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EFFECT OF MEGACID® SUSPENSION ON THE LOWERED RUMEN pH IN CATTLE

In partial fulfilment of the requirements of the B.Sc Animal Science Programme

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B.Sc. Animal Science

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DECLARATION

I declare that this dissertation titled "**Effect of MEGACID® Suspension on the Lowered Rumen pH in Cattle**" is an original work and I have not committed, to my knowledge, any academic dishonesty or resorted to plagiarism in writing the dissertation. All the sources of information and assistance received during the course of the study are duly acknowledged.

Student's Signature: _____ Date:_____

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ABSTRACT

To increase production, dairy cows are fed diets high in grains and other highly fermentable carbohydrates which increase the occurrence of rumen acidosis. Rumen acidosis can be attributed to the switching from higher forage diet to a lower forage diet. To treat rumen acidosis and other digestive disorders in ruminants, antacids are used in Bhutan without knowing the efficacy. Therefore, the present study was undertaken to evaluate the efficacy of MEGACID® as an antacid in lowered rumen pH in cattle. Ten *Thrabum* heifers with mean (± SD) age of 28.50 ± 1.65 months and average weight of 246.30 ±33.27 kg were used for the study. Five heifers were induced mild lactic acidosis (group A) and treated with MEGACID® suspension whereas the other five heifers (group B) did not receive any intervention. The change of rumen pH was measured four hours after feeding a diet with 70% cattle concentrate and 30% kikiyu (*Pennisetum clandestinum*) hay with water made available *ad libitum*. The DMI was rationed to heifers in group A @ 2.5% BW. The rumen fluids were obtained by rumenocentesis and pH was determined immediately using pH meter (*CG-825*). The rectal temperature, pulse rate and respiratory rate were also measured to monitor the health status of the animals. The mean rumen pH in both the group A (7.24 ± 0.24) and B (7.12 ± 0.30) before feeding was at the higher side of the normal range. Although the mean rumen fluid pH decreased significantly ($p < .05$) four hours after feeding (from 7.24 ± 0.24 to 6.68 ± 0.21), the pH did not significantly ($p > .05$) change two hours after oral administration of MEGACID® suspension. The MEGACID® suspension seemed to have maintained the rumen pH near neutrality (6.69± 0.36). The majority (63.6%) of the respondents in the survey reported MEGACID® as effective antacid in treating acidosis in bovine.

Key words: Acidosis, Cattle, Efficacy, MEGACID®, Rumen fluid pH, Rumenocentesis

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LIST OF ABBREVIATIONS

am	Ante meridiem
BW	Body weight
DMI	Dry matter intake
DOL	Department of Livestock
DVH	Dzongkhag Veterinary Hospital
FAO	Food and Agriculture Organization of the United Nations
FMD	Foot and mouth disease
EVDP	Essential Veterinary Drug Program
GDP	Gross Domestic Product
GERD	Gastro-esophageal reflux disease
HCl	Hydrochloric acid
kg	kilogram
LCS	Livestock Centre Store
LEC	Livestock Extension Centre
masl	Metres above sea level
mg	Milligram
ml	Millilitre
MOAF	Ministry of Agriculture and Forests
NCAH	National Centre for Animal Health
NNBF	National Nublang Breeding Farm
pH	power of Hydrogen
pm	Post meridiem
PPI	Proton pump inhibitor
RLDC	Regional Livestock Development Centre
RNR-EC	Renewable Natural Resources- Extension Centre
SARA	Subacute ruminal acidosis
SD	Standard deviation
TMR	Total mixed ration
VFA	Volatile fatty acids
WHO	World Health Organization

CHAPTER ONE

Introduction

1.1. Background

In the world, agriculture is the most important means for livelihood (Upton, 2004). Agriculture production and productivity is required to increase rural incomes, and to support urban population (Upton, 2004). Livestock production is an important component of the agricultural economy for developing countries (Sugiyama *et al.*, 2003). Livestock provides over half of the value of the global agriculture output and one third in the developing countries (Upton, 2004). Livestock in developing countries contribute about 30% of the agricultural gross domestic product, and about 600 million rural poor people rely on livestock for their livelihoods (Swanepoel *et al.*, 2010). Livestock contribute foods in the form of milk and meat and services such as fertilizer and draught power (Sugiyama *et al*., 2003). In Bhutan too, livestock farming is an important activity. Livestock contribution to RNR GDP is 24% (MOAF, 2013a). Through the interventions from the Department of Livestock (DOL), improved breeds of cattle increased from 24.1% in 2012 to 27.4% in 2014. Improved cattle are increasing at the rate of 1.1% annually leading to intensive livestock rearing with use of concentrate diets (MOAF, 2015a).

Due to intensification and commercialization of livestock production systems, economic implications of animal diseases are becoming important at both farm and national levels (Thirunavukkarasu *et al.,* 2010). Livestock diseases can have harmful impact on animal productivity and on the overall process of economic development (FAO, 2016). The world is facing an increasing number of emerging and re-emerging animal diseases due to globalization (FAO, 2016). Production diseases like mastitis may affect dairy productivity through reduced milk yield and quality whereas diseases like tuberculosis and brucellosis may pose risk for human health (FAO, 2016). Productivity of dairy animal is affected by poor management resulting in metabolic disorders such as milk fever, ketosis, retained placenta and ruminal acidosis (Lin, 2009).

Acidosis is one of the non-infectious problems of all ruminants such as cattle, sheep and goat (Alam *et al.*, 2014). Acidosis results from accumulation of acid or depletion of alkaline reserve in the blood (Bramley *et al.*, 2003). Acid accumulation results from feeding high grain diets to the ruminant animals (Oetzel, 2007). Ruminants are affected with acidosis as ruminants have inherent system to digest roughage that is fermented slowly in the rumen (Guo *et al.*, 2013). Based on the severity of the condition, acidosis in animals is classified as

acute and subacute (Lin, 2009). Acute rumen acidosis is more severe whereas subacute acidosis is less severe (Lin, 2009). A field study in United States of America revealed subacute rumen acidosis up to 26% in whole study population of 15 dairy farms (Hussain *et al.*, 2011). However, the current prevalence of rumen acidosis is expected to be low in Bhutan as feedlot is rarely practiced.

To increase production and reap economic benefit, dairy cows are fed diets high in grains and other highly fermentable carbohydrates which increase the occurrence of rumen acidosis in dairy cattle (Enemark *et al*., 2002; Hussain *et al*., 2011). Proper feeding of dairy animals with available feed resources is important to achieve economic benefits for milk production as cost of feeding alone accounts for about 70% of total milk production (FAO, 2015). Dairy cows in transition period (three weeks before and three weeks after parturition) are particularly vulnerable to acidosis due to sudden change in fermentable carbohydrates after parturition (Mathew and Ajithkumar, 2014). High number of acidosis cases was observed during the first month of lactation as dairy cows are exposed too rapidly to high energy diets after calving (Mathew and Ajithkumar, 2014).

In acidotic animals, ruminal epithelial cells are damaged by acids causing rumenitis, erosion and ulceration leading to chronic health problems in dairy cattle (Oetzel, 2007). Therefore, impacts of ruminal acidosis on dairy health are a concern not only for economic reasons but also for animal welfare reasons (Oetzel, 2007). For instance in New Zealand, annual loss per cow from reduced milk yield from subacute acidosis was US $ 54 (Lin, 2009). Lameness attributed by laminitis in acute rumen acidosis is the most important animal welfare issue today in dairy herds (Oetzel, 2007). Therefore, preventing rumen acidosis is important. Rumen acidosis can be prevented by adding dietary buffers ($NaHCO_2$), neutralizing agents ($CaCO_3$), feed microbials (yeast) and fibre in the diets (Bramley *et al.*, 2003). It is also prevented by controlling eating rate through feeding management (Beauchemin, 2007).

Different types of antacids promote healing of gastric ulcers through gastric acid neutralization (Rock, 2007; Wanamaker *et al*., 2009; Reeves *et al*., 2011; WHO, 2011). Most common antacids contain aluminum, magnesium, sodium, calcium or bismuth as cation and hydroxides, carbonate or bicarbonate as anion (Rock, 2007). Aluminum hydroxide is commonly used and it reacts slowly whereas magnesium hydroxide reacts rapidly with HCl (Constable *et al*., 2006). Magnesium hydroxide is usually combined with other antacid drugs such as aluminum hydroxide or sodium bicarbonate and is rarely used in mono-therapy due to

its side effect (Korbely, 2013). Besides, proton-pump inhibitor medicines such as ranitidine, omeprazole, pantoprazole are now in use for treating gastric ulcers (WHO, 2011).

In Bhutan, combination of aluminum hydroxide, magnesium hydroxide and dimethyl polysiloxane suspension known as MEGACID® is commonly used as an antacid in ruminants and small animals (MOAF, 2013b). The drug is supplied in a 450 ml bottle and comes as suspension in brilliant blue and tartrazine color (MOAF, 2013b). Each five millilitre contains dried aluminum hydroxide 250 mg, magnesium hydroxide 250 mg and dimethyl polysiloxane 40 mg (MOAF, 2013b).

1.2. Rationale

All veterinary medicines including antacids are procured and imported from other countries for use in animal treatment in Bhutan as there are no manufacturing companies within the country (MOAF, 2015b). The Department of Livestock (DOL) annually spends about Nu.29 millions for procurement, distribution and management of veterinary medicines and vaccines under the centralized system of Essential Veterinary Drug Programme (EVDP) in the country (MOAF, 2015b). The expenditure on veterinary medicines is increasing annually. Between 2012 and 2016, the expenses on procurement of drugs increased by 17.12%.

The Department procures MEGACID® suspension as an antacid annually and distributes to all Livestock Extension Centres, Central Farms and other agencies in all twenty districts (MOAF, 2013b). On an average, about 800 bottles of MEGACID® suspension is annually procured. Total expenditure incurred for procuring this drug amounts to Nu. 97002.25 on average annually which comprises about 0.37% of the total budget outlay available for procurement of veterinary medicines and vaccines (MOAF, 2015b).

The quality of MEGACID® has been an issue which was raised constantly by the field agencies every year. In absence of drug quality testing facilities, on-farm clinical trial is one way of evaluating efficacy. Seventh National Veterinary Drug Committee also recommended the need to conduct quality assessment of the MEGACID®. Therefore, this study is attempted to evaluate the efficacy of the MEGACID® suspension on the lowered rumen pH in cattle.

1.3. Hypothesis

The hypothesis is that the MEGACID® is effective in treatment of acidosis in cattle.

1.4. Objectives of the study

1. To assess the efficacy of MEGACID® suspension on the lowered rumen pH in cattle.
2. To assess the procurement, distribution and management system of antacids under the Essential Veterinary Drug Programme

CHAPTER TWO

Literature Review

2.1. Importance of animal production

Livestock are capital assets and has very important roles in the economies of developing countries (Upton, 2004). Animals are source of food, income, employment and provide draught power and fertilizers (Upton, 2004). Livestock contributes about 40% to agricultural GDP in the world and 30% GDP in the developing world (World Bank, 2009). Although the demand in developing countries for animal proteins is increasing, animal production is not keeping pace with the increasing demand (Sugiyama *et al.*, 2003). Therefore, developing countries need to understand the roles and importance of livestock to increase livestock contribution (Swanepoel *et al.*, 2010). Livestock products are an example of high value agricultural produce representing important means for poverty reduction (FAO, 2014). Consumption of animal products are growing and eating meat and drinking milk has deep roots in human evolution and culture (von Braun, 2010). The world population is estimated at nine billion by 2050 and the demand for animal products will certainly increase (von Braun, 2010).

Livestock are an integral component of farming system in Bhutan. Over 90% of the households in Bhutan rear livestock (MOA, 2009). Main livestock products in Bhutan consist of dairy products such as milk, butter, cheese (MOAF, 2013a). Currently, Bhutan imports almost all livestock products to meet urban demand except butter and eggs (MOAF, 2013a). An inadequate knowledge on animal husbandry and dairying often lead to low productivity and profitability (MOAF, 2013a).

2.2. Common clinical diseases of ruminants

Animal diseases cause a wide range of biophysical and socio-economic impacts directly or indirectly varying from region to region (Perry *et al.*, 2013). The common impact of diseases are difficult to quantify due to complexity of effects, but may be huge as annual cost of foot and mouth disease (FMD) in Uruguay amounted to $ 8 to 9 million until Uruguay become FMD free in 1997 (Otte *et al.*, 2004). Diseases such as FMD, mastitis, hemorrhagic septicemia, black quarter and milk fever caused 6% of the total milk loss in North-East States of India (Paul *et al.*, 2013). Metabolic disorders such as acidosis, laminitis, bloat, ketosis (acetonemia), hypocalcemia (milk fever), displaced abomasum, and hypomagnesia in dairy cows occur on different farms resulting to loss of profit (Kohn *et al.*, 2011). Outbreak of

notifiable ruminant diseases such as black quarter, food and mouth disease, anthrax and haemorrhagic septicemia were reported in Bhutan during 2015 (NCAH, 2015).

2.3. Acidosis in ruminants

Rumen acidosis is non-infectious problem of all ruminant species caused due to improper feeding practices resulting from inadequate knowledge on risk factors (Alam *et al.*, 2014). Based on the severity of the condition, acidosis in the animals is classified as peracute, acute, subacute and mild (Radostits *et al*., 2007). However, Lin (2009) described only two types of acidosis such as acute and subacute acidosis. The acute acidosis is severe and less common in field while subacute acidosis is less severe and more common in field (Lin, 2009). SARA is caused due to excessive accumulation of VFA with little lactic acid while acidosis in feedlots is usually caused by excessive lactic acid accumulation (Radostits *et al*., 2007; Kahn and Line, 2010; Mutsvangwa *et al.,* 2013). Lactic acidosis (carbohydrate engorgement) has been a common metabolic disease of cattle having access to large quantities of carbohydrate rich diets (Dhanapalan, 2001; Radostits *et al*., 2007; Kahn and Line, 2010). In Bangladesh, ruminal acidosis mostly resulted from accidental intake of cooked rice, rice gruel, potato, bread and jackfruit residue (Alam *et al*., 2014).

Cattle that are not accustomed to grain diets may die after eating 10 kg of grain while adult cattle accustomed to heavy grain diets may eat 15 to 20 kg of grain and develop mild acidosis (Kahn and Line, 2010). Though acidosis is caused by excessive grain feeding, it may still occur in cattle on pasture based system due to low effective fiber level, rapid fiber degradation, high water content and high concentrations of rumen degradable protein (Westwood *et al*., 2003; Li *et al*., 2013). Cows predominantly on rye grass-based pasture were potentially at risk of developing acidosis (O'Grady *et al.,* 2008).

2.4. Economics of rumen acidosis

Ruminant animals such as cattle, sheep and goat are adapted to digest and metabolize forage diets, but their performance increase when they consume high grain diets (Kahn and Line, 2010). Nevertheless, feeding of grains excessively cause rumen acidosis in these animals (Oetzel, 2007). Ruminal acidosis is considered the most important nutritional disorders in US feedlots and dairy industry (Oetzel, 2007). Dairy cows affected with SARA will have a decreased efficiency of milk production and impaired cow health (Mutsvangwa, 2013). For instance in New Zealand, annual lost per cow from reduced milk production from SARA was estimated at $ 54 (Lin, 2009). Mutsvangwa (2013) estimated the annual cost of subacute ruminal acidosis to the US dairy industry at $500 million to 1 billion. According to

Kahn and Line (2010), acidosis can negate production gain that was achieved by grain feeding. Economic damage of acidosis is from reduced milk production, decreased milk solid content (fat and protein), cost of treatment, cost of extra feed due to low feed efficiency, cost of lameness, cost on the other health problems, and cost of culling or death (Lin, 2009). Besides compromises to dairy health and economics, rumen acidosis is an animal welfare concern as lameness and laminitis can impact significantly on cow comfort and general well-being (Oetzel, 2007; Danscher *et al.*, 2015).

2.5. Prevalence of ruminal acidosis in ruminants

Ruminal acidosis has been in focus of dairy health research from mid 1990 and researchers conducted field studies to determine prevalence and to establish influence on production. A study conducted in German dairy herds by Kleen *et al.* (2013) revealed up to 50% prevalence of subacute rumen acidosis. A study conducted by Tajik *et al*. (2009) found 19% prevalence of subacute ruminal acidosis in early lactation cows (2-30 DIM) and 26% in mid-lactation cows (90-120 DIM) after screening 15 Holstein herds in US. A study carried out by Alam *et al*. (2014) observed 2.63% prevalence from a total of 609 ruminants (cattle and goats) (4.04% and 1.9% in cattle and goat respectively) which is not similar to the findings of the Kleen *et al*. (2013) who found a herd prevalence of 20% (63 out of 315 cows) in Germany. In Italy, 3 out of 10 herds were found positive to subacute ruminal acidosis (Morgante *et al.*, 2007). Likewise, 3 out of 12 herds were found positive to subacute ruminal acidosis in Ireland in grazing cows (O'Grady *et al.*, 2008). Krause and Oetzel (2006), observed 4% prevalence in feedlot cattle. No significant differences were observed in prevalence between species, breeds, sex and age groups (Radostits *et al*., 2007; Alam *et al*., 2014).

2.6. Rumen environment homeostasis

Ruminant stomach is composed of four chambers such as rumen, reticulum, omasum and abomasum, with rumen being the largest compartment. Rumen environment is heterogeneous with different temperature, pH and pressure and is affected by many factors such as diet, water intake and rumination (Lin, 2009). The rumen parameters such as pH, ammonia, and lactic acid concentration are affected by diet and ambient temperature (Dwivedi *et al*., 2000). About 10 to 50 billion bacteria, one million protozoa and variable number of yeast and fungi can be found per millilitre of rumen fluid (Chiba, 2014a) indicating majority of rumen microbes are bacteria and protozoa (Lin, 2009). Rumen protozoal population reduces drastically with drop in rumen pH due to acid intolerance showing high correlation (Chiba *et*

al., 2014a; Voia *et al*., 2014). The growth of lactate utilizing bacteria like *Megasphaera elsdenii* is inhibited when rumen pH drops below 5.0 causing further decrease in pH (Lin, 2009). A symbiotic relationship of ruminant animals and rumen micro flora gets disrupted when ruminants are fed protein rich diets (fibre deficient) as ruminal pH declines, microbial ecology changes, and animals suffer from metabolic disorders (Romero-Perez, 2011).

2.7. Treatment of acidosis and availability of antacids

Treatments of acidosis are aimed at reduction of acidity and increase the microbes to restore normal rumen environment (Lin, 2009). Antacids such as aluminum hydroxide, magnesium hydroxides, sodium bicarbonate and calcium carbonate are used most commonly to correct ruminal acidosis (WHO, 2011; Alam *et al*., 2014). Magnesium hydroxide @ 400 gm/adult cow can also be used to treat simple indigestion resulting from excessive grain feeding (Radostits *et al.*, 2007). However, giving 400 gm of magnesium hydroxide or magnesium oxide to normal cattle can cause metabolic alkalosis (Radostits *et al.*, 2007). In severe acidosis, bicarbonate is used as temporary measure, however bicarbonate therapy may cause overshoot alkalosis (Charles and Heilman, 2005). Likewise, in systemic acidosis, 5 litres of 5% sodium bicarbonate solution is used intravenously for over a period of 30 minutes (Radostits *et al*., 2007).

The other medicines such as H_2-receptor antagonist agent (ranitidine, cimetidine) and proton pump inhibitors (PPI) such as omeprazole and pantoprazole are used largely replacing antacids in treatment of gastro-intestinal tract ulcers (Mikota and Plumb, 2003). Despite any treatment in all sort of acidosis, daily monitoring of animals for recovery is important and animal should be able to eat hay, maintain hydration, and pass large quantity of soft feces after treatment (Radostits *et al.*, 2007). Probably treatment is less favorable than prevention as the economic loss will have already been occurred by the time symptoms of acidosis are observed (Lin, 2009). Therefore, proper feeding practices should be advised to the farmers to reduce the risk of ruminal acidosis in ruminants (Alam *et al.*, 2014).

2.8. Efficacy of common antacids

A study conducted on treatment of clinical rumen acidosis with oral antacids by Amstel (1984) found that the alkalizing ability of aluminum hydroxide, magnesium hydroxide, sodium bicarbonate and calcium carbonate were slow and ineffective while magnesium oxide was found to be very potent causing severe rumen alkalosis. Likewise, the antacids such as calcium carbonate and magnesium carbonate were found satisfactory. The onset of effects of calcium carbonate and sodium bicarbonate was slow (Robinson *et al.*, 2002). Non systemic

antacid containing dried aluminum hydroxide 425.53 mg, magnesium hydroxide 400 mg and simethicone 30 mg has more efficacy than antacid containing dried aluminum hydroxide 250 mg and magnesium hydroxide 400 mg (Jakaria *et al.*, 2015). Effective time for antacids in reducing stomach acidity is relatively short on an empty stomach, but can be prolonged to one to three hours by administering with food (Mikota and Plumb, 2003). Antacids containing aluminum hydroxide and magnesium hydroxide and simethicone were found to be the antacids of choice with comparatively less cost per millilitre while antacids containing sodium bicarbonate was the lowest cost effectiveness and least palatable (Nasim *et al.*, 2012). However, almost all antacids interfere in the absorption of other drugs administered concurrently (Reeves *et al*., 2011; WHO, 2011; Korbely, 2013). Chronic administration of antacids can lead to mal-absorption of certain nutrients such as vitamin B_{12} and iron (Rock, 2007). The H_2-receptor antagonist (ranitidine, cimetidine) and PPI (omeprazole and pantoprazole) are found efficacious and safe and are used in young and small animals (Mikota and Plumb, 2003; Radostits *et al*., 2007).

2.9. Ruminal pH profiles

Rumen pH is an important parameter for digestion and rumen health (Lin, 2009) as it plays an important role in the digestibility of feed, protozoal survival and development (Voia *et al*., 2014). The normal rumen pH in dairy cattle ranges from 6.2 to 7.2 at which the rumen environment function at optimum (DeVries, 2010). However, in feedlot cattle the ruminal pH is usually between 5.6 and 6.2 (Schwartzkopf-Genswein *et al.*, 2003). Rumen pH will fall from normal if large quantity of soluble carbohydrates are fed (Thangavel, 2001; Chiba, 2014). Based on the severity of the acidosis such as peracute, acute, subacute and mild, the rumen pH will be < 5, between 5 and 6, between 5.5 and 6.5 and between 6.5 and 7 respectively (Radostits *et al.*, 2007). The mean rumen pH drop from 6.5 after the morning feeding and continued to decline through the afternoon feeding to below 5.5 in the evening (Duffield *et al.*, 2004).

The induction of subclinical rumen acidosis significantly reduced the mean daily rumen pH from 6.36 to 5.72 (Krajcarski-Hunt *et al.*, 2002). To understand the principles of acidosis required certain clarity about the physiological conditions within the digestive tract especially in the reticulo-ruminal compartment (Hussain *et al.*, 2011). Many techniques have been developed to gain insight into the dynamic biochemical processes taking place in the fore stomach of ruminant (Hussain *et al.*, 2011).

CHAPTER THREE

Materials and Methods

3.1. Study Area

The on-farm trial to evaluate the efficacy of MEGACID® was carried out at National Nublang Breeding Farm in Tashiyangphu under Trashigang District (Figure 3.1). The National Nublang Breeding Farm is an *in situ* conservation farm for indigenous breed of cattle (*Nublang/Thrabum*) in Bhutan. The farm is located at an altitude of 2355 masl with the mandate to conserve indigenous breed of cattle in the country (Norbu, 2014). The farm has a total of 139 cattle. The study was carried out between January and March 2016. National Nublang Breeding Farm was chosen for the study as rumenocentesis technique is considered invasive with potential secondary complications such as peritonitis, abscessation and injury. The *Nublang/Thrabum* cattle have more ability to withstand the complications whereas exotic cattle breeds are very sensitive to stress (Dorji *et al*., 2009).

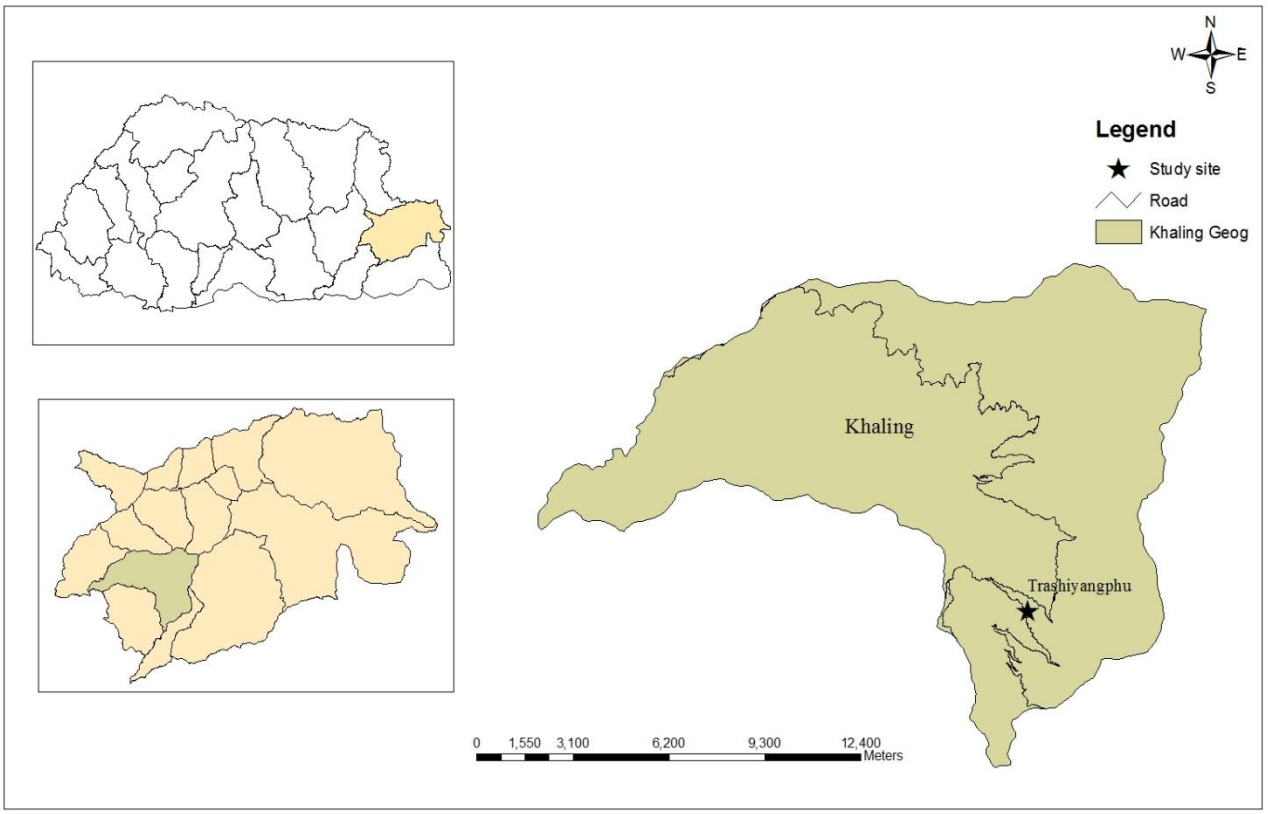

Figure 3.1. Location of on-farm clinical trial

3.2. Experimental design and animals

Ten *Thrabum* heifers were selected using lottery method of sampling (simple random sampling). Animal number was assigned to each member in the target population. Assigned animal number was written down on paper, folded it, mixed well and selected 10 heifers

through lucky draw. The selected heifers were divided into two groups — group A (experimental) and group B (control) of five animals each. The mean (± standard deviation) age of the animals in the clinical trial was 28.50 ± 1.65 months with average weight of 246.30 ± 33.27 kg. Heifers were chosen as the study involved invasive procedures which may affect production. The heifers in the study were not lactating and not pregnant. Although, Dohme *et al.* (2008) suggested using enough animals to study the effect of antacid treatment, this study was able to use only 10 animals due to inadequate animal numbers with same category. Besides, rumenocentesis technique is an invasive method and involved live animals and welfare issues.

Animals in the study were restrained in a stall which allowed access to the left flank. Puncture site was on the left side at the lower angle of the flank as followed by Kleen *et al.* (2009). Rumenocentesis at the lower angle of the left flank is expected to collect rumen fluid from the ventral sac of the rumen which has the lowest pH (Kleen *et al.*, 2009; Li *et al*., 2013). The site of rumenocentesis was slightly clipped to mark the area.

3.3. Management of selected *Thrabum* heifers

The *Thrabum* heifers were housed in a separate pen on the day of experiment. Clean and fresh water was provided *ad libitum* during experiment days as followed by Brown *et al.* (2000) and Mullaert (2010). The clinical examinations of animals under the study included physiological examinations such as body temperature, pulse rate and respiration rate. Body temperature was measured using digital thermometer.

3.3.1. Induction of acidosis and treatment

To calculate dry matter intake (DMI) requirement, body weights of the animals were estimated using RONDO® measuring tape which is calibrated both in kilograms and centimetres. Body weight measurement was carried out in the morning before feeding to avoid possible error resulting from feeding. Dry matter intake (DMI) requirement was calculated at 2.5% of the body weight of each heifer (Chiba, 2014b). Cattle concentrate formulated by Karma feeds and kikiyu (*Pennisetum clandestinum*) hay were weighed using a digital balance. A diet with 70% cattle concentrate and 30% kikiyu (*Pennisetum clandestinum*) hay was fed to lower ruminal pH (acidify) as followed by Rotger *et al.* (2005), Nienaber (2009) and Wang *et al.* (2015). Cattle concentrate and hay were fed separately right after the first rumen fluid collection at once. Four hours after feeding the diet, rumen fluid samples were collected to establish baseline pH values before treatment.

Although two different dose rates of MEGACID® suspension (30 gm/animal and 1 gm/kg BW) are recommended in veterinary drug formulary 2013, in the study dose rate was calculated @ 30 gm/animal. Oral administration MEGACID® @ 1 gm/kg BW involved high volume which may cause alkalosis in the animals affecting animal health and welfare. Moreover, administration of MEGACID® in high volume frequently might not be feasible in field. German *et al.* (2008), observed difficulties in administration of antacids in veterinary patients due to high volume and frequency of treatment required to prevent rebound acid secretion. Frequent oral administration of antacids in vomiting animal patients may be more difficult resulting in poor owner compliance. Therefore, animals were provided 300 ml of MEGACID® suspension without dilution. The actual dose of MEGACID® suspension to be administered was 278 ml per animal. An additional 22 ml of MEGACID® suspension was provided to cover the wastage on drenching. The rumen fluid was collected two hours after MEGACID® administration, as according to Lamarre (2014), antacids work for two to four hours depending on the amount of gastric acid produced. Besides German *et al.* (2008) described magnesium hydroxide as short and rapidly acting antacid while aluminum hydroxide as slow and persistent acting antacid.

3.3.2. Sample collection and pH measurement

A total of 100 rumen fluid samples were collected during the trial period. Rumen fluid samples were collected on four occasions, seven days apart. In group A, rumen fluid were collected before feeding, four hours after feeding and two hours after MEGACID® treatment at 8:00 am, 12:00 noon and 2:00 pm respectively. Rumen fluid samples from group B were collected two times at 8:00 am and 2:00 pm. Rumenocentesis was used to collect rumen fluid as the technique is reported to be superior to other techniques such as stomach tubing and rumen fistula. Stomach tubing is susceptible to saliva contamination whereas use of rumen fistula is not feasible in field. Rumenocentesis was carried out at the lower angle of the left flank as recommended in SOP ATT 019 (Annexure 1) and the collection of fluid generally occur from ventral sac of the rumen (Li *et al*., 2013). During each rumen fluid sampling, approximately 10 ml of rumen fluid from each heifer was collected to a plastic fecal sample vial with screw top. A 15 gauge, 1½ inch hypodermic needle and 20 ml disposable plastic syringe was used to collect rumen fluid. During the experiment days, the sequences of activities were carried out as shown in (Figure 3.2).

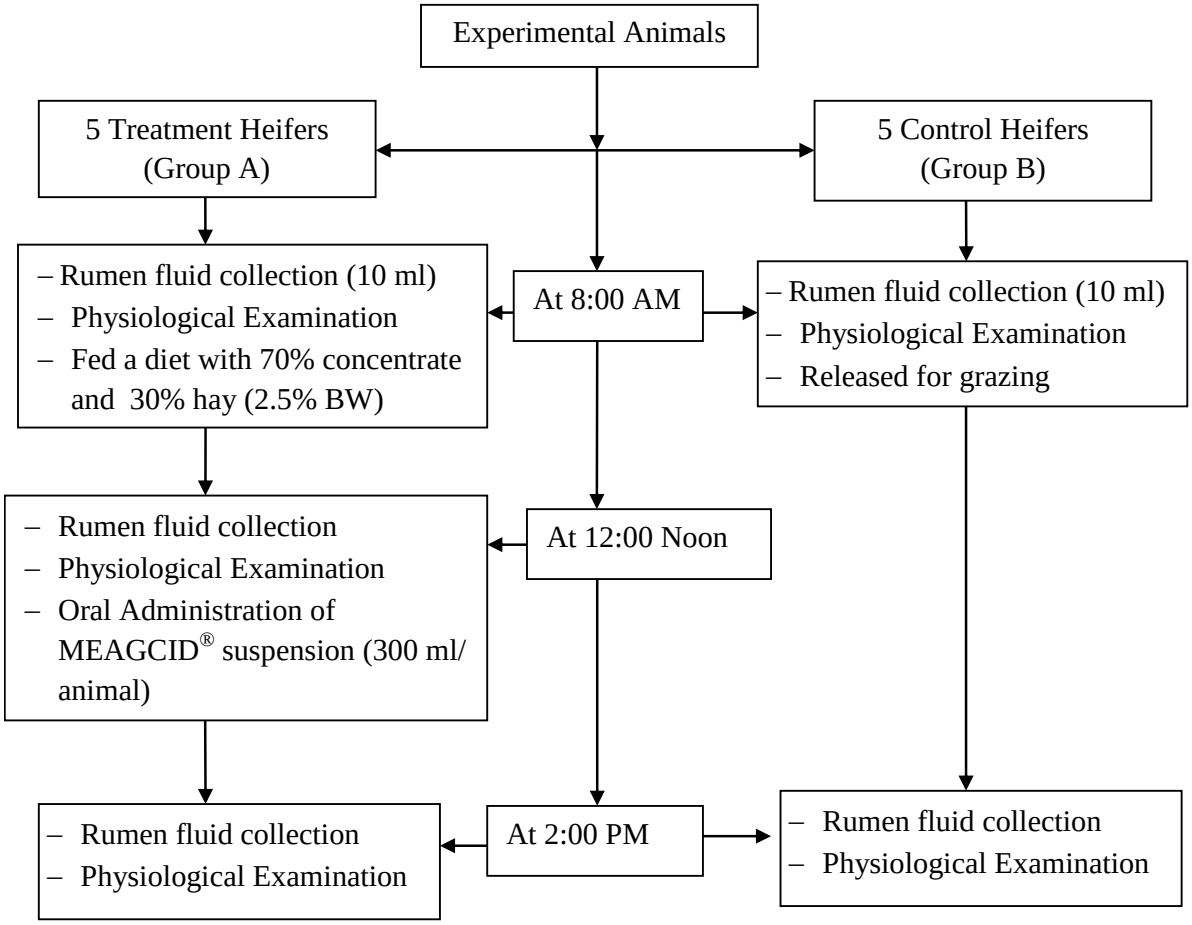

Figure 3.2. Schematic representation of the on-farm clinical trial

The pH of rumen fluid samples were recorded immediately using a Schott Gerate pH-metre, CG-825. The pH metre was calibrated before each examination and used according to the instruction of the manufacturer (Annexure 2). To validate pH values determined by the pH metre, pH of the rumen fluid was also measured using pH indicator paper (range 5-10) (Annexure 3).

3.4. Questionnaire Survey

Apart from on-farm trial, questionnaire survey was carried out. The respondents involved were veterinary officers, heads of central farms and central agencies. Twenty dzongkhag veterinary hospitals (DVHs), nine central agencies and seven central farms were purposively identified for the data collection (Annexure 4)

The questionnaire consisted of six parts (Annexure 5). Part I involved spaces to declare respondent details. Part II was related to indenting and procurement of antacids. Part III consisted of questions related to supply and distribution of antacids. Part IV involved questions relating to usage and management of antacids. Part V dealt with quality issues of

antacids and part VI involved questions related to expiry problems. The questionnaire had 29 closed ended questions and 11 open ended questions. Multiple options were provided in closed ended questions whereas in open ended questions, respondents provided answers. All antacids that are registered for use in the country were included in the survey to compare with MEGACID®. A consent statement was provided in the front page as the questionnaire was self-administered.

Survey was carried out online by email between 17 March and 15 April 2016. Out of 36 targeted respondents, 22 responded to the questionnaire. Sixteen questionnaires were received online through email and six questionnaires were received in printed copies.

3.5. Pre-testing of the survey questionnaire

Pre-testing of the questionnaire was carried out in 10 Renewable Natural Resources Centres under Trashigang dzongkhag. The questionnaire pre-testing was carried out to improve the questionnaire. The respondents were asked to give feedbacks on questions in the questionnaire. Minor corrections were made following the feedbacks from respondents in pre-testing and the questionnaire was finalized for distribution.

3.6. Data Analysis

On-farm trial data were initially collected on a recording sheet and entered into Microsoft Excel 2007. Likewise, the survey data were compiled in Microsoft Excel Sheets 2007 after coding questions and responses. The data were statistically analyzed using the Statistical Package for the Social Sciences (SPSS) version 23.0. Graphs were generated using Microsoft Excel 2007. Paired sample *t* test was used to compare the means differences within the group. Likewise, an independent sample *t* test was used to determine mean differences between the groups.

3.7. Ethical considerations

The study involved invasive procedures such as induction of acidosis and direct puncture of rumen. However, as far as possible gentle handling of animals was ensured to reduce stress and pain during feeding and rumen fluid collection. Water was provided *ad libitum.* The animals were constantly monitored for clinical signs of any illness and for secondary complications.

CHAPTER FOUR

Results and Discussions

4.1. Physiological examinations

The physiological examination of animals included rectal temperature, pulse rate and respiratory rate. The mean rectal temperature at 8:00 am was 99.37 ± 1.10°F and 98.52 ± 1.19°F in group A and B respectively. The rectal temperature in both group A (experiment) and B (control) were found subnormal and differed significantly ($p < .05$) between groups. The normal rectal temperature of dairy cow ranges from 100.4 to 102.8 °F (Reeves *et al.*, 2011). The mean temperature in both groups increased significantly ($p < .05$) during the day. The increase in the environmental temperature during the day might have increased body temperature in the animals.

The mean pulse rate in group A increased significantly ($p < .05$) to 72.20 ± 3.78 per minute at 12:00 noon from 67.70 ± 4.27 per minute at 8:00 am. This increase in pulse rate might be due to induction of acidosis as increased pulse rate was observed in experimentally induced lactic acidotic sheep by Hajikolaei *et al*. (2006). The increase in pulse rate might also be due to stress as Kovacs *et al*. (2013) observed pain and fear affecting pulse rate to increase in dairy cattle.

No significant ($p > .05$) difference was observed in the mean values of respiratory rate between group A and B at 08:00 am. However, significant ($p < .05$) differences were found in the mean values of temperature and pulse rate between the groups (Table 4.1).

Table 4.1. Mean (± SD) of physiological signs at 8:00 am in group A and B

Parameter	Group		*P*-value
	A	B	
Rectal temperature (°F)	99.37 ± 1.10	98.52 ± 1.18	$p < .05$
Pulse/minute	67.70 ± 4.27	71.00 ± 3.64	$p < .05$
Respiration/minute	19.40 ± 4.66	17.15 ± 3.27	$p > .05$

Two hours after treatment, the mean rectal temperature increased significantly while pulse rate decreased significantly in group A. No significant differences were found in the mean values of temperature, pulse rate and respiratory rate between group A and B at 2:00 pm (Table 4.2).

Table 4.2. Mean (± SD) of physiological signs at 2:00 pm in group A and B

Parameter	Group		*P*-value
	A	B	
Rectal temperature (°F)	101.53 ± 0.76	101.80 ± 0.76	$p > .05$
Pulse/minute	70.00 ± 3.95	71.90 ± 3.75	$p > .05$
Respiration/minute	17.50 ± 2.67	18.25 ± 2.83	$p > .05$

4.2. Rumen fluid pH

The mean values of rumen pH were 7.24 ± 0.24 and 7.12 ± 0.30 for group A and B respectively. The pH of rumen fluid samples recorded at 8:00 am (before feeding) to establish baseline pH was at the higher side of the normal range in all animals. The normal range of the rumen pH for cattle is between 6.2 and 7.2 (DeVries, 2010).

After four hours of mild acidosis induction in group A, significant ($p < .05$) decrease in rumen pH occurred. The mean values of rumen fluid pH decreased to 6.68 ± 0.21 from 7.24 ± 0.24 (Table 4.3). The decrease was 0.56 pH unit. This decline in pH was expected to be caused by the diet as Gasteiner *et al*. (2009) observed significant drop of rumen pH after concentrate feeding in steers. Though the decline of mean pH value after four hours of feeding was statistically significant, the decline of rumen pH was not great as compared to pH values obtained by Nianaber (2008) and Wang *et al.* (2015). Feeding 70% concentrate and 30% roughage to dairy cows by Nienaber (2008) and Wang *et al.* (2015) observed decline of rumen pH below 5.8 lasting for more than two hours. However according to Maekawa *et al*. (2002a) and Nocek *et al*. (2002), the decrease of ruminal pH depends on the initial pH of the rumen, feed intake, and salivary secretion. Fermentable acids in rumen increases with increased feed intake causing rumen pH to fall despite saliva secreted during chewing (Maekawa *et al.*, 2002b).

Table 4.3. Mean (± SD) rumen fluid pH and physiological signs at stage 1, stage 2 and stage 3 in group A

Parameters	Group A		
	Stage 1 (8:00 am)	Stage 2 (12:00 noon)	Stage 3 (2:00 pm)
Rumen fluid pH	$7.24^{a, b}$±0.24	6.68^{a}±0.21	6.69^{b}±0.36
Rectal temperature	99.37^{a}±1.10	100.49^{a}±1.01	101.53^{a}±0.76
Pulse/minute	67.70^{a}±4.27	72.20^{a}±3.78	70.00^{a}±3.95
Respiration/minute	19.40^{a}±4.66	18.90^{b}±3.58	$17.50^{a, c}$±2.67

Values with same superscripts (a, b, c) within rows are significantly different at p < .05.

Two hours after treatment of animals in group A with single dose of MEGACID® suspension, the mean rumen fluid pH increased by 0.01 pH units. The increase of pH was not significant ($p > .05$). Mean rumen pH did not return to baseline level (7.24 ± 0.24) and the mean pH curve remained flat (Figure 4.1). Therefore, this study did not observe any marked effect in increasing the rumen pH suggesting that the MEGACID® suspension was not efficacious in correcting the lowered ruminal pH in cattle. However, the MEGACID® suspension probably maintained the rumen pH near neutrality (6.69) after two hours of treatment without allowing rumen pH to decrease.

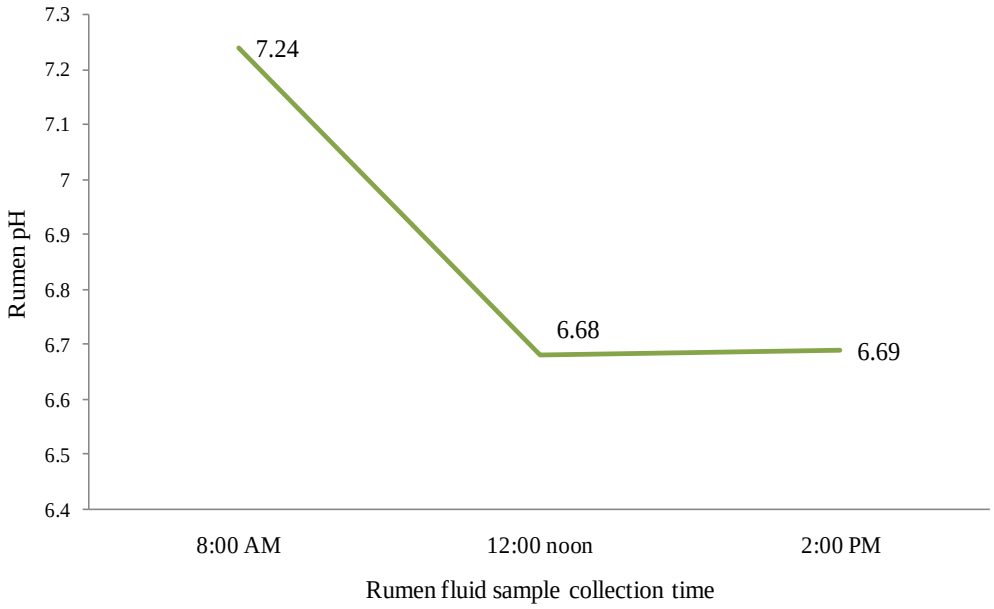

Figure 4.1. Mean rumen fluid pH of group A

An antacid containing aluminum hydroxide (250 mg) and magnesium hydroxide (400 mg) neutralized 1.5 ml of HCl while antacid with aluminum hydroxide (425.53 mg), magnesium hydroxide (400 mg) and simethicone (30 mg) neutralized 2.5 ml of HCl (Jakaria *et al.*, 2015). A study carried out by Ahmed *et al.* (2002) to evaluate the effect of Extra-strength Maalox® containing aluminum hydroxide (0.10 gm/ml) and magnesium hydroxide (0.90 gm/ml) revealed increase in abomasal pH on dose dependent manner in calves. The first dose increase abomasal pH by < 1 pH unit whereas the second and third dose increased mean pH by 1.5 and 2.5 pH units for less than three hours. This indicates that the acid neutralization increased when the antacid was administered repeatedly and at higher doses. According to German *et al.* (2008), to be effective antacids must be given in at least every four hours as infrequent administration of antacids may result increased gastric acid production, and observed clinical efficacy with higher doses in human. Likewise, Rock

(2007) suggested giving antacids every two to four hours. In this study, dose was not repeated as is not recommended in the national veterinary drug formulary 2013.

The mean rumen fluid pH between group A and B were compared for the study at 8:00 am and 2:00 pm. There was no significant difference ($p > .05$) in mean rumen pH between group A (7.24 ± 0.24) and B (7.12 ± 0.30) at 8:00 am. In contrast, the mean rumen pH value of group A (6.69 ± 0.36) and B (6.91 ± 0.25) is statistically significant ($p < .05$) at 2:00 pm (Table 4.4). The mean rumen pH of group A (6.69 ± 0.36) was significantly ($p < .05$) lower than B (6.91 ± 0.25), but still within the pH boundaries of cow on normal diet.

Table 4.4. Mean (± SD) rumen fluid pH values at 8:00 am and 2:00 pm in group A and B

Parameter	Group		*P*-value
	A	B	
Rumen fluid pH at 8:00 am	7.24 ± 0.24	7.12 ± 0.30	$p > .05$
Rumen fluid pH at 2:00 am	6.69 ± 0.36	6.91 ± 0.25	$p < .05$

Although the animals in group A were managed under same diet and condition, the rumen pH values differed ranging from 6.35 to 6.98 at four hours after feeding. The pH of six rumen fluid samples collected two hours after treatment with MEGACID® suspension further decreased from the baseline pH recorded at 12:00 noon (before treatment). These differences in individual pH values might have caused due to several factors such as DMI, capacity of the animals to buffer and absorb organic acids produced in the rumen (Schwartzkopf-Genswein *et al*., 2003; Krause and Oetzel, 2006). The animals in the study differed in their feed and water intake behavior as some animals were found eating feed more and rapidly while some animals refused to eat all the diet rationed. Likewise certain animals took more water while others refused to drink water. The recent water intake affects the rumen pH due to dilution of rumen fluid (Atkinson, 2013). Certain animals were found eating only concentrate while some ate both hay and concentrate differing diet selection behavior. Thus, these factors might have resulted to variation in rumen pH of the animals. The variation in rumen pH is also due to variability of animals such as age, genetics, rumen microbial population and previous exposure to acidosis (Dohme *et al.*, 2008).

4.3. Effects of Rumenocentesis on animals

One out of ten animals (10%) involved in the study was observed with abscess on the rumenocentesis site. Abscess incidence of 5.5% was reported by Kleen *et al*. (2004) whereas 33.33% was observed in a study conducted by Duffield *et al*. (2004) at the puncture site after

rumenocentesis. All animals that underwent rumenocentesis reacted aggressively to the procedure suggesting pain and discomfort. This result provided evidence that the rumenocentesis has adverse local or systemic effects on animal health and performance. Similar problems related to rumenocentesis such as abscesses and peritonitis has been reported by Aceto *et al.* (2000) and Strabel *et al*. (2007). However, a study on effect of rumenocentesis by Gianesella *et al.* (2010) observed minimal effects on cow health. Likewise, Morgante *et al*. (2007) carried out rumenocentesis in 120 cows and observed no local or general problems following the procedure. Similar findings were reported by Nordlund *et al*. (2003) and suggested that the rumenocentesis technique can be readily used in practice.

4.4. Indenting, procurement and supply of antacids

The most common types of antacids requisitioned annually in terms of quantity, field requirements, and frequent usage by the respondents (n=20) are MEGACID® (81.8%) followed by Ranitidine and Sodium bicarbonate (72.7% each), Omeprazole (50.0%), Pantoprazole (40.9%) and Silica dimethicone (27.3%). Although the survey involved respondents from District Veterinary Hospitals and Central Farms and Central Agencies, MEGACID® is observed to be the most preferred antacids for the respondents. The preference for MEGACID® over other antacids was attributed to its easy route of administration and availability.

In terms of supply and distribution of antacids, 86% of the respondents were satisfied with the quantity of antacids supplied by the Department and 73% of respondents have not faced shortages of antacids for the last three years. In terms of accessibility to antacids and its supply, 23% of the respondents said that it was excellent, 58% said that it was good while 14% of the respondents felt that it was poor or not satisfactory (Figure 4.2). The poor accessibility to antacids was attributed to the fact that the budget allocated for medicines was prioritized for other essential veterinary drugs.

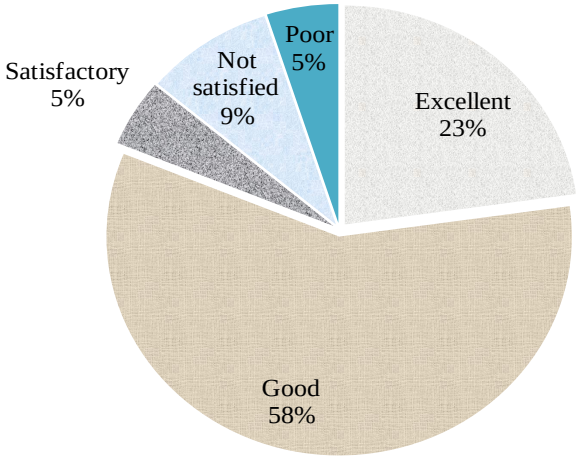

Figure 3.2. Rating on accessibility and supply of antacids

The antacids are mostly used in bovine species followed by canine, swine, feline, caprine, ovine and least in equine (Figure 4.3). MEGACID®, Silica dimethicone and Sodium bicarbonate are mostly used in ruminants and mono-gastric animals whereas Ranitidine, Omeprazole and Pantoprazole are mostly used in pet animals.

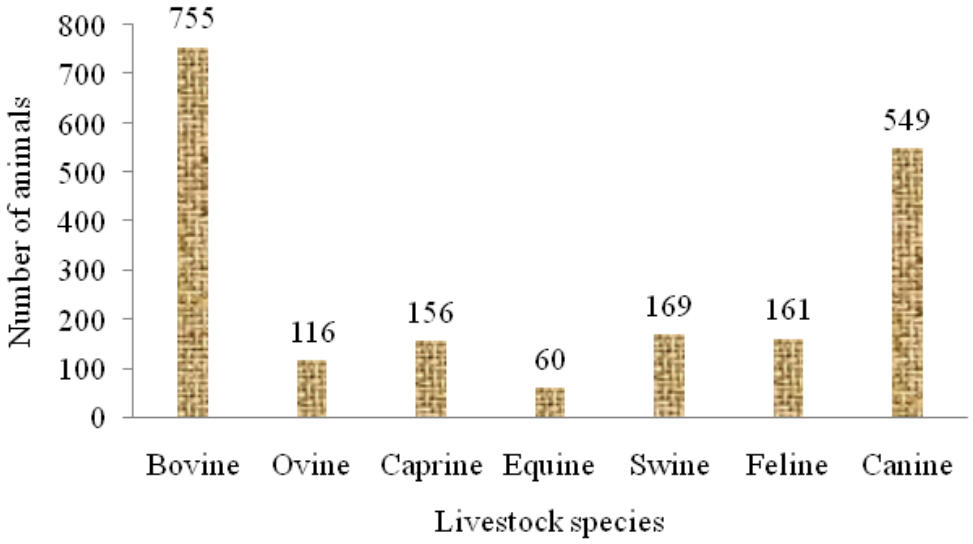

Figure 4.3. Number of different livestock species treated by the respondents with different types of antacids against digestive disorders over the last 12 months

There is an increasing trend in the usage of MEGACID® suspension by the respondents (Figure 4.4). Between 2012 and 2015, quantity of MEGACID® suspension used by the respondents increased by 17%.

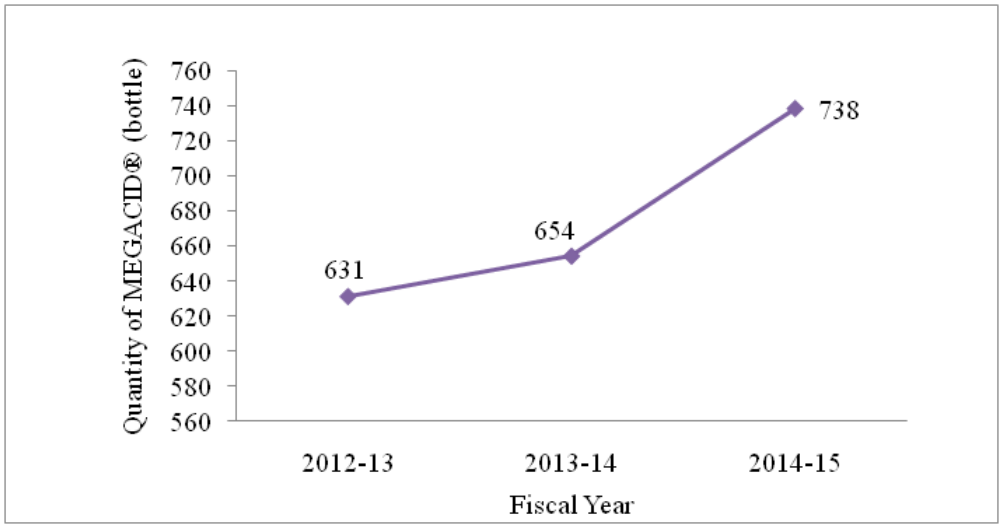

Figure 4.4. Quantity of MEGACID® used by the respondents over the last three fiscal years

Majority (63.6%) of the respondents reported that MEGACID® is effective while 36.4% did not comment on its efficacy. Similarly, 95.5% of the respondents reported that the MEGACID® supplied by NCAH at present is of good quality. In contrast, 13.6% of the respondents reported that they have encountered inferior quality of MEGACID® during 2013. The problem was mainly an organoleptic issue reported in one batch of MEGACID® supplied to the field.

Antacid drugs expiry problems were experienced by 54.5% of the respondents. The 22.7% of the respondents reported that the frequency of expiry is comparatively higher in Omeprazole and Pantoprazole followed by Ranitidine (18.2%) and least in MEGACID® (9.1%). Generally, there is an increasing trend in expiry problems for different antacids such as MEGACID®, Omeprazole, Ranitidine, Pantoprazole and sodium bicarbonate (Figure 4.5). The increasing trend in the expiry is attributed to increased demand of these drugs every year.

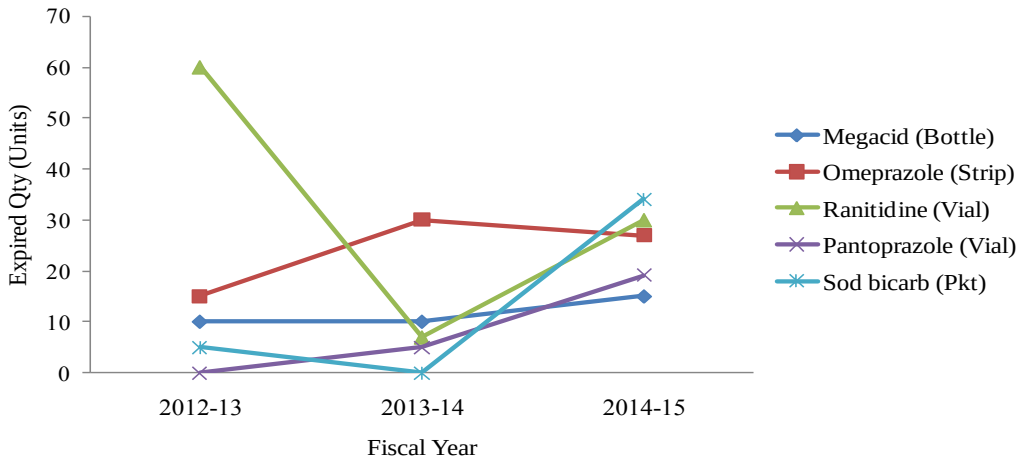

Figure 4.5. Trends in the expiry of antacids over the last three fiscal years

CHAPTER FIVE

Conclusion and Recommendation

5. 1. Conclusion

The survey on antacid drugs established that MEGACID® suspension as the most preferred and commonly used antacid in the field. The preference of MEGACID® suspension over other antacids was attributed to its easy route of administration and availability. The use of MEGACID® suspension by the respondents has increased due to increasing occurrence of rumen acidosis in dairy cattle due to intensification and commercialization resulting from feeding carbohydrate rich diet.

The increase of rumen pH two hours after treatment with MEGACID® suspension in cattle with lowered rumen pH was generally poor and non significant. This suggests that MEGACID® suspension has little effects on increasing rumen pH. However, MEGACID® suspension was found to keep neutralizing rumen acid though it could not increase rumen pH significantly. The MEGACID® suspension seemed to have played an important role to maintain rumen pH near neutral while the rumen pH reduction may be prolonged for certain period of time due to slow digestion. Therefore, based on the outcomes of the current study following recommendations were deduced.

1. Feeding concentrate can reduce the rumen pH and cause rumen acidosis, the use of dietary manipulation to induce a low rumen pH seems to be unfeasible in practice in rumenocentesis as that would most likely lead to metabolic disturbance like acidosis. The pH decrease caused by the diet in this study was probably not low enough to determine significant effect of MEGACID® suspension. Thus, further study is required to evaluate the efficacy of MEGACID® suspension more accurately. A laboratory analysis would help determine the efficacy of the MEGACID® suspension more accurately and would not involve the use of live animals and welfare issues. Evaluation on onset of the antacid action, rate of neutralization, and duration of action were important factors for determining the efficacy of the antacid.
2. If follow up study is considered with rumenocentesis technique, feeding animals *ad libitum* with high concentrate diet would create lower rumen pH necessary to investigate the effect of the MEGACID® suspension. Jersey breeds of cattle would be employed as they are comparatively docile and have higher DMI. The rumen pH would be monitored over 6 hours after oral administration of MEGACID® to avoid prolonged rumen pH reduction caused by slow digestion of feed affecting the

effectiveness of MEGACID® suspension. It would be recommended not to divide animals into groups, instead compare mean rumen pH after and before treatment following acidosis induction to determine efficacy.

3. The sample size of 22 respondents limited the power of survey, thus increasing the number of respondents to consolidate this findings would further support the study results.

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Annexure 1. SOP No. ATT019, rumenocentesis technique followed during the rumen fluid collection

THE UNIVERSITY OF QUEENSLAND
STANDARD OPERATING PROCEDURES
LARGE ANIMAL TEACHING

SOP No:	**ATT 019**
SUBJECT:	**Rumenocentesis – Rumen Fluid Collection in Cattle (April 2015)**
POLICY:	**This procedure may only be performed by, or under the supervision, of an operator skilled in the technique**
PRECAUTIONS:	**Aseptic conditions are required to avoid introduction of pathogens into the abdominal cavity. Restraint of the animal is necessary for the procedure, ideally a crush with a headlock**
EQUIPMENT:	**16 gauge x 12 to 15 cm needles (or similar)** **5 to 10 mL syringes** **Animal clippers** **Alcohol (or other surgical preparation solution) swabs** **Iodine (or other surgical preparation solution) swabs**
PROCEDURE:	**The site of introduction of the needle is midway along an imaginary line drawn between the costochondral junction of the last rib and the patella. An alternative site for the procedure is located on the lower angle of the left paralumbar fossae. Prior to introducing the needle, the area is surgically prepared. The needle is introduced into the rumen and with minimal aspiration a small sample of fluid can be collected.**
RECOMMENDATIONS:	**Fluid analysis will guide subsequent decisions.**

DATE APPROVED: **April 2009**

REVISED: **19.12.2012**
15.04.2015

Source: *http://www.uq.edu.au/files/animals/sops/att/*

Annexure 2. Operation of Schott Gerate pH-metre CG-825

As per the manufacture's guidelines:

1. Connected the Schott Gerate pH-metre CG 825 to the socket with electricity supply
2. Connected the electrode to the pH-metre

Calibration of pH-Metre to the function of electrode

The pH-metre was calibrated according to the factory calibration process before each experiment as below and is believed to ensure accuracy of the pH data. The calibration was carried out based on calibration process:

1. The Schott Gerate pH-metre CG 825 was turned on to the position of 'pH'
2. Selected two buffer solutions with pH value of 7.0 and 4.0
3. Removed the rubber cap of the electrode and rinsed the electrode with distill water
4. Immersed the electrode in a buffer solution with pH value of zero (i.e. pH= 7.0) and set digital display by means of 'Δ pH' knob to the value of the buffer solution
5. Rinsed the electrode with distill water before immersing electrode into the second buffer solution of pH 4.0 and set digital display to the value the second buffer solution (i.e. pH= 4.0) by means of 'mV/pH' knob.
6. Thus the unit is set to electrode characteristics or calibrated.
7. Rinse the electrode

pH Measurement

1. For measuring the pH value, immersed the calibrated electrode in rumen fluid
2. After adequate tempering time, the pH value of the rumen fluid is read and recorded from the display.

Annexure 3. Validation of rumen fluid pH using pH indicator paper (range 5-10).

Annexure 4. Purposive sample list for questionnaire survey on antacids

DVH	Central Agency	Central Farm
Bumthang	RLDC, Kanglung	BSCBC, Jakar
Chukha	SVL, Deothang	NJBC, Samtse
Dagana	RLDC, Tsimasham	NNBF, Yashiyangphu
Gasa	RLDC, Wangdue	NSBC, Jakar
Haa	RLDC, Zhemgang	RMBF, Wangdigang
Lhuentse	SVL, Gelephu	RMBF, Arong
Mongar	NAH, Chubachu	CRC, Wangkha
Paro	NCAH, Thimphu	-
Pema Gatshel	CVH, Phuntsholing	-
Punakha	-	-
S/jongkhar	-	-
Samtse	-	-
Sarpang	-	-
Trashiyangtse	-	-
Thimphu	-	-
Trashigang	-	-
Trongsa	-	-
Tsirang	-	-
Wangdue	-	-
Zhemgang	-	-

Annexure 5. Antacid drugs survey questionnaire

SELF-ADMINISTERED SURVEY QUESTIONNAIRE

Consent Statement

The information in this schedule has to be collected from the heads of the Central Agencies/Farms and Focal Persons of Essential Veterinary Drug Program in Regional Livestock Development Centers/District Veterinary Hospitals or any other competent/relevant person in their absence.

The information you provide will assist in developing appropriate strategies to optimize the proper use of government funds in the procurement of antacids in Essential Veterinary Drug Program. Therefore, please answer the following questions honestly based on the current field scenario. This should help us in streamlining the current procurement, distribution and management of antacids in the Essential Veterinary Drug Program.

The study is conducted by a student from the College of Natural Resources, Lobesa in collaboration with Department of Livestock. There is need to involve many animal health service providers all over the country to participate in the interview. The question is to basically ask you about the different aspects of antacids in treating cattle with digestive tract disorders due to dietary management as well as clinical entities.

All the responses provided by you will be used for the purpose of the research only and will be kept confidential.

Part I: Identification of Central Agency/Central Farms/RLDCs/DVHs

Name of Respondent: ..... Date of Interview: _____/_____/_____

Type of Respondent: ☐Central Agency ☐Central Farms ☐RLDCs ☐DVHs

Name & Location of CA/CF/RLDC/DVH: ……..

Dzongkhag: …… Region: …….

Part II: Indenting and Procurement

1. How often do you indent drugs in a year?
   ☐Biannually ☐Annually
2. What is the frequency of indenting that you would prefer?
   ☐Biannually ☐Annually
3. Do you include any antacids in your annual requirements/indenting of drugs?
   ☐ Yes ☐ No
4. If yes, which are the most common antacids that you requisition for procurement? Tick (√) all that you requisition for.
   a) Aluminum hydroxide, Magnesium hydroxide & Dimethly Polysiloxane (MEGACID® suspension/ULGICEL® suspension) ☐
   b) Omeprazole tablet ☐
   c) Ranitidine Hcl tablet/injection ☐
   d) Pantoprazole injection ☐
   e) Sodium bicarbonate ☐
   f) Other antacids (specify with brand name & active ingredients): ……
5. What quantity of antacids do you indent annually? Please tick(√) the appropriate
   ☐ < 10 bottles/year ☐11-50 bottles/year ☐ 51-100 bottles/year ☐> 101 bottles/year
6. Rank the types of antacids given below according to your requirements or indenting quantities (Rank 1 for that you indent maximum and 5 for that you indent the minimum)
   a) Aluminum hydroxide, Magnesium hydroxide & Dimethly Polysiloxane (MEGACID® suspension/ULGICEL® suspension) ☐
   b) Omeprazole tablet ☐
   c) Ranitidine Hcl tablet/injection ☐
   d) Pantoprazole injection ☐
   e) Sodium bicarbonate ☐

Part III: Supply and Distribution of Antacids

1. How is the supply and distribution of antacid drugs done?
   ☐Biannually ☐Annually
2. In how many lots do you usually receive antacids in your unit?
   ☐Once/year ☐Twice/year
3. What quantity of MEGACID® did your office receive in the last one year?
   ☐ < 10 bottles/year ☐11-50 bottles/year ☐ 51-100 bottles/year ☐> 101 bottles/year

4. Are you satisfied with the quantity of antacids that you receive?
   ☐Yes ☐No

5. If "No," give reasons why?
   a) …….
   b) …….

6. Did your office face any shortage of antacid drugs during the last 2-3 years?
   ☐Yes ☐No

7. If yes, how did your office manage the shortage?
   ☐Emergency/ad hoc lifting from LCS ☐Inter-Dzongkhag mobilization
   ☐Intra-Dzongkhag mobilization ☐Others (Specify)……

8. How would you rate the accessibility and supply of antacids from LCS/DVEU?
   ☐Excellent ☐Good ☐Satisfactory ☐Poor

9. If "Poor" give reasons why?
   a) …….
   b) …….

Part IV: Usage and Management of Antacids

1. Which of the following antacids are commonly available and used in the field? (Tick the appropriate)
   a) Aluminum hydroxide, Magnesium hydroxide & Dimethly Polysiloxane (MEGACID® suspension/ULGICEL® suspension) ☐
   b) Omeprazole tablet ☐
   c) Ranitidine Hcl tablet/injection ☐
   d) Pantoprazole injection ☐
   e) Sodium bicarbonate ☐
   a) Other antacids (Specify)……

2. Rank the types of antacids below according to your preferences for use in the field.
   a) Aluminum hydroxide, Magnesium hydroxide & Dimethly Polysiloxane (MEGACID® suspension/ULGICEL® suspension) ☐
   b) Omeprazole tablet ☐
   c) Ranitidine Hcl tablet/injection ☐
   d) Pantoprazole injection ☐
   e) Sodium bicarbonate ☐

3. Give 2 reasons for the preferences of the rank 1 antacids that you mentioned above
   a) ……..
   b) ……

4. From the lists of antacid drugs given below, which antacid do you use the most in the field? Tick (√) only one antacid drug from the list below.
   a) Aluminum hydroxide, Magnesium hydroxide & Dimethly Polysiloxane (MEGACID® suspension/ULGICEL® suspension) ☐
   b) Omeprazole tablet ☐
   c) Ranitidine Hcl tablet/injection ☐
   d) Pantoprazole injection ☐
   e) Sodium bicarbonate ☐

5. Give 2 reasons for maximum use of the particular antacid that you mentioned above
   a) ……
   b) ……

6. How often do you encounter digestive tract disorders in bovine? Tick (√)
   ☐Every week ☐Every two weeks ☐Every month ☐Rarely ☐Never

7. During the last three years, what quantity of antacid (MEGACID®) did your dzongkhag/agency/farm used? (Provide the quantity only and rate and amount will be calculated later)

Year	Quantity (Bottle)	Rate (Nu)	Amount (Nu.)
2014-15			
2013-14			
2012-13			

8. How many livestock did you treat with antacid drugs in the last 12 months?

Species	**No. of animals**	**Name an antacid that you used to treat**
Bovine		
Ovine		
Caprine		
Equine		
Swine		
Feline		
Canine		

9. Have you done any follow up after administration of an antacid (MEGACID®)?
   ☐Yes ☐No

10. If yes, is it effective in the treatment of ruminal acidosis or digestive tract disorders in cattle?
    ☐Yes ☐No

11. If "No," give possible reasons for its poor efficacy
    a) ……
    b) ……

12. If antacids are not used in your office/unit/agency, what are the possible reasons for not using them?
    a. The antacids are not effective in the treatment of digestive disorders in animals
    b. Antacids are not available for use in animal treatment
    c. Antacids are procured in limited quantity and thus low distribution
    d. There are no digestive tract disorders cases in animals to treat
    e. Others (specify)……

Part V: Quality Issues related to Antacids

1. Do you think the antacids that DVEU/LCS procures are of good quality?
   ☐Yes ☐No

2. Give possible reasons for your answer? Why 'Yes'? If yes and Why 'No'? If no.
   a) ……
   b) ……

3. Have you encountered any inferior quality of antacid (MEGACID®) that was supplied to you by DVEU/LCS?
   ☐Yes ☐No

4. If "Yes," specify the problems of inferior quality
   a) ……
   b) ……

5. Did you receive any complaint from animal owners with regard to quality and efficacy of antacids (MEGACID®) that your office dispensed for treatment?
   ☐ Yes ☐ No

6. If yes, in what species of animal?
   Cattle ☐Sheep ☐Goat ☐Horse ☐Pig ☐Others (Specify)…….

7. Have you ever reported the quality related issues of antacids to relevant authorities? (Tick (√) appropriate) ☐No ☐NCAH ☐RLDC ☐DVH ☐DRA ☐Others (Specify).....

Part VI: Expiry Problems of Antacids

1. Do you experience expiry problems in antacids in your agency?
   ☐ Yes ☐ No

2. If "Yes," which of the antacids below frequently get expired in the field? Please tick (√) the appropriate ones.
   a) MEGACID® suspension/ULGICEL® suspension ☐
   b) Omeprazole tablet ☐
   c) Ranitidine Hcl tablet/injection ☐
   d) Pantoprazole injection ☐
   e) Sodium bicarbonate ☐

3. What is the quantity of antacids expired in the last 3 years in your centre?

Type of Antacids	**Unit**	**2014-15**	**2013-14**	**2012-13**
Megacid/Ulgicel	Bottle			
Omeprazole tablet	Strip			
Ranitidine Hcl tablet	Strip			
Ranitidine Hcl injection	Ampoule			
Pantoprazole injection	Ampoule			
Sodium bicarbonate pdr.	Packet			

4. What are the reasons for the expiry? (Tick)
   a) Antacid drugs are supplied with shorter shelf life
   b) Antacids are supplied in large quantities by DVEU/LCS (Not as per indent)
   c) Only few animals suffer from digestive disorders (Limited use only)
   d) Others (Specify): ……

5. How do you dispose the expired antacids?
   ☐Direct incineration ☐Directly into disposal pit ☐Facilitated through RLDCs/NCAH
   ☐Direct dumping in LCS ☐No disposal mechanism in place

6. What are the difficulties that you face in disposal of these expired antacids?
   a) ……
   b) ……

"THANK YOU" FOR COMPLETING THIS QUESTIONNAIRE