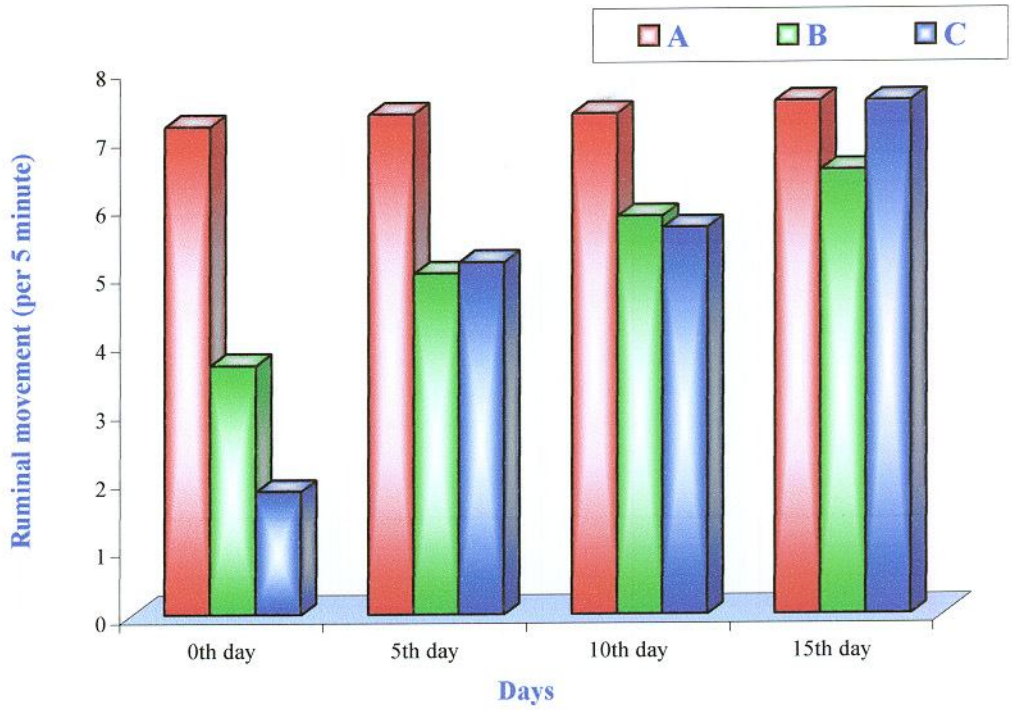


Fig. 7 : Showing mean values for ruminal movement (per 5 min.) of three different groups of animals during pre and post operative periods

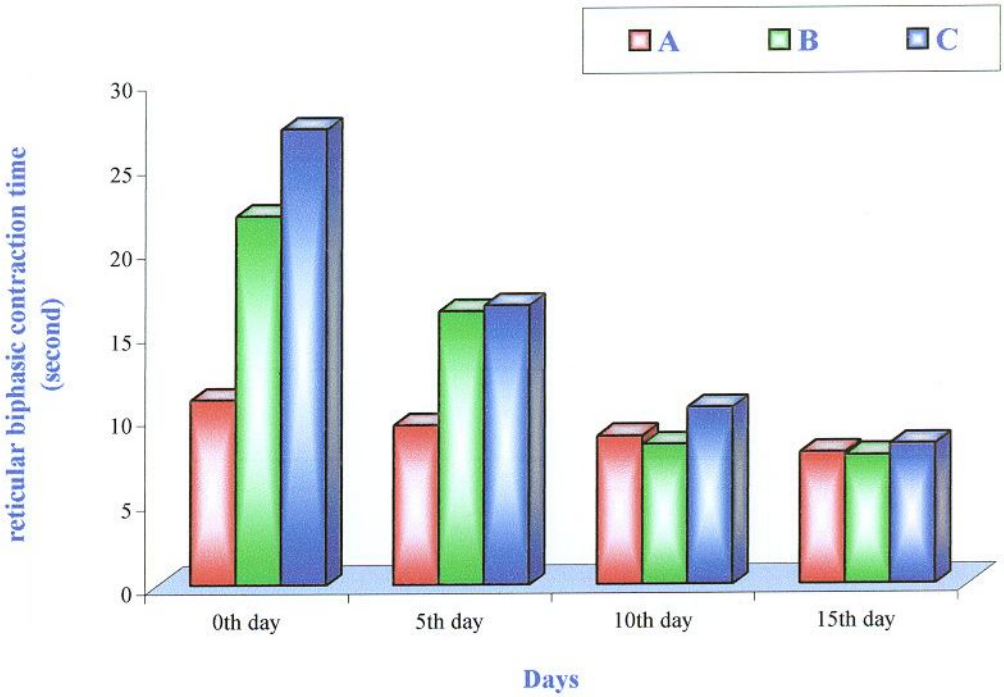


Fig. 8 : Showing mean values for reticular biphasic contraction time (second) of three different groups of animals during pre and post operative periods

Rumen liquor pH ale -

4.1.10 pH of rumen liquor

The mean values of pH of rumen liquor of all the animals of group 'A', 'B' and 'C' during pre-operative and 5th, 10th and 15th day post-operatively are presented in Table 7 depicted in Fig. 9.

The mean values for ruminal pH recorded during different period for group 'A', 'B' and 'C' were 6.65 ± 0.04, 7.10 ± 0.27 and 7.17 ± 0.29, respectively. The ruminal pH of treatment group was significantly ($P<0.01$) higher than control group 'A'. However, the differences of both the treatment group were comparable. The ruminal pH was found to be decreased significantly ($P<0.01$) from 0th day to 15th day post-operatively in both the treatments. However, the pH value for 10th and 15th day were comparable for the treatment. The pH values for control group did not show any significant difference and were comparable during the various period of the study.

The pH values for control group 'A' were within normal range reported by Radostitis (1994) . The increasing pH of rumen liquor could be attributed to the reduction in total volatile fatty acid concentration due to disturbed microbial activity and reduction in total protozoal count as reported by Misra and Tripathy (1963). Mohanty *et al.* (1977), also reported increased rumen liquor pH due to indigestion as result of presence of foreign bodies in rumen. In impaction and alkaline indigestion predominance of gram negative bacilli are responsible for increasing pH from normal range to alkaline range (Singh and Rathod, 1977). Change in ruminal pH from normal i.e. 6.76 to 8.60 towards either acidic or alkaline side indicate disturbance in ruminal microbial activity (Arora, 1983). Increase in pH of rumen liquor could also be due to poor buffering

Table 7 : Mean values for ruminal pH of three different groups of animals during pre and post operative periods

Group	Periods				Pooled mean for group
	0th day	5th day	10th day	15th day	
A	6.53^{Aa} ± 0.08	6.65^{Aa} ± 0.10	6.76^{Aa} ± 0.08	6.68^{Aa} ± 0.10	6.65^{a} ± 0.04
B	7.88^{Cb} ± 0.22	7.23^{Bb} ± 0.15	6.65^{Aa} ± 0.15	6.46^{Aa} ± 0.13	7.1^{b} ± 0.27
C	8.06^{Cb} ± 0.27	7.35^{Bb} ± 0.23	6.7^{Aa} ± 0.13	6.58^{Aa} ± 0.10	7.17^{b} ± 0.29
Pooled mean of period	7.49^{D} ± 1.73	7.07^{C} ± 1.73	6.70^{A} ± 0.12	6.57^{A} ± 1.72	

The values bearing the common capital alphabets within the respective row and common small alphabets within the respective coloumn indicate non-significant differences

Analysis of variance for ruminal pH

S.V.	D.F.	S.S.	M.S.S.	F. cal.
Treatment	11	19.86851	1.769864	11.30123
A	2	3.52417	1.762085	11.25156**
B	3	9.183838	3.061279	19.54739**
A x B	6	6.760498	1.12675	7.19471**
Error	60	9.396484	0.1566081	
Total	71	28.86499		

** - Significant 0.1 % level

CD for treatment = 0.22

CD for period = 0.26

capacity of rumen fluid against production of large quantity of ammonia. (Sahu *et al.*, 1993).

During post-operative treatment from 0th day to onward period rumen liquor pH was restored to normal due to removal of foreign bodies and drenching of fresh rumen cud along with bolus of live yeast culture and 3 % acetic acid @ 500 ml for 5 days for correction of rumen microflora.

4.1.11 Total protozoal count (10^5/cmm) (c) Microflora Count

The mean values of total protozoal count x 10^5/ cmm in strained rumen liquor of animals at different periodic interval for all the treatment groups are presented in Table 8 and depicted in Fig. 10.

Significant differences ($P<0.01$) were observed for total protozoal count between different treatment. The mean values for total protozoal count for the group 'A', 'B' and 'C' were 7.15 ± 0.07, 5.06 ± 0.90 and 5.12 ± 0.93 x 10^5/ cmm, respectively. The total protozoal count significantly ($P<0.01$) increased from 0th day (2.45 ± 0.27 x 10^5/ cmm) to 15th day (6.93 ± 0.36 x 10^5/ cmm) in group 'B' as well as in group 'C' from 2.57 ± 0.45 x 10^5/ cmm (0th day) to 7.13 ± 0.27 x 10^5/ cmm (15th day). The total protozoal count for the control group 'A' was comparatively similar from 0th day to 15th day of study. The normal total protozoal count observed on 10th day post-operatively in both the groups 'B' and 'C' which was also comparable with the total protozoal count of 15th day post operatively in either treatment.

The reduction in total protozoal count on 0th day in both the treatment might be due to putrification of ruminal ingesta (Sethuraman and Rathor, 1979), due to presence of non-penetrating foreign body in rumen causing alkaline indigestion and loss of motor functions of ruminoreticular

Table 8 : Mean values for total protozoal count (1 x 10^5/ cmm) of three different groups of animals during pre and post operative periods

Group	Periods				Pooled mean for group
	0^{th} day	5^{th} day	10^{th} day	15^{th} day	
A	7.13^{Ab} ± 0.09	7.10^{Ab} ± 0.12	6.97^{Aa} ± 0.14	7.40^{Aa} ± 0.27	7.15^{b} ± 0.07
B	2.45^{Aa} ± 0.27	4.34^{Ba} ± 0.42	6.53^{Ca} ± 0.74	6.93^{Ca} ± 0.36	5.06^{a} ± 0.90
C	2.57^{Aa} ± 0.45	4.15^{Ba} ± 0.36	6.66^{Ca} ± 0.20	7.13^{Ca} ± 0.27	5.12^{a} ± 0.93
Pooled mean of period	4.05^{A} ± 1.25	5.19^{B} ± 0.77	6.72^{C} ± 0.10	7.15^{C} ± 0.11	

The values bearing the common capital alphabets within the respective row and common small alphabets within the respective coloumn indicate non-significant differences

Analysis of variance for total protozoal count

S.V.	D.F.	S.S.	M.S.S.	F. cal.
Treatment	11	229.3621	20.8511	27.38443
A	2	67.64746	33.82373	44.42181**
B	3	109.9697	36.65658	48.14228**
A x B	6	51.74488	8.624146	11.32637**
Error	60	95.68531	0.7614218	
Total	71	275.0474		

** - Significant 0.1 % level

CD for treatment = 0.50

CD for period = 0.58

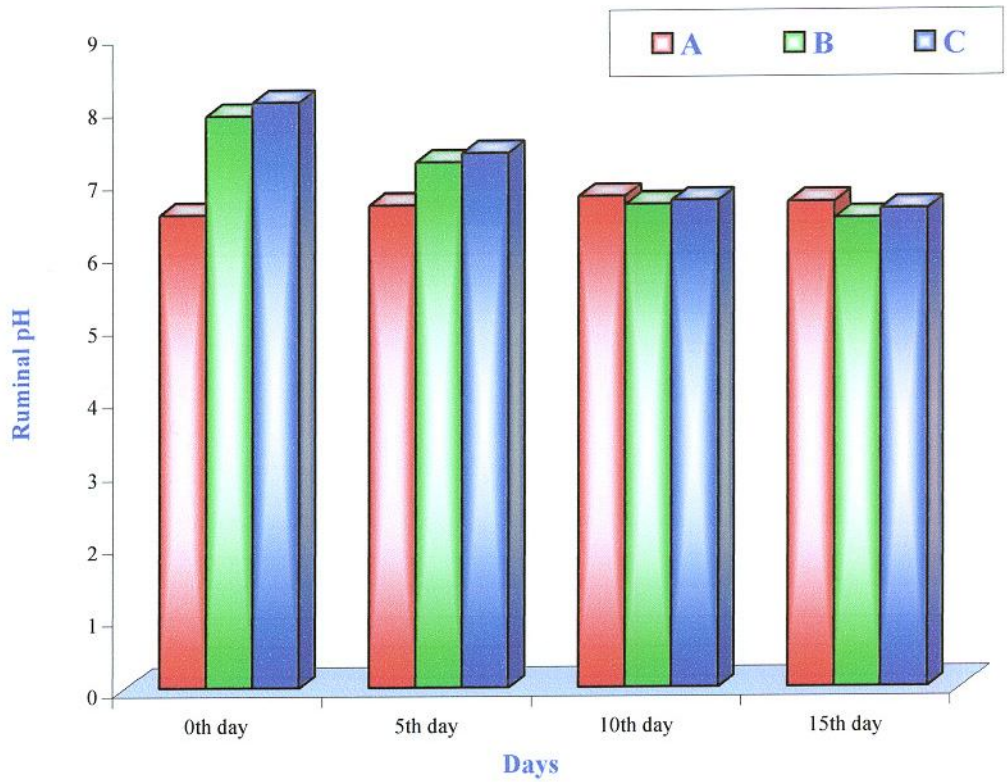


Fig. 9 : Showing Mean values for ruminal pH of three different groups of animals during pre and post operative periods

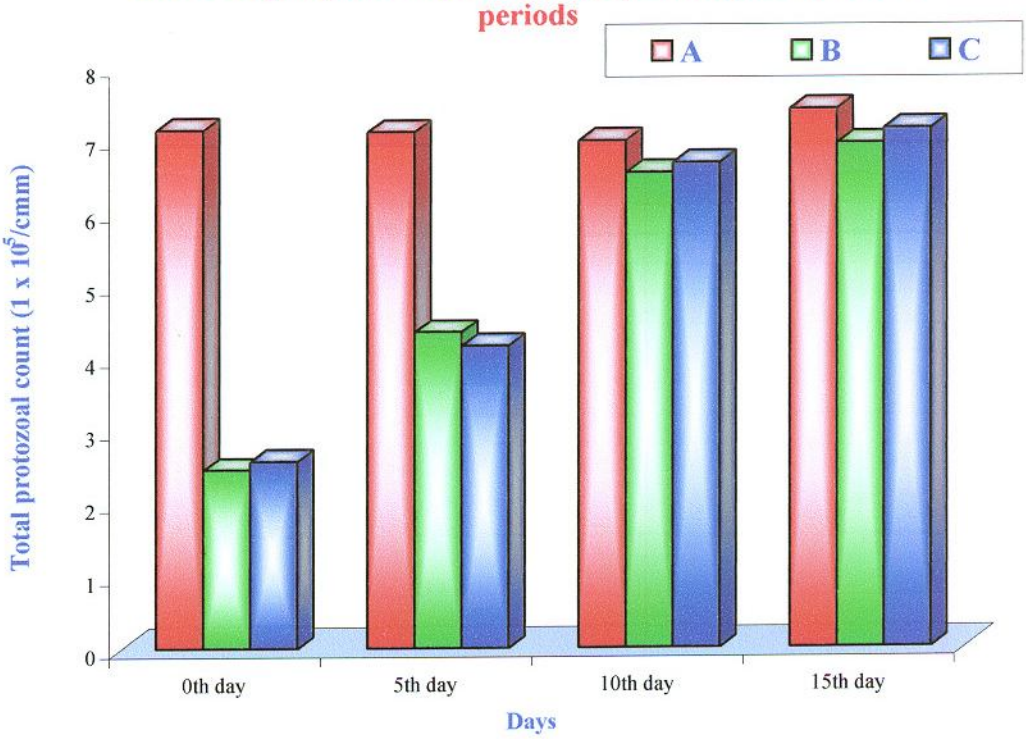


Fig. 10 : Showing mean values for total protozoal count (1 x10^5/ cmm) of three different groups of animals during pre and post operative periods

neuromusculature resulting in ruminal stasis (Misra and Tripathy, 1963 and Joshi and Misra, 1977).

The rise in protozoal count near to normal during post-operative treatment period might be due to elimination of foreign bodies and ultimately elimination of toxic putrefactive ingredients from rumen and reticulum and also due to the supportive treatment with fresh rumen cud and bolus of live yeast culture.

4.1.12 Total volatile fatty acids (m.mol/ 100 ml SRL)

The mean values of total volatile fatty acid (m. mol/100 ml SRL) of animals at different periodic intervals for all the different treatment groups are presented in Table 9 and depicted in Fig. 11.

Significant ($P<0.01$) differences were noticed for total volatile fatty acids between the different group's obtained during various period. The mean T.V.F.A. concentrations were 11.62 ± 0.12, 9.10 ± 1.17 and 8.00 ± 1.40 m. mol./100 ml SRL, for group 'A', 'B' and 'C', respectively. The significant decrease was observed on 0^{th} day (5.57 ± 0.42) m. mol/ 100 ml SRL) for T.V.F.A. concentration. However, the increasing trend was observed from 0^{th} day to 15^{th} day (11.33 ± 0.30 m.mol./100 ml SRL) in group B. Similar increasing trend was also noticed in the group 'C' which is having presence of 10 per cent and above (per 100 kg body weight) foreign body from 3.67 ± 0.41 m.mol/100 ml SRL to 10.73 ± 0.52 m.mol./100 ml SRL. The mean T.V.F.A. concentration on 10^{th} day and 15^{th} day was comparable in group 'B' as well as in group 'C'.

The decrease in T.V.F.A. concentration observed in group 'B' and 'C' might be due to the reduction in ruminal microbial activity because of the non-penetrating foreign body that resulted in increased pH which is negatively

Table 9 : Mean values for total volatile fatty acids (m.mol/100 ml SRL) of three different groups of animals during pre and post operative periods

Group	Periods				Pooled mean for group
	0^{th} day	5^{th} day	10^{th} day	15^{th} day	
A	11.68^{Ac} ± 0.54	11.95^{Ac} ± 0.29	11.26^{Ab} ± 0.51	11.60^{Ab} ± 0.50	11.62^{c} ± 0.12
B	5.57^{Ab} ± 0.42	8.41^{Bb} ± 0.28	11.10^{Cb} ± 0.45	11.33^{Cb} ± 0.30	9.10^{b} ± 1.17
C	3.67^{Aa} ± 0.41	7.40^{Ba} ± 0.79	10.23^{Ca} ± 0.69	10.73^{Ca} ± 0.52	8.00^{a} ± 1.40
Pooled mean of period	6.97^{A} ± 1.97	9.25^{B} ± 1.12	10.86^{C} ± 0.26	11.22^{C} ± 0.20	

The values bearing the common capital alphabets within the respective row and common small alphabets within the respective coloumn indicate non-significant differences

Analysis of variance for total volatile fatty acid

S.V.	D.F.	S.S.	M.S.S.	F. cal.
Treatment	11	486.8428	44.25844	29.32437
A	2	164.8901	8246908	54.62641**
B	3	202.4072	19.92424	44.70363**
A x B	6	119.5454	1.509253	13.20139**
Error	60	90.55518		
Total	71	577.398		

** - Significant 0.1 % level

CD for treatment = 0.71

CD for period = 0.82

correlated with T.V.F.A. production (Radostitis *et al.*, 1994). However, Singh *et al.* (1997) reported that alkalinity inhibit the ruminal muscular activity by acting on rumen wall and reducing production and disappearance of T.V.F.A. from rumen.

The reduction in T.V.F.A. concentration may also be due to the significant increase in pH and ammonia nitrogen value, which accounted for change in rumen microbial population resulting in marked reduction in digestibility and fermentation process (Ahuja *et al.*, 1989).

The pre operative treatment values of group 'B' and 'C' were significantly increased on 5^{th}, 10^{th} and 15^{th} day post operative treatment period indicating increasing trend in T.V.F.A. after operation.

The mean values for T.V.F.A. were within normal range within a period of 10-15 days post-operatively might be due to the restoration of normal rumen function after removing the etiology.

4.1.13 Ammonia nitrogen (mg/ 100 ml SRL)

The mean values of the ammonia nitrogen in rumen liquor of three different groups of animals pre-operative treatment periods have been presented in Table 10 and depicted in Fig. 12.

The mean values for ammonia nitrogen estimated from rumen liquor were 12.89 ± 0.23 mg/100 ml SRL, 15.21 ± 1.05 mg/100 ml SRL and17.36 ± 1.83 mg/100 ml SRL for groups 'A', 'B' and 'C', respectively with significant ($P<0.01$) variation within different groups. The ammonia nitrogen values significantly reduced from 0^{th} day (18.18 ± 0.64 mg/100 ml SRL) to 15^{th} day (12.6 ± 0.54 mg/100 ml SRL) in group B. Similar trend was also observed from (22.63 ± 0.91 mg/100 ml SRL) to (14.16 ± 0.88 mg/100 ml SRL) in group 'C'.

Table 10 : Mean values for ammonia nitrogen (mg/100 ml SRL) of three different groups of animals during pre and post operative periods

Group	Periods				Pooled mean for group
	0^{th} day	5^{th} day	10^{th} day	15^{th} day	
A	13.05^{ABa} ± 8.38	13.16^{ABa} ± 0.26	12.11^{Aa} ± 0.39	13.27^{Bab} ± 0.23	12.89^{a} ± 0.23
B	18.18^{Db} ± 0.64	16.06^{Cb} ± 0.59	14.01^{Bb} ± 0.54	12.6^{Aa} ± 0.54	15.21^{b} ± 1.05
C	22.63^{Cc} ± 0.91	18.01^{Bc} ± 1.09	14.67^{Ab} ± 1.06	14.16^{Ab} ± 0.88	17.36^{c} ± 1.83
Pooled mean of period	17.95^{D} ± 2.49	15.75^{C} ± 1.15	13.59^{A} ± 0.62	13.34^{A} ± 0.47	

The values bearing the common capital alphabets within the respective row and common small alphabets within the respective coloumn indicate non-significant differences

Analysis of variance for ammonia nitrogen

S.V.	D.F.	S.S.	M.S.S.	F. cal.
Treatment	11	627.3379	57.03072	19.89715
A	2	241.3672	120.6836	42.10467**
B	3	248.4317	82.81055	28.89134**
A x B	6	137.5391	22.92218	7.997547**
Error	60	171.9766	2.866276	
Total	71	799.3145		

** - Significant 0.1 % level

CD for treatment = 0.98

CD for period = 1.13

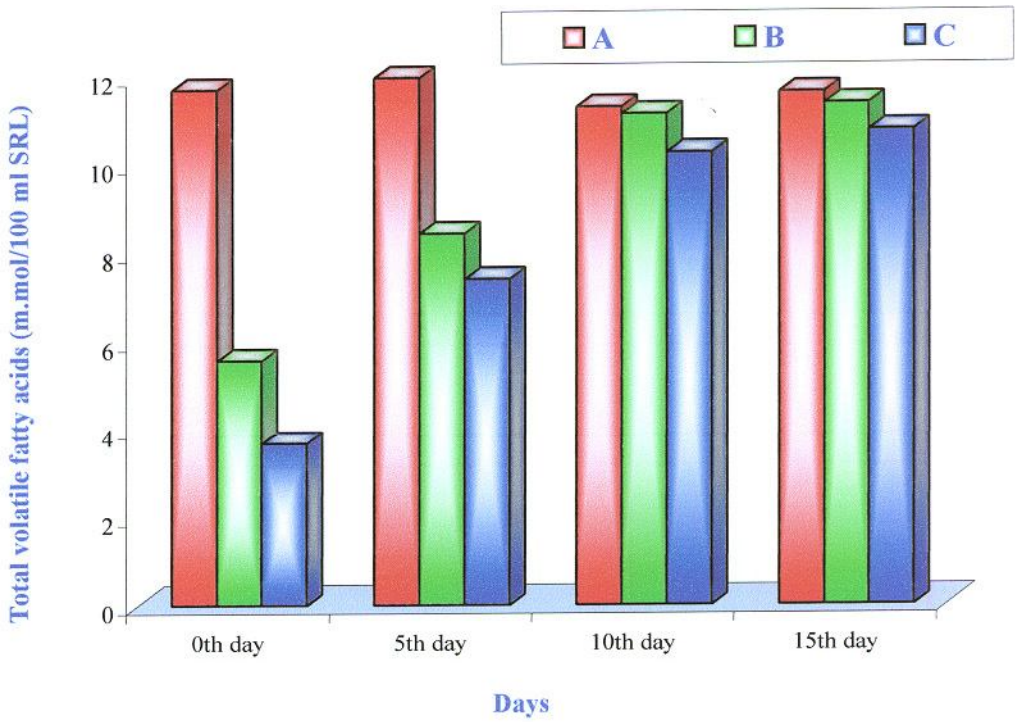


Fig. 11 : Showing mean values for total volatile fatty acids (m.mol/100 ml SRL) of three different groups of animals during pre and post operative periods

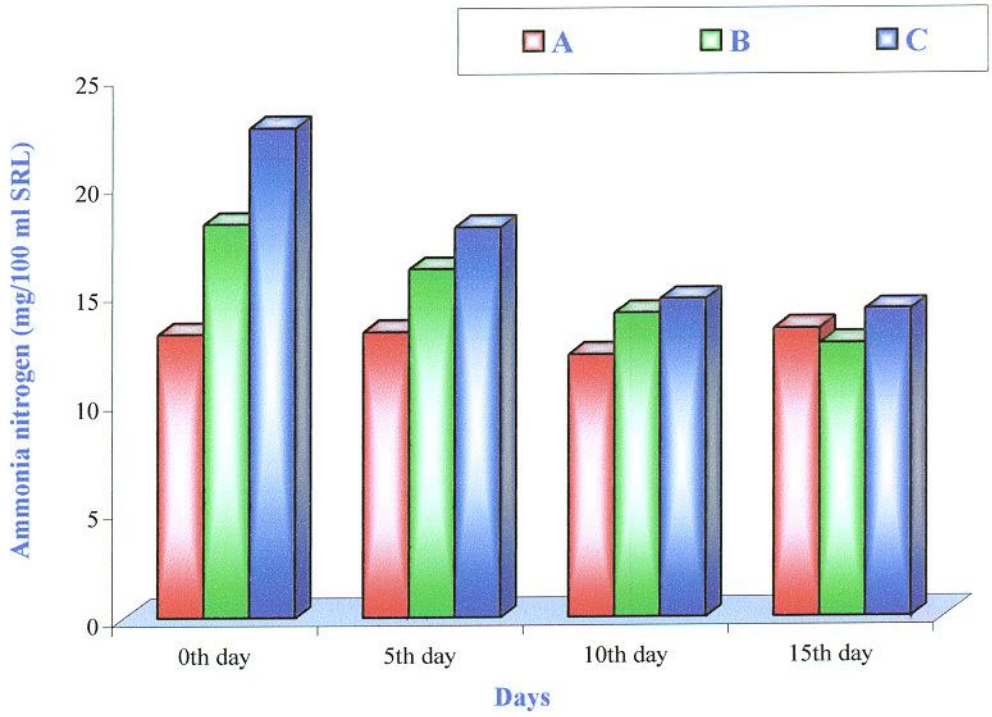


Fig. 12 : Showing mean values for ammonia nitrogen (mg/100 ml SRL) of three different groups of animals during pre and post operative periods

However, the ammonia nitrogen observed for 10th and 15th day post operatively was comparable in group 'C'.

Whenever the available Carbohydrates in the ration are inadequate, the amino acids arising from protein degradation in the rumen deaminate to give rise to ammonia (Langar, 1959). Increase in ammonia nitrogen content of group 'B' and 'C' at zero day might be due to the ruminal atony and interference in the absorption of ruminal ammonia nitrogen as reported by Jones (1982). Significant increase in ruminal ammonia nitrogen concentrations observed in the study could be due to rapid microbial hydrolysis of urea which occurred faster than assimilation of the liberated ammonia. (Ahuja *et al.*, 1989). Similar observation have also been reported by Sahu *et al.* (1993) and Venkateshwarlu (1998).

Post operative values of ammonia nitrogen during 5th, 10th and 15th day were significantly lower than their pre-operative values in both group 'B' and 'C'. These changes indicated decreasing trend in ammonia nitrogen after operation. This decreasing trend was observed in 5th, 10th and 15th day after removal of etiology may be due to improvement in digestion and ruminal atony which led to increase in the pH, whereas total protozoal count and improve metabolic function of body.

4.1.14 Blood glucose (mg/dl)

The mean values of blood glucose (mg/dl) and their overall mean values at different periodic intervals for all the different treatment groups are presented in Table 11 and depicted in Fig 13.

It was observed from Table 11, that the blood glucose varied significantly ($P<0.01$) between the different groups as well as within the pre-operative and post-operative periods.

The average mean values of blood glucose estimated during various periods for group 'A', 'B' and 'C' were 40.54 ± 0.48 mg/dl, 50.89 ± 2.25 mg/dl and 61.51 ± 5.14 mg/dl respectively. The blood glucose values were significantly ($P<0.01$) higher in group 'C' (79.18 ± 1.88 mg/dl) with the presence of 10 per cent and above (per 100 kg body weight) foreign body and in group 'B; (58.03 ± 1.78 mg/dl) with the presence of 5-10 per cent (per 100 kg body weight) foreign body as compared to control group 'A' (42.20 ± 0.62 mg/dl) on 0^{th} day (pre-operative) of experiment. The mean blood values of blood glucose in both the treatment groups reduced to normal on 15^{th} day post-operatively of the study that is 50.67 ± 3.44 mg/dl and 57.59 ± 3.75 mg/dl in group 'B' and 'C' respectively. It is observed that with in the control group 'A' the blood glucose values did not show significant difference through out the study.

It was observed that in group 'B' and 'C' the blood glucose values were increased at 0 day of the experiment. It might be due to stress over animal resulted from digestive disorder which leads to release larger quantities of adrenocorticoids resulting in hyperglycemia in animals showing indigestion due to digestive disorders (Singh *et al.*, 1996). Strawtiz *et al.* (1961) reported that increase in blood glucose levels might be due to suppression of insulin release and increased production of glucose in liver. While Venkateswarlu (1998) reported that decrease utilization of glucose as a result of impairment of T.C.A. cycle or stimulated glycogenolysis in the liver. The increase in ammonia nitrogen content might also be a contributing factor for hyperglycaemia, also the glucose

Table 11 : Mean values for blood glucose (mg/dl) of three different groups of animals during pre and post operative periods

Group	Periods				Pooled mean for group
	0th day	5th day	10th day	15th day	
A	42.20^{Aa} ± 0.62	40.28^{Aa} ± 0.27	40.02^{Aa} ± 0.60	39.68^{Aa} ± 0.55	40.59^{a} ± 0.48
B	58.03^{Cb} ± 1.78	49.20^{ABb} ± 0.99	45.68^{Ab} ± 1.23	50.67^{Bb} ± 3.44	50.89^{b} ± 2.25
C	79.18^{Cc} ± 1.88	55.59^{ABc} ± 4.19	53.70^{Ac} ± 3.23	57.59^{Bc} ± 3.75	61.51^{c} ± 5.14
Pooled mean of period	59.80^{B} ± 8.74	48.35^{A} ± 3.62	46.46^{A} ± 3.24	49.31^{A} ± 4.25	

The values bearing the common capital alphabets within the respective row and common small alphabets within the respective coloumn indicate non-significant differences

Analysis of variance for blood glucose

S.V.	D.F.	S.S.	M.S.S.	F. cal.
Treatment	11	8329.375	757.2159	23.45381
A	2	5278.297	2639.149	81.7443**
B	3	1947.234	649.0781	20.10438**
A x B	6	1103.844	183.974	5.698361**
Error	60	1937.125	32.28542	
Total	71	10266.5		

** - Significant 0.1 % level

CD for treatment = 3.29

CD for period = 3.80

might be poorly utilized by the tissues due to toxic metabolic products and adrenal secretion might have also been stimulated.

The decrease in blood glucose after operative treatment could be attributed to elimination of stress due to indigestion from the animals.

4.1.15 Serum calcium (mg/dl)

The mean values of serum calcium (mg/dl) and their overall mean values at different periodic intervals for all the different treatment groups are presented in Table 12 and depicted in Fig 14.

It was observed form Table 12, that serum calcium (mg/dl) varied significantly ($P<0.01$) between the treatment and within pre-operative and post operative periods.

The serum calcium level in control group 'A' were in range of 9.83 ± 0.20 mg/dl to 10.10 ± 0.33 mg/dl with an overall mean of 9.97 ± 0.05 mg/dl which was with in normal range reported by Radostitis *et al.* (1994). The mean values of serum calcium estimated during various periods for group 'A', 'B' and 'C' were 9.97 ± 0.05 mg/dl, 8.94 ± 0.65 mg/dl and 6.95 ± 0.43 mg/dl respectively. The serum calcium values were significantly ($P<0.01$) lower in group 'C' (5.91 ± 0.27 mg/dl) with the presence of 10 per cent and above (per 100 kg body weight) foreign body and in group 'B' (7.56 ± 0.23 mg/dl) with presence of 5-10 per cent (per 100 kg body weight) foreign body as compared to control group 'A' (9.83 ± 0.20 mg/dl) on 0 day of experiment. It shows significant variation between both treatment group.

Radostitis *et al.* (1994) reported that calcium and phosphorous metabolism in animals was influenced by parathyroid hormone, calcitonin and Vit. D. The parathyroid hormone secreted in response to hypocalcaemia stimulate

Table 12 : Mean values for serum calcium (mg/dl) of three different groups of animals during pre and post operative periods

Group	Periods				Pooled mean for group
	0th day	5th day	10th day	15th day	
A	9.83^{Ac} ± 0.20	9.91^{Ac} ± 0.30	10.1^{Ac} ± 0.33	10.05^{Ab} ± 0.26	9.97^{c} ± 0.05
B	7.56^{Ab} ± 0.23	7.90^{Ab} ± 0.17	9.50^{Bb} ± 0.24	10.83^{Cc} ± 0.37	8.94^{b} ± 0.65
C	5.91^{Aa} ± 0.27	6.31^{Aa} ± 0.37	7.55^{Ba} ± 0.30	8.03^{Ca} ± 0.11	6.95^{a} ± 0.43
Pooled mean of period	7.76^{A} ± 0.92	8.04^{A} ± 0.85	9.05^{C} ± 0.62	9.63^{D} ± 0.68	

The values bearing the common capital alphabets within the respective row and common small alphabets within the respective coloumn indicate non-significant differences

Analysis of variance for calcium

S.V.	D.F.	S.S.	M.S.S.	F. cal.
Treatment	11	173.9541	15.81401	34.52598
A	2	114.3574	57.17871	124.8356**
B	3	4125586	13.75195	30.02399**
A x B	6	18.34082	3.056804	6.673774**
Error	60	27.48193	0.4580322	
Total	71	201.436		

** - Significant 0.1 % level

CD for treatment = 0.39

CD for period = 0.45

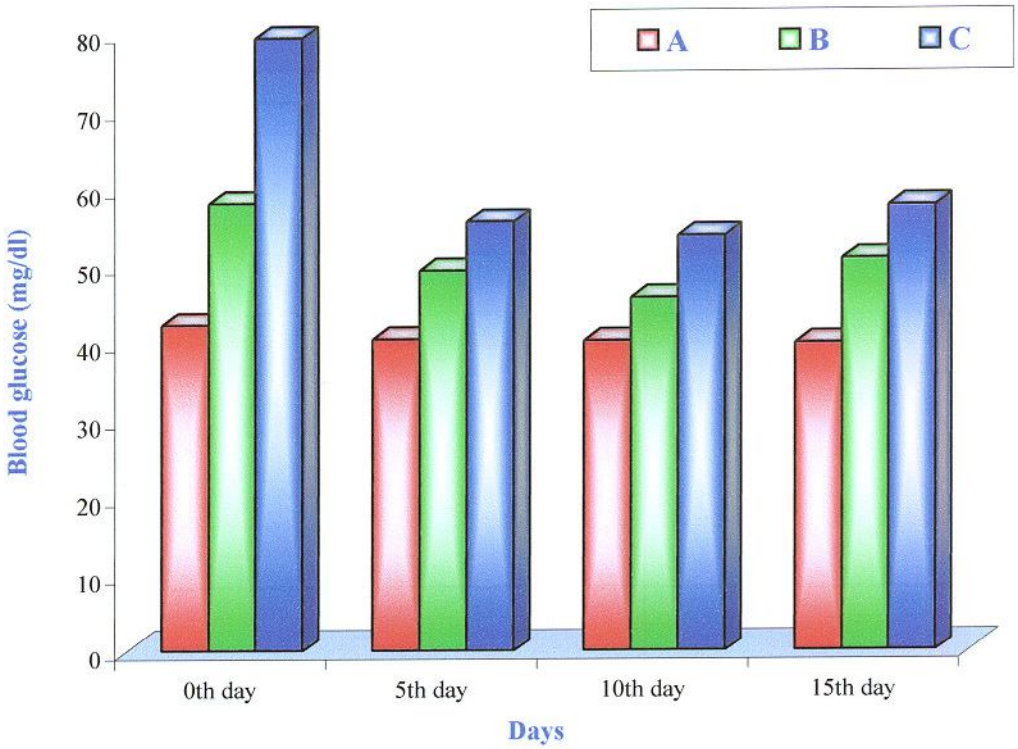


Fig. 13 : Showing mean values for blood glucose (mg/dl) of three different groups of animals during pre and post operative periods

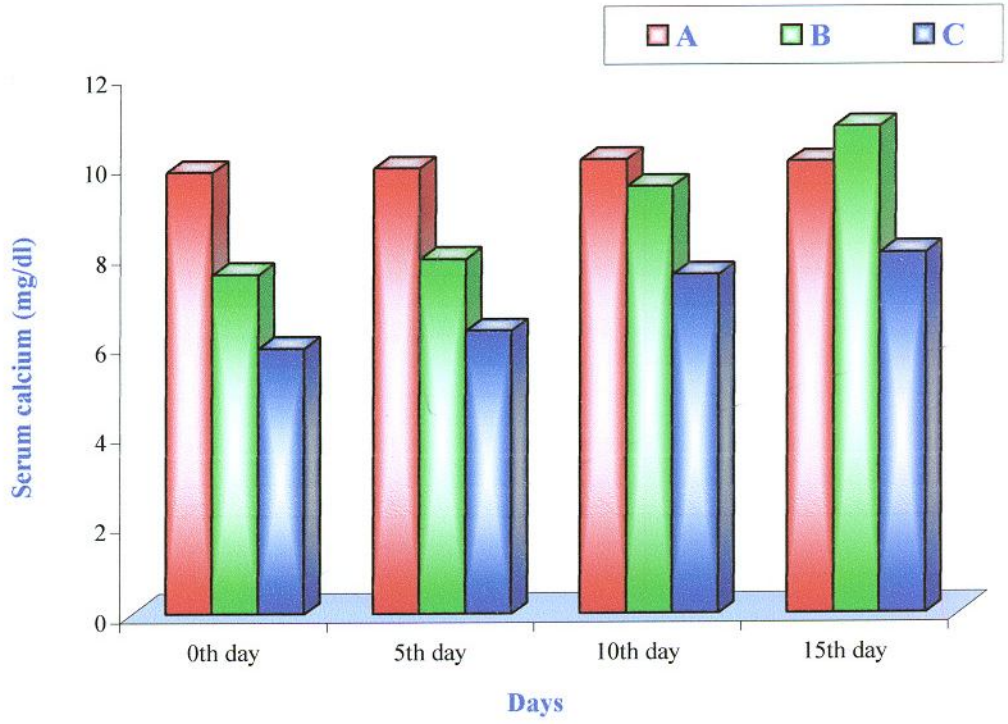


Fig. 14 : Showing mean values for serum calcium (mg/dl) of three different groups of animals during pre and post operative periods

the conversion of 25, dihydroxy Cholecalciferol to 1-25-dihydroxycholecalciferol (1-25-DHCC) PTH and 1-25-DHCC together stimulate reabsorption from bone and 1-25-DHCC stimulates intestinal absorption of calcium. So in the present study lower calcium level may be due to digestive disorder which resulted from accumulation of non-penetrating foreign body in forestomach.

In group 'B' and 'C' the pre-treatment levels of serum calcium were 7.56 ± 0.23 mg/dl and 5.91 ± 0.27 mg/dl which increased to (7.9 ± 0.17 mg/dl, 9.5 ± 0.24 mg/dl and 10.83 ± 0.37) on 5^{th}, 10^{th} and 15^{th} day after operation in group 'B' and 6.31 ± 0.37 mg/dl, 7.55 ± 0.30 mg/dl and 8.03 ± 0.11 mg/dl) on 5^{th}, 10^{th} and 15^{th} in group 'C', respectively. Thus rise in the serum calcium levels after 0^{th} day of operation might be due to increase in calcium absorption and restored calcium and phosphorus metabolism as a result of removal of foreign bodies and improvement in the digestion pH as well as parathyroid function.

Decrease serum calcium might also be associated with poor absorption of calcium due to dysfunction of forestomach, inappetance and severe alkalosis. Similar findings were reported by Pandiya *et al.* (1977) and Sivaiah *et al.* (1986). The lower calcium and phosphorous ratio may also be observed due to inhibition of dietary calcium absorption when animals were fed different feeds (Sivaiah, 1986). Thus hindrance in the calcium absorption might be due to the dysfunction of forestomach where the main digestion begins.

4.1.16 Serum phosphorous (mg/dl)

The mean values of serum phosphorus in mg/dl at various periods in different treatment groups have been present in Table 13 and depicted in Fig. 15.

The level of serum phosphorous within the groups varied significantly ($P<0.01$).

The serum phosphorous level, in control group 'A' were in the range of 5.50 ± 0.60 mg/dl to 6.25 ± 0.15 mg/dl with over all mean of 6.27 ± 0.43 mg/dl.

It is observed from Table 13, that their was apparent increase in serum phosphorous level during pre-operative period i.e. at 0^{th} day in group 'B' and 'C' as compared to control group 'A'. However, the level of serum phosphorous in group 'C' was comparatively higher than group 'B'. The mean phosphorous value in group 'B' were gradually reduced from 0^{th} day (9.40 ± 0.14 mg/dl) to 15^{th} day (7.40 ± 0.18 mg/dl). Similarly also in group 'C' form (11.70 ± 1.48 mg/dl) to (7.20 ± (0.50 mg/dl) similar findings were reported by Pandiya *et al.* (1977) and Sivaiah *et al.* (1986).

It is evident that hyperphosphataemia was associated with calcium levels. Therefore increase in serum phosphorous might be due to reduction in serum calcium as a result of disturbed calcium and phosphorous metabolism which may be due to poor absorption in appetence and digestive dysfunction (Siviah, 1986) due to presence of non-penetrating foreign bodies.

The observation shows that their was reduction in the values of serum phosphorous within 15^{th} day after operation associated with rise in serum calcium as a result of improvement in digestive process with calcium and phosphorous metabolism with removal of foreign bodies.

The increase in serum phosphorous level may be due to the reduction in serum calcium level due to disturbed metabolism of digestive system

Table 13 : Mean values for serum phosphorous (mg/dl) of three different groups of animals during pre and post operative periods

Group	Periods				Pooled mean for group
	0^{th} day	5^{th} day	10^{th} day	15^{th} day	
A	5.50 ± 0.60	6.10 ± 0.30	6.30 ± 0.25	6.25 ± 0.15	6.27^{a} ± 0.43
B	9.40 ± 0.14	8.90 ± 0.28	8.20 ± 0.44	7.40 ± 0.18	8.47^{b} ± 0.37
C	11.70 ± 1.48	10.21 ± 0.84	8.57 ± 0.48	7.20 ± 0.50	9.42^{c} ± 0.84
Pooled mean of period	8.86 ± 1.47	8.40 ± 0.98	7.69 ± 0.57	6.95 ± 0.28	

The values bearing the different superscript within the coloumn indicate non-significant differences

Analysis of variance for serum phosphorous

S.V.	D.F.	S.S.	M.S.S.	F. cal.
Treatment	11	120.5248	14.38523	3.70846
A	2	118.126	50.55789	17.7586**
B	3	8.192139	3.597068	1.02454^{NS}
A x B	6	12.1388	3.084280	0.8228453
Error	60	152.922	2.278976	
Total	71	270.4872		

** - Significant 0.1 % level

CD for treatment = 0.67

NS - Non-significant

particularly the absorption of serum calcium and phosphorous from feed (Sivaiah *et al.*, 1986).

4.1.17 Serum sodium (m.Eq/l)

The mean values for serum sodium in m.Eq/l in all the animals have been given in Table 14 and depicted in Fig. 16.

It was observed from Table 14, that the serum sodium varied significantly ($P<0.01$) between the different treatment groups and various periods.

The serum sodium levels in control group 'A' were in the range of 139.5 ± 2.78 m.Eq/ l to 140.83 ± 1.53 m.Eq/l with overall mean of 140.28 ± 0.25 m.eq/l which was within the normal range reported by Radostitis *et al.* (1994).

The mean values of serum sodium observed during various periods for group 'A', 'B' and 'C' were 140.28 ± 0.25 m.Eq/l, 136.74 ± 5.65 m.Eq/l and 123.12 ± 5.68 m.Eq/l, respectively. The serum sodium level was significantly ($P<0.01$) lower in group 'C' (106 ± 4.58 m.eq/l) and in group 'B' (122.5 ± 4.60 m.eq/l) as compared to group 'A' (140.83 ± 1.53 m.eq/l) at 0^{th} day of experiment, showing significant variation between the treatment group.

Significant ($P<0.01$) increase was observed in the values of serum sodium during post-operative period of experiment on 5^{th}, 10^{th} and 15^{th} day as 129.16 ± 4.22 m.Eq/l, 145.16 ± 4.46 m.Eq/l and 150.16 ± 5.38 m.Eq/l, respectively in group 'B' and corresponding values for group 'C' were 120.50 ± 6.20 m.Eq/l, 129.66 ± 6.11 m.Eq/l and 136.33 ± 3.48 m.eq/l, respectively.

The decrease in the serum sodium level at 0^{th} day might be due to the large volume of fluid accumulated after ingestion by animal and are present in the fore-stomach, this large amount of fluid is not absorbed from the small

Table 14 : Mean values for serum sodium (m.Eq/l) of three different groups of animals during pre and post operative periods

Group	Periods				Pooled mean for group
	0th day	5th day	10th day	15th day	
A	140.83^{Ac} ± 1.53	140.66^{Ac} ± 1.89	140.16^{Ab} ± 2.05	139.50^{Aa} ± 2.78	140.28^{b} ± 0.25
B	122.50^{Ab} ± 4.60	129.16^{Ab} ± 4.22	145.16^{Bb} ± 4.46	150.16^{Bb} ± 5.38	136.74^{b} ± 5.65
C	106.00^{Aa} ± 4.58	120.50^{Ba} ± 6.20	129.66^{Ca} ± 6.11	136.33^{Ca} ± 3.48	123.12^{a} ± 5.68
Pooled mean of period	123.11^{A} ± 8.21	130.10^{B} ± 4.76	138.32^{C} ± 3.72	141.9^{D} ± 3.41	

The values bearing the common capital alphabets within the respective row and common small alphabets within the respective coloumn indicate non-significant differences

Analysis of variance for serum sodium

S.V.	D.F.	S.S.	M.S.S.	F. cal.
Treatment	11	10122.5	920.2273	8.488366
A	2	3943	1971.5	18.18552**
B	3	3869.625	1289.875	11.89807**
A x B	6	3869.625	1289.875	11.89807**
Error	60	6504.625	108.4104	
Total	71	16627.13		

** - Significant 0.1 % level

CD for treatment = 6.03

CD for period = 6.96

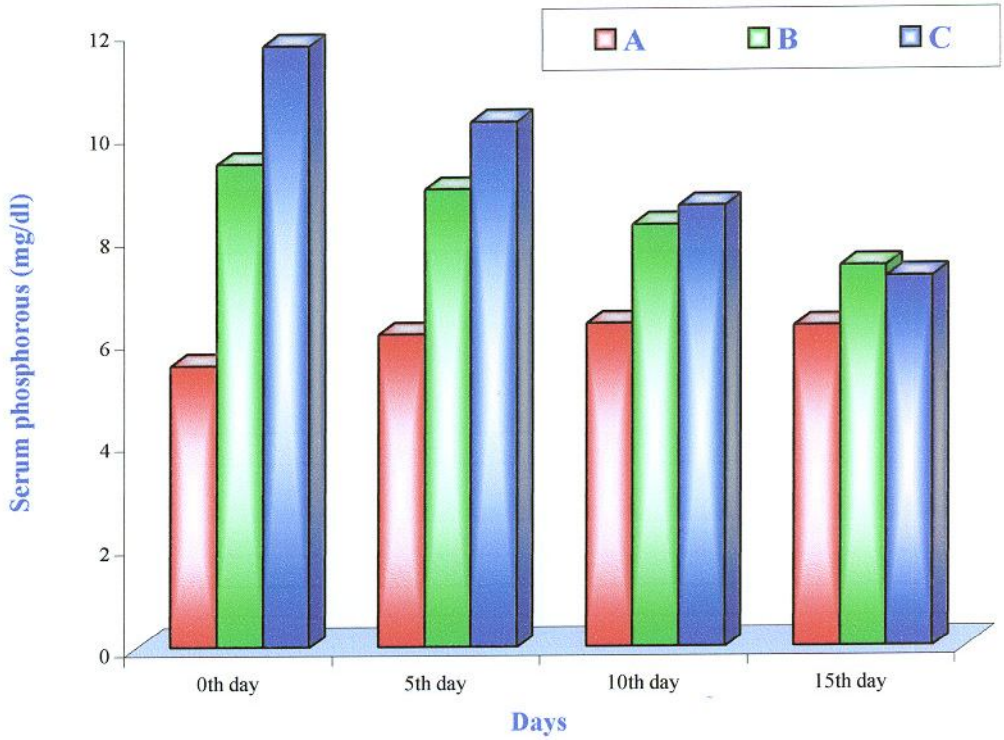


Fig. 15 : Showing mean values for serum phosphorous (mg/dl) of three different groups of animals during pre and post operative periods

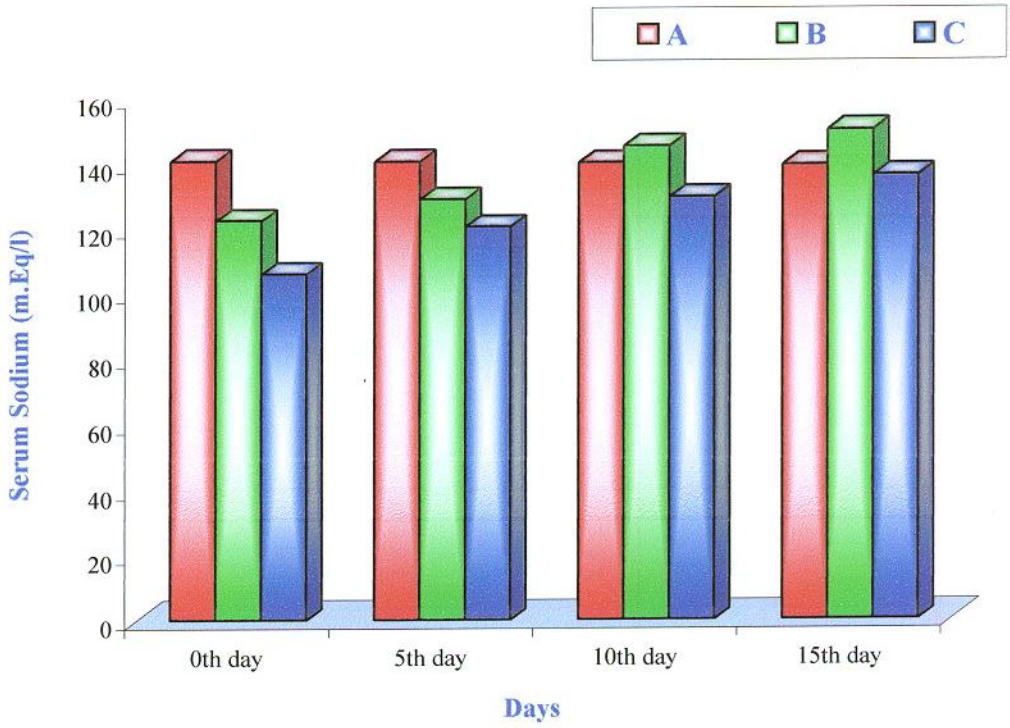


Fig. 16 : Showing mean values for serum sodium (m.Eq/l) of three different groups of animals during pre and post operative periods

intestine leading to fluid or electrolyte imbalance Svendsen (1969). Disturbance in the fluid and electrolyte balance may also be due to stasis of bowel and obstruction (Pearson, 1973).

The decrease in the serum sodium level may also be attributed to ion trapping of sodium in the dilated rumen associated with accumulation of the fluid in the rumen and dehydration may be the cause of reduction in sodium level in the body (Thorat, 1997). The stratum granulosum layer of ruminal epithelium is responsible for transport of sodium ion (Dellmann 1971). Whereas in the histopathological investigation of present study revealed damage to stratum granulosum so it may be one of the contributing factor for reduction in sodium level.

4.1.18 Serum potassium (m.Eq/l)

The mean values of serum potassium (m.Eq/l) and their overall mean values at different periodic intervals for all the treatment groups are presented in Table 15 and depicted in Fig. 17.

It was observed from Table 15, that serum potassium (m.Eq/l) level showed the non-significant differences between the treatment and different pre-operative as well as post-operative periods.

The mean serum potassium values for treatment 'A', 'B' and 'C' were 4.79 ± 0.06 m.Eq/l, 5.17 ± 0.12 m.Eq/l and 5.11 ± 0.23 m.Eq/l, respectively.

The overall mean values of serum potassium observed during the study were in the normal range (3.9 - 5.8 m.Eq/l) reported by Radostitis *et al.* (1994).

Table 15 : Mean values for serum potassium (m.Eq/l) of three different groups of animals during pre and post operative periods

Group	Periods				Pooled mean for group
	0^{th} day	5^{th} day	10^{th} day	15^{th} day	
A	5.01 ± 0.25	4.70 ± 0.24	4.78 ± 0.1	4.68 ± 0.23	4.79 ± 0.06
B	5.58 ± 0.33	5.13 ± 0.23	5.10 ± 0.31	4.90 ± 0.48	5.17 ± 0.12
C	5.66 ± 0.24	5.46 ± 0.27	4.46 ± 0.23	4.88 ± 0.48	5.11 ± 0.23
Pooled mean of period	5.41 ± 0.16	5.09 ± 0.17	4.78 ± 0.15	4.82 ± 0.05	

Analysis of variance for serum potassium

S.V.	D.F.	S.S.	M.S.S.	F. cal.
Treatment	11	9.348633	0.8498757	1.445061
A	2	2.02417	1.012085	1.720868^{NS}
B	3	4.736206	1.578735	2.684355^{NS}
A x B	6	2.588257	0.4313762	0.7334775^{NS}
Error	60	35.28748	0.5881246	
Total	71	44.63611		

NS - Non-significant

The mean potassium values in the present study corroborates with the values observed by Throat (1997) in has comparative study of induced penetrating and non-penetrating foreign body syndrome in bovine.

4.1.19 Serum total proteins (g/dl)

The mean values for serum total protein (g/dl) at different periods in various groups have been presented in Table 16 and depicted in Fig. 18.

It was observed from Table 16, that serum total protein (g/dl) varied significantly ($P<0.01$) between the treatment and different pre-operative and post operative periods.

The serum total protein in control group 'A' was in the range of 6.65 ± 0.29 to 6.86 ± 0.23 with an overall all mean of 6.75 ± 0.03 g/dl which was within the normal range reported by Radostitis *et al.* (1994). The serum total protein level was significantly ($P<0.01$) reduced in treatment group over the control group on 0^{th} day the total protein was significantly increased was 0^{th} day (4.31 ± 0.45 mg/dl) to 15^{th} day (11.23 ± 1.05 mg/dl) in group 'B' as well in group 'C' from 4.40 ± 0.47 to 9.16 ± 1.28 mg/dl.

The average mean value of serum total protein in group 'A', 'B' and 'C' were 6.75 ± 0.03 g/dl, 8.36 ± 1.35 g/dl and 7.71 ± 1.13 g/dl, respectively. The serum total protein level on 10^{th} day in group B and C was comparable which was significantly higher than observed in group A on 10^{th} day,

The significant decrease in the values of serum total protein may be due to decreased feed intake of complete inappetance and less plasma protein synthesis in liver (Pradhan and Misra, 1991) . The decrease in the serum total protein also might be due to an increase in globulin component of serum protein with simultaneous decrease in albumin level. As liver is the sole organ to

Table 16 : Mean values for total protein (g/dl) of three different groups of animals during pre and post operative periods

Group	Periods				Pooled mean for group
	0^{th} day	5^{th} day	10^{th} day	15^{th} day	
A	6.65^{Ab} ± 0.29	6.75^{Aa} ± 0.31	6.75^{Aa} ± 0.23	6.86^{Aa} ± 0.23	6.75^{a} ± 0.03
B	4.31^{Aa} ± 0.45	7.51^{Ba} ± 0.71	10.41^{Cb} ± 1.06	11.23^{Cc} ± 1.05	8.36^{b} ± 1.35
C	4.4^{Aa} ± 0.47	6.83^{Ba} ± 0.26	9.66^{Cb} ± 0.32	9.16^{Cb} ± 1.28	7.71^{b} ± 1.13
Pooled mean of period	5.12^{A} ± 0.62	7.03^{B} ± 0.19	8.96^{C} ± 0.91	9.35^{C} ± 1.05	

The values bearing the common capital alphabets within the respective row and common small alphabets within the respective coloumn indicate non-significant differences

Analysis of variance for total protein

S.V.	D.F.	S.S.	M.S.S.	F. cal.
Treatment	11	305.3301	27.75728	10.43957
A	2	33.23364	16.61682	6.249617**
B	3	177.7822	59.26074	22.28808**
A x B	6	94.31421	15.71904	5.911958**
Error	60	159.5313	2.658854	
Total	71	464.8614		

** - Significant 0.1 % level

CD for treatment = 0.94

CD for period = 1.09

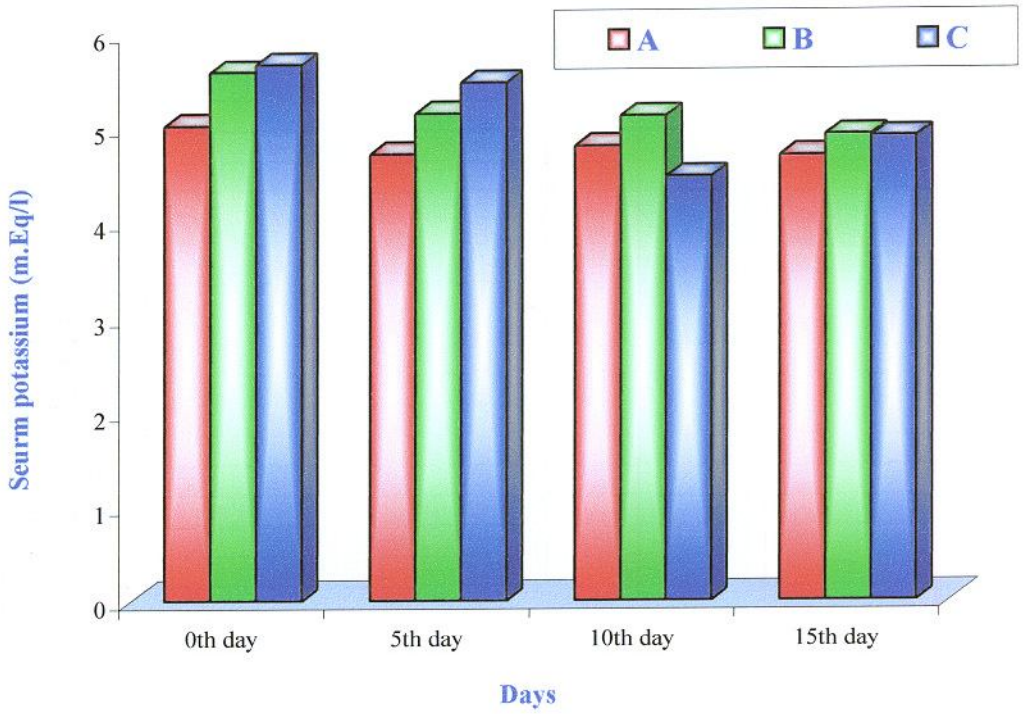


Fig. 17 : Showing mean values for serum potassium (m.Eq/l) of three different groups of animals during pre and post operative periods

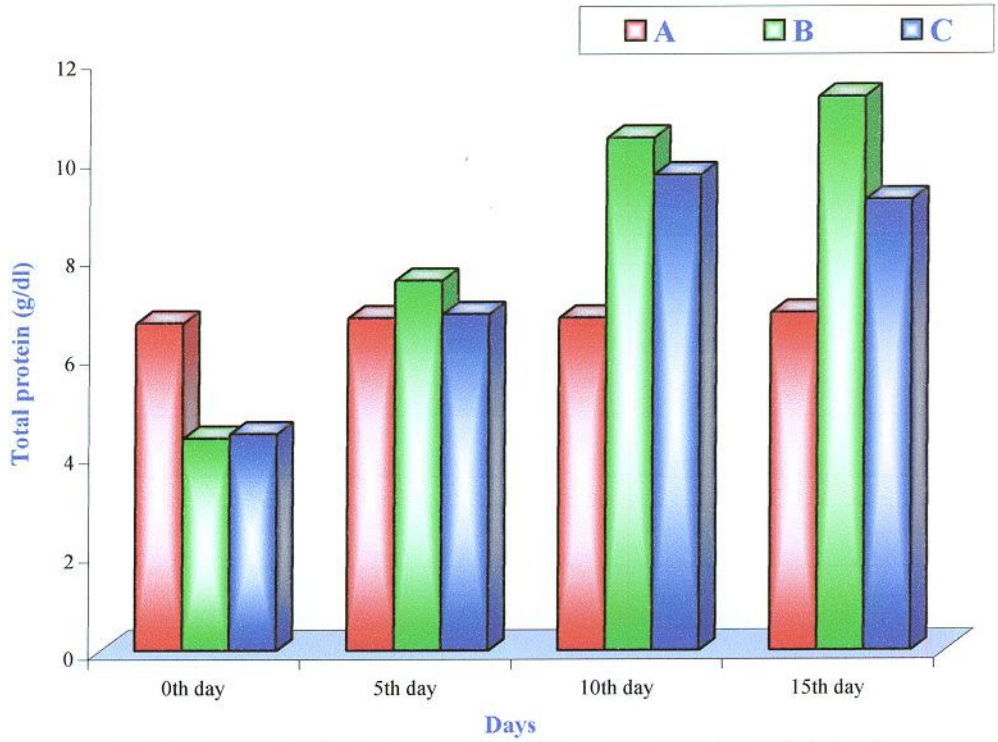


Fig. 18 : Showing mean values for total protein (g/dl) of three different groups of animals during pre and post operative periods

synthesize albumin and part of globulin it is imperative that in hepatitis the synthesis would be gradually reduced (Sethuraman and Verma, 1979).

The serum total protein returned rapidly to normal within 15th day after operation might be due to increased synthesis of plasma proteins (Pradhan and Misra, 1991) with improvement in digestion.

4.2 Histopathological examination

Histopathological examination of ruminal mucosa shows significant difference between the treatment group 'C' when compared to control group 'A', whereas the apparant changes were noted between both of the treatment group 'B' and 'C'.

Hiostologically the rumen of control group 'A' shows stratified squamous keratinized epithelium. The stratum cornium consists of squamous shaped stainable nuclei with smaller or vesiculated cells. The stratum granulosum was thick and the cells were distantly flattened with granules in the cytoplasm. The stratum spinosum consists of polyhedral cells which were slightly larger than the basal cells. (Plate 9)

The histopathological examination of rumen in group 'C' revealed that the stratified squamous keratinized layer of epithelium appared to be more compact as compared to the control group 'A' also the stratum corneum layer appears to be thinner in group 'C' as compared with control group 'A'. The stratum granulosum layer showed disquamation of the cells along with the leucocytic infiltration in group 'C'. Both the layers as stratum granulosum and stratum spinosum showed degenerative changes in group 'C'. In addition to that

the superficial coagulative necrosis were also observed in the mucosa with less number of cellular sheets. (Plate 11)

Similar types of changes were also observed in group 'B'. However the intensity of the lesions were comparatively less. In addition to that the stratum corneum layer showed separation from stratum granulosum layer, whereas the stratum granulosum layer showed disintegration with infiltration of leucocytes. (Plate 10)

These pathological changes such as thinning and compactness of epithelial layers with degenerative and inflammatory changes with less number of cellular sheets may be due to constant high pressure exerted over the ruminal wall by non-penetrating foreign body (Hailat, 1996). However the Dewan (1995) reported that these pathological changes may be due to chronic irritation of the forestomach wall by the presence of non-penetrating foreign body leaving the wall exposed to secondary infection which results in both inflammatory and degenerative changes.

The present findings of histopathological examination are also in accordance with (Rook and Thomas, 1983, Barker and Van Dreumel, 1985, Tanimato, 1994) those reported in cattle.

The post operative treatment with injection B- complex powder, Himalayan Battisa, fresh rumen cud plays an important role to bring the ruminal environment towards normal and 3 % dilute acetic acid is useful in correction of ruminal pH. Similar findings were also observed by Rohi (2003).

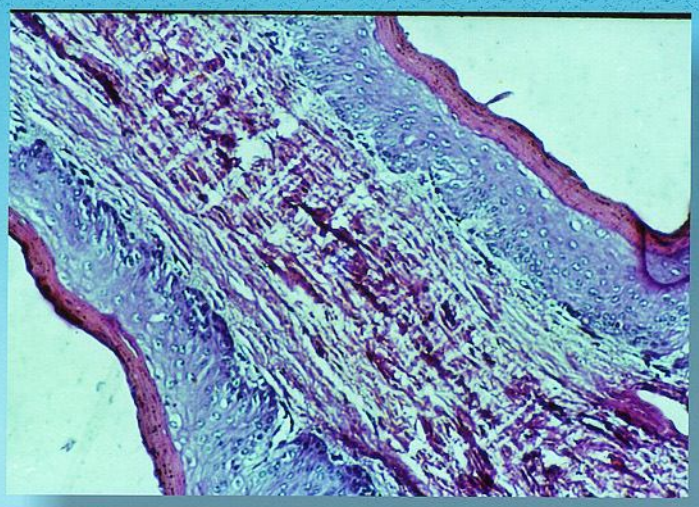


Plate 9 : Showing histological structure of rumen in control group 'A'

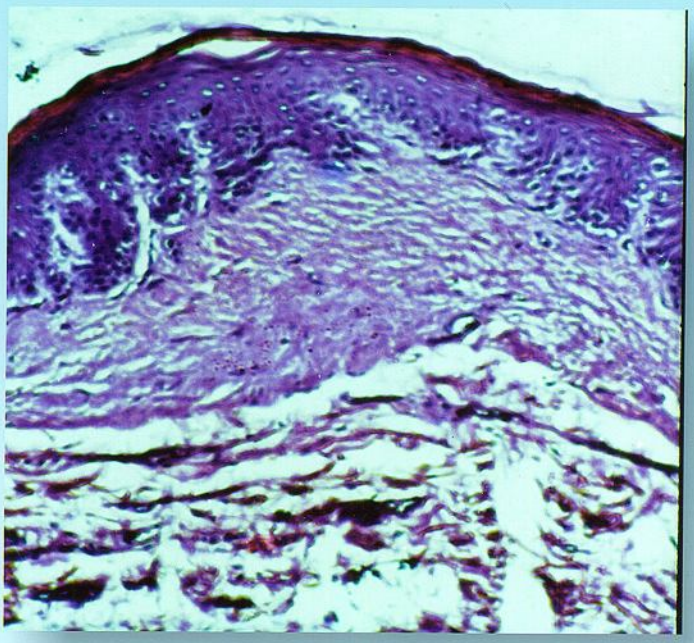


Plate 10 : Showing histolpathological changes of rumen in group 'B'

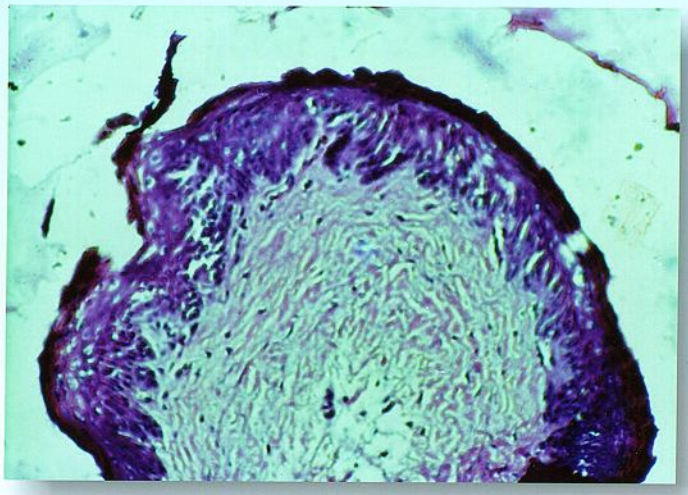


Plate 11 : Showing histolpathological changes in the rumen of severaly affected group 'C'

CHAPTER - V

Conclusions

CHAPTER V

CONCLUSIONS

It is concluded from present investigation that the presence of non-penetrating foreign bodies in the forestomach of animals leads to harmful effect over the health status of animal and showing the critical symptoms on heavy consumption of non-penetrating foreign bodies.

1. Presence of the non-penetrating foreign body showed alternation in clinical observation rumen liquor and biochemical profile with remarkable changes in the histopathological observations of the ruminal mucosa.
2. Consumption of non-penetrating foreign body leads to inappetance, complete anorexia, arched back distention of abdomen, luster less rough hair body coat, lethergic movement and severe dehydration. Lateral recumbence and hide bone condition was predominant symptom on heavy consumption of non-penetrating foreign bodies, however all the affected animals showed the normal health status within 10-15 days post operatively.
3. The ruminal motility per 5 minute was decreased and reticular biphasic contraction time (second) was increased during pre-operative period and normalized within 10 days after operation.
4. The pH of rumen liquor was more alkaline before operation in group 'C' as compared to group 'B' which is associated with the presence percentage of non-penetrating foreign bodies in their forestomach.

5. There was significant increase in the ammonia nitrogen level in rumen liquor and significant reduction in total protozoal count and total volatile fatty acid concentration in group 'B' and 'C'. After 10-15 days, the metabolism and the serum biochemical values were normalized.
6. Blood biochemical profile revealed the increased blood glucose, serum phosphorous, total protein and decrease in the serum calcium and sodium level.
7. Histopathological examination of the rumen in affected animal shows the pathological changes such as compactly arranged and thinning of the layer of ruminal epithelium with degenerative and inflammatory changes with less number of cellular sheets.

From the overall investigation it is suggested to performe laparoruminotomy operation for removal of non penetrating foreign bodies along with supportive treatment with fresh rumen cud and 3% dil. acetic acid to restore the normal ruminal environment with improvement in digestion and also to achieve normal blood biochemical profile of animals.

CHAPTER - VI

Summary

CHAPTER VI

SUMMARY

The present research work was undertaken to study the "Effect of non-penetrating foreign body on clinical, biochemical and rumen function with histopathological examination of ruminal mucosa. Under the study 12 animals were selected with the history of inappetance, loss of health, distended abdomen and lethargic movement. Further 6 normal healthy animals were also selected. These 18 animals were divided into three equal group comprising 6 animals in each group. The clinical, biochemical and rumen liquor profile were studied pre operatively i.e. 0^{th} day and also on 5^{th}, 10^{th} and 15^{th} day post operatively.

The sample of rumen was collected for histopathological examination at the time of laparoruminotomy operation.

Group A : In this control group the animals were selected randomly from DBR-TVOR, IVF, Project, Department of Gynaecology, PGIVAS, Akola.

Group B : In this group the animals having presence of non-penetrating foreign material 5-10 per cent /100 kg body weight were included.

Group C : This group includes the animals having the presence of non-penetrating foreign material at the rate of 10 per cent (per 100 kg body weight) and above.

Clinical observations

Clinical observations in affected animals before surgical intervention revealed anorexia, dehydration, dullness, depression, increased heart rate, pulse rate, respiration rate with reduction in ruminal movement and

increased reticular biphasic contraction time, distended abdomen Lusterless rough hair body coat, lethargic movements and hide bone condition were also noticed.

After 10-15 day post-operatively animals were active looking with normal appetite, heart, pulse and respiration rate. Ruminal movements were increased and reticular biphasic contraction time was also normalized. Further animal showed the normal locomotary movement in both the treatment group 'B' and 'C'.

Rumen liquor profile

The rumen liquor profile of affected animals revealed increased in the rumen liquor pH and ammonia nitrogen with marked reduction in total protozoal count and total volatile fatty acid in group 'B' and 'C' before the operation at '0' day when compared with control group. While after 10-15 days of operation rumen liquor pH, ammonia nitrogen, total protozoal count and total volatile fatty acid concentrations were normalized.

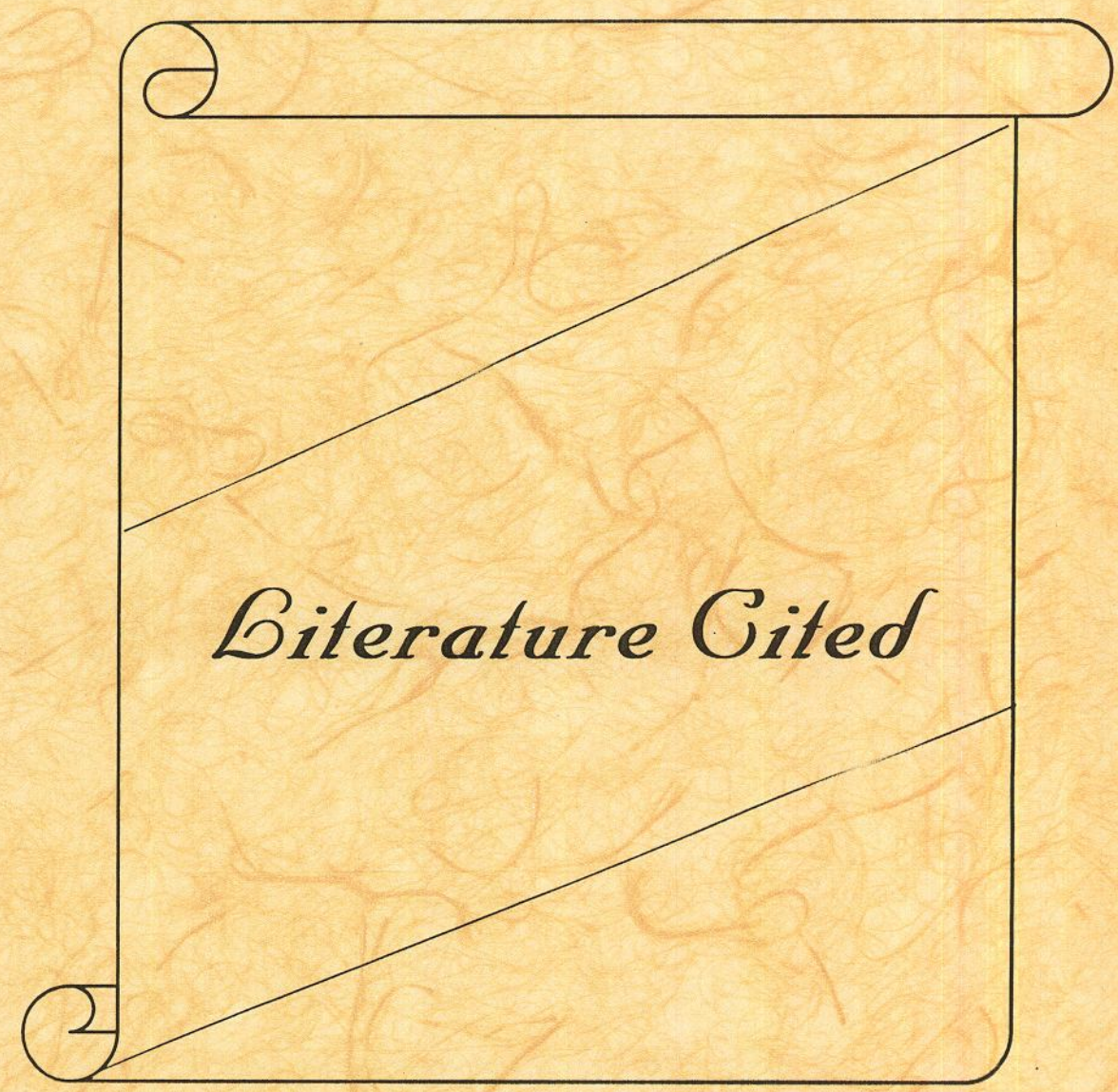
Serum biochemical profile

Blood biochemical analysis in affected animal revealed increased blood glucose, serum phosphorous, total protein and decrease in the serum calcium while the serum electrolyte analysis indicated the decrease in sodium level with non-significant changes in the serum potassium level at 0^{th} day of investigation.

After 10-15 day of operation the blood glucose, serum phosphorous, serum total protein and serum calcium and sodium were tending towards the normal level in affected animals.

Histopathological examination

The histopathological observation in affected animals shwed that the stratified squamous epithelium layer was appeared more compact as that of the normal histological structure. The thinning of stratum corneum layer along with infiltration of the leukocytes with degenerative changes and superficial couglative nacrosis in stratum granulosum as well as stratum spinosum layer was observed in affected animals.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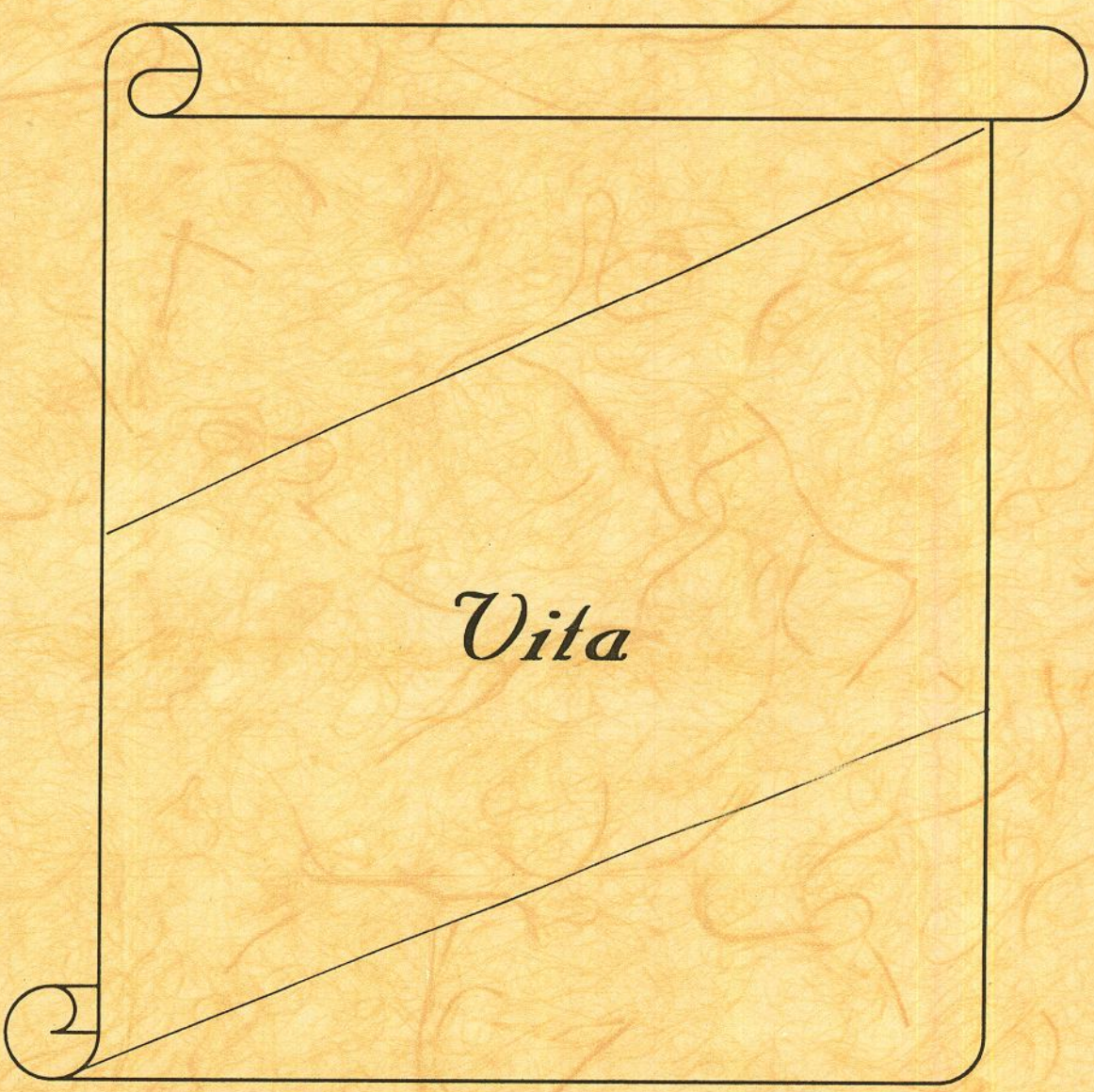
Vita

VITA

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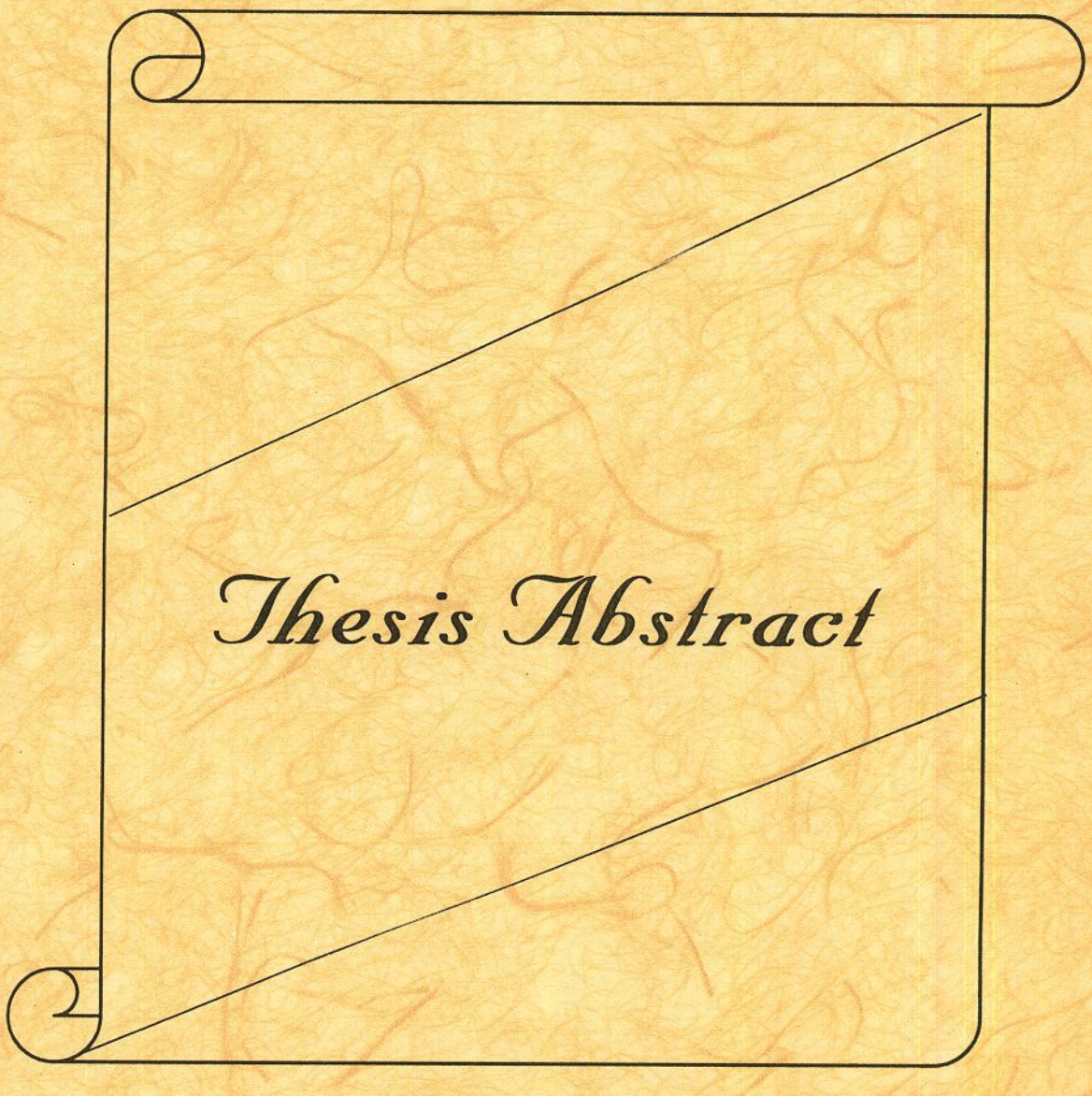
Thesis Abstract

THESIS ABSTRACT

a)	**Title of the Thesis**	: **"EFFECT OF NON-PENETRATING FOREIGN BODY ON CLINICAL, BIOCHEMICAL AND RUMEN FUNCTION WITH SPECIAL REFERENCE TO HISTOPATHOLOGY OF RUMINAL MUCOSA"**
b)	**Full Name of Student**	: **Rahul Bhanudas Patil**
c)	**Name & Address of Major Advisor**	: **Dr. S. P. Mehesare** Associate Professor, Department of Veterinary Surgery and Radiology, PGIVAS, Akola.
d)	**Degree to be awarded**	: M. V. Sc. (Surgery)
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f)	**Major Subject**	: Veterinary Surgery and Radiology
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ABSTRACT

The present investigation entitled **"Effect of non-penetrating foreign body on clinical, biochemical and rumen function with special reference to histopathology of ruminal mucosa"** was conducted at Department of Veterinary Surgery and Radiology, PGIVAS, Akola.

During the study 18 animals were divided into three groups comprising six animals in each. The selection of animals were randomly carried

out on the basis of history and symptoms such as loss of appetite, loss of health status and distended abdomen. The first group 'A' having normal and healthy animals was kept as control. The second group 'B' comprised of animals having presence of 5 to 10 per cent per 100 kg body weight of non-penetrating foreign body, while third group 'C' containing 10 per cent and above per 100 kg body weight of non-penetrating foreign bodies. These three groups were subjected to clinical, biochemical rumen function study before and 5^{th}, 10^{th} and 15^{th} day post operatively.

Clinical observations in affected animals revealed anorexia, dehydration, dullness, depression, increased heart rate, pulse rate, respiration rate with reduction in ruminal movement and increased reticular biphasic contraction time, Lusterless rough hair body coat, lethargic movements and hide bone condition was noticed in some animals before the surgical intervention. All the clinical parameters were normalized after 10-15 day of operation.

The rumen liquor profile of affected animals revealed rise in the rumen liquor pH and ammonia nitrogen with marked reduction in total protozoal count and total volatile fatty acid concentration before operation when compared with control group. The ruminal environment was normalized within 10-15 days of operation.

Serum biochemical profile of affected animals showed increased blood glucose, serum phosphorous, total protein. Whereas, decrease in serum calcium and sodium level in the body, however, serum potassium was unaffected due to presence of non-penetrating foreign bodies. The blood glucose, serum calcium, serum phosphorous, serum total protein and sodium levels were normalized within 10-15 days of operation.

The histopathological examination in affected group revealed that the stratified squamous epithelium layer was appeared to be more compact as that of the normal. The thinning of stratum corneum layer along with infiltration of the leukocytes with degenerative changes and superficial couglative nacrosis in stratum granulosum as well as stratum spinosum layer was observed in affected animals.

From the overall investigation it is suggested to performe laparoruminotomy operation for removal of non penetrating foreign bodies to restore the normal ruminal environment with improvement in digestion and also to achieve normal blood biochemical profile of animals.