



UNIVERSITI PUTRA MALAYSIA

**A RETROSPECTIVE STUDY (2013-2019) IN CLINICAL MANAGEMENT
OF DIARRHEA IN RUMINANTS FROM SELECTED FARMS IN KLANG
VALLEY, MALAYSIA**

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FPV 2020 30**

A RETROSPECTIVE STUDY (2013-2019) IN CLINICAL MANAGEMENT OF DIARRHEA
IN RUMINANTS FROM SELECTED FARMS IN KLANG VALLEY, MALAYSIA



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A project paper submitted to the

Faculty of Veterinary Medicine, Universiti Putra Malaysia

In partial fulfillment of the requirement of the

DEGREE OF DOCTOR OF VETERINARY MEDICINE

Universiti Putra Malaysia, Serdang, Selangor Darul Ehsan.

2020/2021

CERTIFICATION

It is hereby certified that we have read this project entitled “ A Retrospective study (2013-2019) In Clinical Management Of Diarrhea In Ruminants From Selected Farms In Klang Valley, Malaysia”, by Muhd Nazreen Shah bin Sarbani and in our opinion it is satisfactory in terms of scope, quality and presentation as partial fulfilment of the requirement for the course VPD4999- Final Year Project

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ACKNOWLEDGEMENT

Alhamdulillah, Allah SWT the Great and the Merciful Lord, for giving me strength, comfort and ability to finish this journey.

Firstly, outmost gratitude to my supportive supervisor, Prof Jesse Faez Firdaus Abdullah for all encouragement, guidance and support throughout this entire project. Thank you for everything starting from beginning until the end.

Next, to my beloved parents, Sarbani bin Abu and Suriati binti Kamaruddin. Thank you for always giving me lot of moral supports and advices throughout this project.

Million thanks to :

Mr Jefri

Dr Azrol Harith

Syed Amirul Hakim bin Syed Luqman

Filzah Nur Aqilah binti Faudzi

Revathi a/l Wardan

Shazem Ashril bin Sulaiman

Abdul Aziz bin Ismail

Nurul Azillah binti Hamzah

Adila Farhana binti Kamaruzzaman

And All my DVM 21 friends

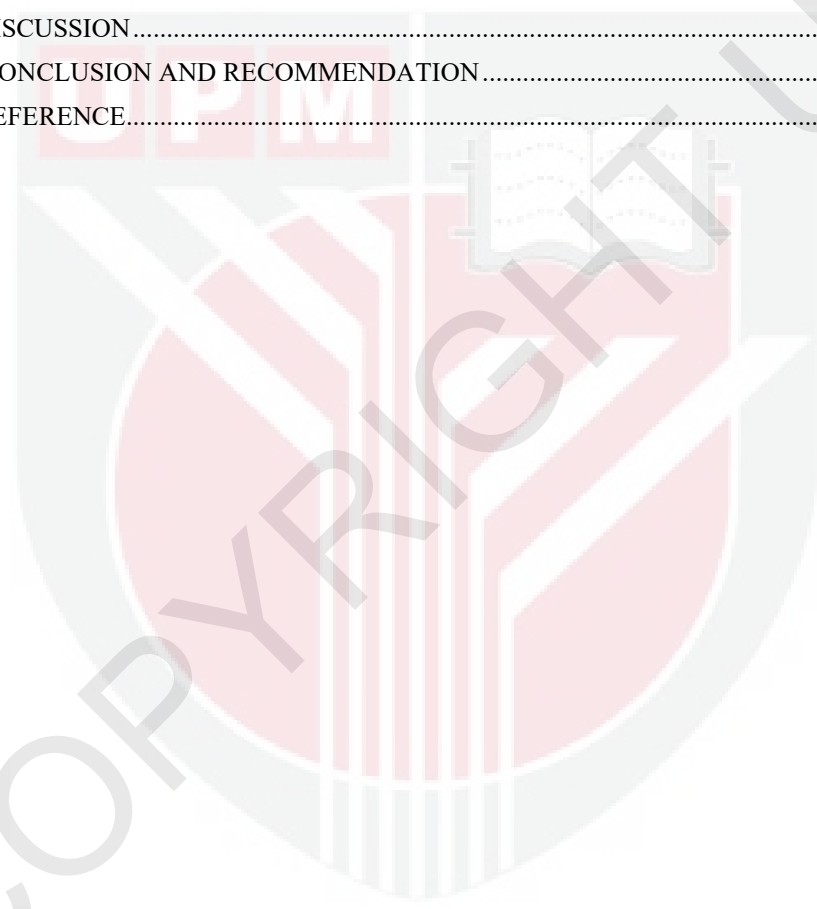
This project would be nothing without all your endless guidance and supports.

I am grateful and lucky to have all of you.

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ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfillment of the course VPD 4999 - Final Year Project.

A RETROSPECTIVE STUDY (2013-2019) IN CLINICAL MANAGEMENT OF DIARRHEA IN RUMINANTS FROM SELECTED FARMS IN KLANG VALLEY

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2020

Supervisor: Prof. Dr. Faez Firdaus Jesse Abdullah

Diarrhea is one of the most common gastrointestinal system problem occurs in ruminants in Malaysia and it has been classified as one of the most costly disease throughout the world. However, there is a lack of published studies or data pertaining to this topic despite its high incidence particularly in our local setting. In this study, data on common diarrhea problem and its clinical signs, common drug usage for treatment, and further follow-up plan after first farm visit was tabulated and analyzed and the correlation with the effectiveness and successful rate in curing the disease from the planned treatment was tabulated. From this study, Coccidiosis (%) is the most prevalent protozoan parasitic disease that cause diarrhea in large ruminant whereas most small ruminant are reported with other infectious causes such as bacteria, viral and parasite. Thus, diarrhea are clinically managed with proper diagnosis and treated with Oxytetracycline as preferred antibiotics and Flunixin Meglumine as anti-inflammatory drug of choice. Most of the reported diarrhea cases, the animals were treated commonly with vitamin such Vitavet and anti-diarrheal such as kaolin pectin and scourban plus. It is found that not many diarrhea cases were revisited after the first farm visit. In conclusion, from this study the data on common diarrhea cases and its clinical signs, common drug usage for treatment, and further follow-up plan after first farm visit were identified and this will give additional information's and will assist field veterinarians on clinical management in small and large ruminant livestock in our local settings and also to understand the necessity in the compliance of the veterinarians/clinicians in updating the clinical cases by constant follow up via farm revisits.

Keywords: Clinical Management, Gastrointestinal System Problem, Diarrhea, Ruminant, Clinical Signs, Treatment Regime and Revisit.

ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999 - Projek Ilmiah Tahun Akhir.

KAJIAN RETROSPEKTIF (2013-2019) MENGENAI PENGURUSAN KLINIKAL DALAM CIRIT-BIRIT HAIWAN RUMINAN DARIPADA LADANG-LADANG TERPILIH DI KAWASAN KLANG VALLEY

Oleh

Muhammad Nazreen Shah bin Sarbani

2020

Penyelia: Prof. Dr. Faez Firdaus Jesse Abdullah

Cirit birit adalah salah satu daripada masalah sistem gastrousus yang paling kerap berlaku dalam kalangan haiwan ruminan di Malaysia dan ia telah diklasifikasikan sebagai penyakit yang mempunyai dampak ekonomik yang merugikan pada industri ruminan di pelbagai negara di seluruh dunia. Walaubagaimanapun, kurang kajian atau data yang diterbitkan tentang topik ini meskipun masalah ini kerap berlaku di kawasan tempatan. Dalam kajian ini, data mengenai masalah cirit birit yang utama, tanda-tanda klinikal, penggunaan ubat-ubatan yang lazim untuk rawatan, dan pelan susulan selanjutnya selepas lawatan ladang pertama diteliti dan dianalisis, korelasi dengan keberkesanan dan kadar yang berjaya dalam menyembuhkan penyakit dari rawatan yang telah dirancang dijangkakan. Dari kajian ini, koksidiosis adalah salah satu penyakit protozoa parasit yang paling lazim bagi ruminan besar, manakala bagi ruminan kecil, kebanyakannya dilaporkan dengan pelbagai penyebab jangkitan lain seperti bakteria, virus dan parasit. Sehubungan dengan itu, masalah cirit birit diuruskan secara klinikal dengan diagnosis yang sistematik, dan dirawat dengan Oxytetracycline sebagai antibiotic pilihan dan Flunixin Meglumine sebagai ubat anti-radang pilihan. Kebanyakan kes cirit birit yang telah dilaporkan, kesemua haiwan telah dirawat dengan menggunakan vitamin seperti Vitavet dan anti cirit seperti kaolin pectin dan scourban plus. Kebanyakan kes-kes cirit birit didapati tidak dikunjug semula untuk pemerhatian progres penyakit. Berdasarkan penemuan kajian ini, maklumat tambahan boleh diberi untuk membantu doktor veterinar untuk memperbaiki pengurusan klinikal penyakit pernafasan yang melibatkan haiwan ruminan yang sedia ada demi masa akan datang.

Kata Kunci: *Pengurusan Klinikal, Haiwan Ruminan, Masalah Sistem Gastrousus, Cirit birit, Tanda-Tanda Klinikal.*

Chapter 1

INTRODUCTION

Diseases involving digestive system in small and large ruminants can be caused by various etiological agents such as virus, bacteria and parasite (Holland, 1990). The major complaint that usually found in the farm (particularly in the first few months of life) will be diarrhea (Frank and Kaneene, 1993; Abhishek, 2011) and the onset form of diarrhea depends on the severity of the infection. This condition can be caused by infectious agents such as virus, bacteria, parasite as well as non-infectious agent, such as nutrition, hygienic and farm management (Smith, 2009; Bartels *et al.*, 2010, Izzo *et al.*, 2011). In small and large ruminants, infectious diarrhea of neonatal animals is one of the commonly reported as gastrointestinal related disease and causes major economic loss in agriculture industry (House, 1998; Wudu, 2008). In 2007, stated that about 57% of weaning calf mortality is due to diarrhea condition and age of affected calves are less than 1 months old (USDA, 2008). Moreover, it has been estimated that 50% of calf mortality in dairy herds is pre-weaning due to acute diarrhea (Aldridge and Potter, 2011).

Many cases of neonatal diarrhea are possibly mixed infections where there are more than one of the pathogenic agents. Generally, complex interaction between the environment, infectious agent and the calf itself are contributing to the diarrhea and causing major constraint for raising the replacement stock (Yimer *et al.*, 2015). Clinical presentation can range from mild diarrhea without systemic disease to serious, acute diarrhea associated with severe dehydration, significant acid-base and electrolyte balance disruption, and death (Gruenberg, 2014).

One of the main examples of bacterial agents causing diarrhea in small and large ruminants is *Escherichia coli* (*E. coli*). According to the literature, the agent is one of the common resident microbiota of the intestinal tract of calves and able causing mortality in young animals (Sharma *et al.*, 2006; Quinn, 2011). The prevalence quoted in the literature of *E. coli* O157 in individual cattle varies considerably, with rates of 1.8% in Japan (Miyao *et al.*, 1998), 1.9% in Australia (Cobbold & Desmarchelier, 2000), 1.5% in Brazil (Cerqueira *et al.*, 1999). There is also been reported a prevalence of 0.2% in lambs taken to slaughter in Italy (Battisti *et al.*, 2006). According to Quinn *et al.* (2011) stated that pathogenic strains of *E. Coli* causing severe diarrhea, dehydration, fever, fatigue, malaise and depression that results in economic losses in both dairy and beef calves production. Based on the clinical case report by Jesse *et al.* (2016), stated that a 2 weeks old Frissien cross calf diagnosed with colibacillosis had clinical sign of body condition score of 2/5, was dull and depressed, had bilateral sunken and congested eyes, faeces soiled perineal region and watery faecal material with evident haematochezia. The clinician also described that the treatment administered for this case was antibiotic, (NSAID's) such as Flunixin meglumine and fluid therapy by administering lactated Ringers (LR) solution and 20% glucose saline (G20).

On the other hand, the common viral caused agents involved in diarrhea for ruminants is Rotavirus (Gruenberg, 2014). Enteritis and diarrhea seem to be the major clinical findings in neonatal lamb (Theil *et al.*, 1996; Wani *et al.*, 2004) and calves within few days of their birth (McNulty, 1978; Holland, 1990; Steele *et al.*, 2004). In 1979, the prevalence was reported to be as high as 98 percent in USA while prevalence rate of 90 percent was recorded in Italy, 1988 (Schlafer and Scott 1979; Castrucci *et al.*, 1988b). In infants the infection with rotavirus is usually characterized by watery diarrhea and severe dehydration whilst adult

infection is often subclinical (Malik *et al.*, 2005; Ramani and Kang 2007). Many other factors such as dehydration, unhygienic environment, winter temperature variations or chilling and high population density in farms can also increase the severity of the disease (Woode 1976; Chauhan and Singh 1996). The main treatment for viral diarrhea in young animals by administering fluid therapy to restore the fluid reserve and the usage of antibiotic was not indicated in viral infection unless it is used for secondary bacterial infection (Murphy *et al.*, 1999; Steele *et al.*, 2004).

Apart from that, parasitic infection also one of the infectious agents causing diarrhea and enteritis in small and large ruminants (Zainalabidin *et al.*, 2015). The major nematodes that infest goats in Malaysia, causing severe morbidity and mortality annually are the Strongyles (Nor-Azlina *et al.*, 2011). According to Eysker and Hassan (2005), clinical manifestations of parasitic gastroenteritis include diarrhea, body weight loss, anaemia, lethargy, tachypnea, tachycardia and collapse. A clinical case report by Jesse *et al.* (2017), reported that Jamnapari crossed goat aged two years with a history of diarrhea for about a week were presented with poor body condition, dull and depressed and wet and dry fecal traces were observed around the groin region.. Therapeutic plan for this case were gastrointestinal protectant (kaolin pectin), antihelminthic drug (levamisole) and fluid therapy (lactated ringers). This particular clinical case followed up for one week post treatment and it showed where the condition improved and the patient was in bright and alert.

Another common protozoan parasite related to the gastrointestinal diarrhea in small and large ruminant will be *Cryptosporidium*. *Cryptosporidium andersoni* infects the abomasum and *Cryptosporidium parvum* infects the small intestine are two species which are significantly importance for livestock animals (Taylor *et al.*, 2007; Radostits *et al.*, 2008). Cryptosporidiosis

not only can be found in neonatal calves, but lamb and kids also might be affected (Radostits *et al.*, 2008). According to Sevinc (2004), the prevalence of the cryptosporidiosis become epidemic to many countries and major economic problem for lambs and kids in Turkey. Clinical sign such as weight loss, anorexia, diarrhea, dehydration and high morbidity can observed in cases of cryptosporidium parvum between age 5 to 15 days old calves and 5 to 10 days for kids and lambs (Navarre and Pugh, 2002; Radostits *et al.*, 2008). Till date there is no any successful treatment used in ruminants to treat cryptosporidiosis (Navarre and Pugh, 2002). Klein (2008) stated that by administering oral dose of Halofuginone (0.1mg / kg) daily for 7 days can reduce oocyte excretion and diarrhea intensity due to cryptosporidiosis. Navarre and Pugh (2002) and Matthews (2009) have stated that Decoquate, (2.5 mg/ kg) can be effective for cryptosporidiosis prevention in goats and lambs.

Non infectious agent also contributed to gastrointestinal inflammation and diarrhea in small and large ruminants. It have been reported that consuming elemental sulfur (Albert *et al.*, 1956; Bird and Hume, 1971), calcium sulfate (Barrentine and Ruffin, 1958) or sodium sulfate (Johnson *et al.*, 1968) in very large quantities can lead to toxification. According to Coghlin (1944) and White (1964), stated that toxicity sign such as muscle twitching, diarrhea abdominal pain may be observed in cattle while sheep will exhibit sign of strong odor of sulfide on breath and black diarrhea. Other causes such as acute arsenic toxicosis can occur when the animals have access to old outbuildings, discarded materials or areas that consist of arsenic to chromium and lead (Neiger *et al.*, 2004). According to the cases presented in Purdue University Veterinary Teaching Hospital, combination treatment of sodium thiosulfate with oral and intravenous fluid resulted in reduce in blood arsenic concentration in all animals (Bertin *et al.*, 2013). Many published report stated that the prognosis for acute arsenic toxicosis is grave as the animal may

not tolerate with the treatment and dose of toxicity (Hatch *et al.*, 1978; Thatcher *et al.*, 1985; Faires, 2004; Neiger *et al.*, 2004). Another noninfectious causes diarrhea in neonatal ruminant may due to improper mixing of milk replacer, improper handling milk or milk replacer and grain overload (Meera and Munashe, 2018) while for adult ruminant it may caused by copper deficiency, renal amyloidosis and grain overload.

Rotavirus, E. coli and Cryptosporidium parvum are the common infectious agent of diarrhea among neonatal farm animals. Common clinical signs such anorexia, frequent voiding of watery feces, weakness and dehydration tend to be observed in the affected animals. Tentative diagnosis was made based on the age of animal at onset of diarrhea, characteristic of the feces, duration and severity of diarrhea and how well the animal response to the treatment. Multifactorial problems such as host immunity, environmental factors, nutritional factors, and management conditions play role in the development of diarrhea in animals (Steele *et al.*, 2004).

There is a lack of study and gap of information on retrospective study in clinical management of diarrhea in small and large ruminants. Therefore, this study was designed to observed previous clinical management diarrhea problems and suggest recommendations in the clinical management with current known knowledge of this disease. From the literature, there are several retrospective studies that were carried out but there is still a lack of published studies or data pertaining to this topic despite its high incidence particularly in our local setting. In this study, data on common diarrhea problem and its clinical signs, common drug usage for treatment, and further follow-up plan after first farm visit will be tabulated and analyzed and the correlation with the effectiveness and successful rate in curing the disease from the planned treatment will be tabulated. The findings from this study may give additional information and

assist field veterinarians on improving the clinical management of diarrhea involving small and large in future. Therefore, the objectives of this study are:

1. To identify the common diarrhea problems in ruminants presented to University Veterinary Hospital, Universiti Putra Malaysia (UVH-UPM) and Taman Pertanian Universiti, Universiti Putra Malaysia (TPU-UPM) from 2013-2019.
2. To categorize the severity onset of the diseases, the common treatment regime used in (UVH-UPM) and (TPU-UPM) to treat gastrointestinal system diseases in ruminant from 2013-2019.
3. To report the result of follow-up by clinicians after the first farm visit.

Chapter 2

LITERATURE REVIEW

2.1 Definition

Diarrhea in neonatal ruminants is typically associated with small intestine disease, which may be caused by hypersecretion or malabsorption. Hypersecretory diarrhea occurs when an excessive amount of fluid is secreted into the intestine, which exceeds the mucosal resorptive ability (Gruenberg, 2014). According to Chigerwe & Heller (2018), diarrhea is likely to occur in adult ruminants because of maldigestion and malabsorption secondary to infectious enteritis, whereas osmotic form may develop secondary to carbohydrate concentration. However, most of diarrheal cases were found among calves 0 to 4 weeks old and concentrated between calves 0 to 2 weeks old (Yimer, 2015). About 50% of diarrhea condition in ruminants was observed to be caused by more than one pathogen rather than by primary pathogen in some cases (Cho, 2012). Diarrhea, or scours in small and large ruminants can be due to the infectious and non infectious factors (Smith, 2009; Bartels, 2010; Izzo, 2011) such as viruses, bacteria, protozoa, insufficient uptake of colostrum, poor sanitation, stress and cold weather. Common bacterial pathogens that contributes to the diarrhea condition in ruminants are *Salmonella* spp., *E.coli* K99+., *Clostridium*; and in other hand, Rotavirus, Coronavirus, Bovine Viral Diarrhoea Virus (BVDV) are some of the important viral pathogens while *Cryptosporidium* spp., as protozoan agent (Bhat *et al.*, 2012; Bhat *et al.*, 2013; Singla *et al.*, 2013).

2.2 Infectious diarrhea

Neonatal infectious diarrhea is one of the most severe and economically devastating conditions in the animal-farming industry (Wudu, 2008). Severity of diarrhea is determined by

the age of animals, immune status of dams and environmental condition in farms (Andrews, 2004; Cho and Yoon, 2013).

2.2.1 Bacterial enteritis

Enteritis defined as inflammation of intestine. According to Ghanem et al (2012), there is some predisposing factors cause enteritis. Firstly, neonatal kids with immunoglobulin deficiency are more vulnerable than adults. Second, multiple stresses such as transportation, food and water deprivation or weaning can cause the animal to suffer with immunosuppression and enteritis. Last, prolonged oral use of antibacterial agents can alter the intestinal microflora and enable the organisms to develop resistance. In adult cattle and small ruminants, various bacterial, protozoan and viral diseases cause infectious enteritis. According to Heller & Chigerwe (2018), the most common sign of infectious enteritis in ruminants is diarrhea. One of predominant infectious agents causing enteritis are bacteria such as *E.coli* and *Salmonella* spp., or *Clostridium perfringens* (Bergeland and Henry, 1982; Acha *et al.*, 2004; Brown, 2007; Bhat *et al.*, 2012).

According to Holschbach & Peek (2018), *Salmonella* is a genus of gram-negative anaerobic facultative bacteria belonging to the Enterobacteriaceae family. The most important etiologic agents causing salmonellosis in cattle are *S. enterica* serovar typhimurium (*S. typhimurium*) and serovar dublin (*S. dublin*) (Sojka *et al.*, 1977). Within hours of birth, calves can become infected with a wide range of salmonella serotypes (Anderson, 2001). He stated that outbreaks of neonatal disease are commonly seen in calves aged between 4 and 28 days. Older calves can however be affected. *Salmonella* can cause diarrhea in both adult and calf cattle thus infection is much more common and often causes severe symptoms in 10-day to 3-month-old calves (Fossler et al., 2005). *Salmonella enteritica* serovar Typhimurium is generally

known for enteric disease outbreaks in calves below 2 months of age (Wray and Davies 2000; Gelberg, 2001). Adult cattle commonly infected with *S. typhimurium* will exhibit predominant clinical sign such as diarrhea and dullness (Veling et al., 2002). In the UK, the most common serovar cattle infection is *S. dublin* (66.3%) followed by *S. Mbandaka* (10%) and *S. typhimurium* (4.8%) (DEFRA, 2012). Infection with salmonella has a wide variety of clinical symptoms, from asymptomatic to clinical salmonellosis. Infections of salmonella are well known in dairy cattle for their association with clinical signs of enterocolitis, septicemia and abortion (Peek, 2017). Clinical signs include fever, slow mentation, loss of appetite and scours that often include increased mucus and blood (Wray and Davies, 2000; Gelberg, 2001; Quinn *et al.*, 2002; Smith, 2002). Another point of view by Fossler et al (2005), affected calves may be presented with clinical sign such as watery and mucoid diarrhea with fibrin and blood. Apart from that, Mohler et al (2009) reported that in acutely affected calves, dehydration combined with acid base and electrolyte derangements, leads to fatigue and depressed mentation. Usually the first clinical symptoms found in acute infections are inappetence and depressed mentation. Pyrexia and diarrhea accompany post infection in 48 to 72 hours. Post infection can persist for up to 7 days (Mohler *et al.*, 2006;2008). Infection with Salmonella is most frequently spread through fecal – oral infection from other animals, rats, birds or by consuming animal by-products of infected protein sources (Smith, 2009). Other routes recorded include the upper respiratory and conjunctival mucosa. Upon ingestion, salmonellae colonize the intestinal tract and invade enterocytes by M-cells which is specialized in intestinal lymphoid tissues (Holt, 2000; Reis, 2003). Enterocolitis caused by Salmonella spp, due to inflammation associated with maldigestion and malabsorption, and lesser extent from secretory mechanism and leads to fresh blood usually seen in the feces of both adults and calves (Wray, 2000; Peek,

2017). All in all, the extent and duration of clinical disease in calves is correlated with strain virulence, challenge dosage, calf age, passive immunity capacity, diet, and degree of stress on the environment (Mohler *et al.*, 2009).

Besides that, Colibacillosis, an *Escherichia coli* (*E. coli*) infection seems to be a significant cause of death in young calves (Sharma, 2006). According to Raji (2014), *E. coli* also causes diarrhoea and mortality in kids and lambs, and may also pose severe health risks. *Escherichia coli* is a gram negative, rod-like, facultative anaerobic bacteria commonly found in humans and animals' intestines (Fairbrother and Nadeau, 2006); yet other strains of this organism are pathogenic (Quinn *et al.*, 2011). *Escherichia coli* is classifiable into six virulence-based pathogroups: enterotoxigenic *E. coli* (ETEC), shiga toxin-producing *E. coli*, enteropathogenic *E. coli*, enteroinvasive *E. coli*, enteroaggressive *E. coli*, and enterohaemorrhagic *E. coli* (Kaper *et al.*, 2004; Wani *et al.*, 2013). Study was made by Hornitzky et al (2005) stated that two diarrhoeagenic pathotypes *E. coli* is most widely known as enteropathogenic *E. coli* (EPEC), and Shiga toxin-producing *E. coli* (STEC) Identified as Enterohemorrhagic *E. coli* (EHEC). Certain serotypes of Enterotoxigenic *E. coli* can cause septicaemia or diarrhea in very young calves (Kang et al., 2004; Gruenberg, 2014). Septicemic colibacillosis is a main cause of early deaths of calves. The disease is frequently fatal or leads to post-septicaemic infections, which are often untreatable (Bashahun and Amina, 2017). Neonatal calves are most prone to ETEC infection in the first 4 days after birth and if infected, exhibit watery diarrhea (Foster and Smith, 2009) while lambs aged 2 to 6 weeks are commonly diagnosed with colisepticemia, with serious illness and rapid death (Hassan *et al.*, 2014). These pathogenic strains can be transmitted by polluted water, food, direct or indirect contact with infected animals or a human (Kahn and Line, 2005; Fair brother and Nadeau, 2006). Another sources reported that transmission occurs

most often by the oral-faecal route by the ingestion of infected feed and water, but contamination by the umbilical vein and nasopharyngeal was thought to occur in some serotypes of *E.Coli* (Radostits *et al.*, 2007). In neonatal animals, clinical symptoms such as diarrhea, rise in body temperature, general weakness, dehydrated and anorexic usually reported. Coma and death followed within few hours after symptoms (Radostitis *et al.*, 2000; Blood *et al.*, 2011). From a case report by Jesse *et al* (2016), typical clinical manifestations for enteric Colibacillosis which includes diarrhea and dehydration, weakness accompanied by loss of condition; systemic reaction as well as abdominal distention were observed. In acute cases collapse, with no signs but a few animals exhibit signs of stiff gait and tetanic convulsions with acute meningitis. The symptoms of arthritis occur in chronic cases. There may be no major lesions, but there may be subserous and submucosal petechial haemorrhage and enteritis in those who have died from colisepticaemia (Rosilawati *et al.*, 2016). Profuse, foul-smelling, yellow to white diarrhea may infect the lungs, navel or joints with dull and emaciated infected calves and can cause sudden death in calves below two weeks of age due to septicemia or toxemia (HMD, 2010). Infection become localize as there is extent of clinical course as polyarthritis, ophthalmitis, omphalophlebitis, and meningitis may occur within the first week of the initial bacteremic phase (Gruenberg, 2014). Shesh (2013) stated that Septicaemic colibacillosis also occurs as a acute infection and typically results in the calf's rapid death from bacteraemia *E. coli*. To conclude, young small ruminants are particularly susceptible as septicemic colibacillosis may occur due to inadequate intake of colostrum leading to circulating immunoglobulin deficiency in the body (Hassan *et al.*, 2014).

Next, *Clostridium perfringens* is a Gram-positive, sporeforming anaerobic bacterium which causes a wide range of mammalian and bird diseases (Van Immerseel *et al.*, 2004) and

can be found in intestinal tract of human, animal, insect and soil. According to Popoff and Bouvet (2009), Clostridium species are common cattle flora and are only problematic with dietary stress, injury, management changes, parasitism that leads to the production of potent toxins. In sheep, goats and other animals the diseases are generally called enterotoxemia (Uzal and Songer, 2008). This disease is one of the prevalent diseases in Pakistan causing deaths in lambs and kids up to 100 per cent (Javed *et al.*, 2009). Based on its toxin production, it is divided into five types (types A-E) i.e. alpha, beta, epsilon and iota toxin (Shimizu *et al.*, 2002; Gokce *et al.*, 2007; Uzal and Songer, 2008). Clostridium perfringens type A has been associated with several conditions in cattle, including clostridial enteritis in neonates with hemorrhagic abomasitis and abomasal ulceration (Songer and Miskimins, 2005) in affected calves, hemorrhagic enteritis in adult cattle and calves (Manteca *et al.*, 2002), and type A hemorrhagic enteritis, and sudden death in calves at specific times during feeding. Constable (2017) also reported that although Clostridium infections are more prevalent in young ruminants, *C. perfringens* type A was associated with highly fatal hemolytic enteritis in adult cattle animals and sheep and hemolytic enterotoxemia in goats. Moreover, Beta toxin produced by *Clostridium perfringens* type B and C causes hemorrhagic enteritis in young lambs and kids thus causing diarrhea and dysentery (Iqbal *et al.*, 2017). *C. Perfringens* type D also produces various toxins, the most potent of which is epsilon toxin, which is absorbed into the bloodstream and damages the intestinal vascular system and increases the permeability (HADİMLİ *et al.*, 2012). The clinical manifestation and extent of the resulting infection differs greatly depending on the toxigenic type involved and the particular toxin produced (Greco *et al.*, 2005). Clostridial enteritis occurs in all type (A-E) and the clinical signs varies according to the toxin produced. Acute onset of depression, dyspnea, pyrexia, vomiting, yellow or jaundiced mucous

membranes, stomach pain, and hemoglobinuria are typical clinical signs (Chigerwe & Heller, 2018). Based on the case conducted by Elsify et al (2016), there three clinical form was observed; acute onset of depression, pale mucous membrane, collapse, dyspnea and extreme abdominal pain define the first stage. This process ended with the death of sick animals within the same day of disease onset, although few animals could live for many days. The second form involves sudden death. Depression was observed in some cases, with abdominal pain and extreme, bloody to greenish diarrhea. The last form observed is due to diarrhea, inappetence, depression which ended with collapse and death. In certain cases, progressive fatigue with the development of nervous symptoms such as dullness, ataxia, instability and paralysis of the head with the neck rest seen laterally on the shoulder. According to Simpson et al (2018), affected animals with type A usually will presented with inappetance and enteritis that occur in short period, acute condition. The animals will not exhibit any clinical signs and had normal temperature unless generalized sepsis is present. Haemorrhagic diarrhea will develop later as the disease become chronic. Type C was documented frequently in conjunction with calf diarrhea among these types, but not as frequently as some enteric pathogens like *E. Coli*, and *Salmonella* (Muktar *et al.*, 2015).

Johne 's disease (JD) is a chronic recurrent, gastroenteric ruminant disease caused by *Mycobacterium avium* subsp. Paratuberculosis (MAP) (Geraghty *et al.*, 2014). MAP is thought to be unable to multiply outside a host, although the organism can remain viable in the environment for long periods of time, surviving in faeces for more than a year (Whittington *et al.*, 2004) depending on climate (Eppleston *et al.*, 2014). Ayele et al (2004) stated that MAP is transmitted via fecal and milk ingestion from infected animals and likely through placenta in pregnant animals and in semen in infected bulls. This organism then incubate in the small

intestine, and the cattle exhibit only clinical signs at age 3-5 (Franklyn, 2011). Another view, Radia et al., (2013) identified calving environment as the primary source of infection, with indoor calving, faecal contamination in the calf house and the time spent with the dam as the major risk factors for infection. Clinical sign of JD in cattle easily to identified such as watery diarrhea, weight loss with good appetite, edema and hypoproteinemia caused by protein losing enteropathy (Sweeney *et al.*, 2012). It affects all ruminants' small intestines, causing chronic diarrhoea that is not receptive to treatment (Harris, 2001). The most persistent clinical symptom in sheep and goats with a healthy appetite, is a chronic weight loss. While severe diarrhea is common in cattle with Johne 's disease, this sign is not common in sheep or goats (Michael, 2019). Gilmour (1954) stated that diarrhea in Johne 's disease develops slowly, beginning with occasional diarrhea, and then gradually becoming more severe until it is persistent. Subclinical carriers excrete variable numbers *M. Paratuberculosis* in the faeces, while more organisms are excreted in the most of cases as clinical disease develops (OIE,2008). Lastly, it is important to remember that the elimination of infected animals in a herd is one of the best management practises because JD is very difficult to monitor and eradicate (Salem *et al.*, 2013; Ritter *et al.*, 2016).

2.2.2 Viral enteritis

Rotavirus and coronavirus are common viruses in cattle herds and are associated with approximately 60 percent of reported outbreaks of calf diarrhea (VLA, 2004). An early analysis at the US Sheep Experiment Station found that diarrhea accounted for 46 percent of lamb death (Schoenian, 2007). Some of researchers also documented a detection rate of ~60 per cent for Rotavirus A in diarrheal goat samples in Italy (Legrottaglie, 1993). Rotavirus is a non-enveloped virion with 11 double-stranded RNA (16~21 kb) segments and is very stable over a

wide range of pH with heat lability (Fenner *et al.*, 2011). Bovine rotaviruses (BRV) greatly contribute to enteritis and diarrhea in intensively reared neonatal calves (Pisanelli *et al.*, 2005; Rathi *et al.*, 2007). Rotavirus not only causing problem to cattle and buffalo calves, it also affect piglets, foals, lambs, kids and poultry (Steele *et al.*, 2004). He reported there are seven serogroups (A through G) of rotaviruses based on the intermediate capsid protein (VP6) antigenic and genetic similarities hence conclude that group A rotaviruses are the primary cause of rotaviral infection in farm animals. Based on literature by Fukai et al (2004), Rotaviruses are usually species-specific but transmission of cross-species and fecal-oral route was also recorded. The clinical signs is generally seen only in young animals, aged 1-8 weeks and with growing age the vulnerability to viral enteritis decreases. Clinical symptoms are present within 1 to 3 days of infection, and last 5 to 9 days. During pregnancy and especially at parturition, adult cows may be subclinically infected and shed virus intermittently (Large internal medicine, 2014). According to Murphy et al (1999) and Steele et al (2004), the virus enters calves within a few days of their birth and the infected calves exhibit watery diarrhoea, and severe dehydration also results in fatalities. Concurrent infection with other pathogens such as *Escherichia coli* and Bovine Viral Diarrhoea Virus (BVDV) will potentiate the effects of BRV infection in calves causing more serious enteric disease.

Bovine Viral Diarrhea (BVD) is a viral disease that primarily infects cattle but is able to infect horses, goats, deers and pigs (Hurtado *et al.*, 2003). BVD can affect immune and reproductive status of the herd (Brownlie, 2005). Peili (2018) defined BVDV is an enveloped, positive strand RNA virus belonging to the family Flaviviridae genus Pestivirus. BVD virus was also identified as an immunosuppressive agent, increases the possibility of infections in calves, such as respiratory disease, diarrhea and pneumonia, salmonellosis, interdigital

dermatitis and mastitis (Waage, 2000). In addition, Constable (2017) reported that peracute diarrhea due to infection with the BVD virus may occur in immunocompetent, nonpersistent adult ruminants. He also stated that the clinical signs such as severe diarrhea, pyrexia, thrombocytopenia, hemorrhagic disease,agalactia, and death may exhibited by the peracute BVD host as well as it induced reproductive disorders include reduced rates of pregnancy , abortion, stillbirth, congenital defects and weak calves. Typical signs of acute clinical BVD include biphasic fever (~104°F [40°C]), depression, decreased milk production, transient inappetence, rapid respiration, excessive nasal secretion, excessive lacrimation and diarrhea (Gruenberg, 2014).

2.2.3 Parasitic gastroenteritis (Protozoa)

Cryptosporidium parvum is a protozoan parasite generally associated with human and neonatal gastrointestinal tract disease (Yong and Yoon, 2014). *Cryptosporidium* spp. are protozoan intracellular parasites that cause gastrointestinal disease and diarrhea and are a significant infection in young ruminants (Taylor *et al.*, 2007). According to Radostits *et al* (2008), Cryptosporidiosis predominantly occurs in neonatal calves but also in lambs and kids. Calves are highly susceptible within 1-15 days (El- Khodery and Osman, 2008). Moreover, animals of all ages can be affected, but only young animals suffer from diarrhea (Gunn *et al.*, 2009). It indicated that asymptomatic adult sheep and goats are sources of environmental contamination by *C. parvum* (Castro-Hermida *et al.*, 2007). Clinical signs are characterised by anorexia, depression, weight loss, vomiting, dehydration, high morbidity and likely death due to dehydration in *Cryptosporidium parvum* infections (Sima, 2012). Furthermore, diarrhea recurrences are very common, and *Cryptosporidium parvum* is typically a component of mixed infections (Navarre and Pugh, 2002). Heller & Chigerwe (2018) documented that epithelial

destruction caused by sporulated oocyst induce mild to moderate villous atrophy which leads to malabsorptive diarrhea.

Coccidiosis is a protozoan parasitic (*Eimeria* genus) disease which causes diarrhoea in calves, lambs, and kids (Radostits *et al.*, 2008). In cattle, life threatening disease is most commonly caused by *Eimeria bovis* and *Eimeria zuernii* (Constable *et al.*, 2017). Moreover, Coccidiosis occurs generally in young animals between 3 weeks and 6 months of age, causing major economic losses, but often in cattle aged 1 year or older (Radostits *et al.*, 2008; Ballweber, 2009). He added that Coccidiosis is one of the most common, important and higher infection rates disease in lambs and kids that kept in small areas contaminated with oocysts (Radostits *et al.*, 2008). Intestinal epithelial cell tragedy rarely causes bloody diarrhea. Dehydration may occur but anaemia may occur occasionally. In serious infections the typical clinical signs are diarrhea that may be mucoid or bloody, tenesmus, abdominal pain, anorexia, dehydration and weight loss. In addition, Ballweber (2009) reported that Coccidiosis in lambs is typically similar to that in calves but normally dysentery does not occur. Clinical signs of infected kids include watery diarrhoea , vomiting, anorexia and weight loss.

2.3 Noninfectious diarrhea

2.3.1 Grain overload (lactic acidosis)

Grain overload is an acute ruminant disease characterized by rumen hypomotility to atony, vomiting, acidemia, diarrhea, depressive symptoms, confusion, breakdown, and death

in severe cases (Gruenberg, 2015). He also reported this is the most common disease in cattle that accidentally gains access to a large amount of readily digestible carbohydrates, particularly grain. Grain overload is also common in feedlot cattle when introduced too quickly into heavy grain diets. Wheat, barley, and corn are the grains that are most readily digestible. Signs of grain poisoning will be serious depending on the amount of grain consumed and degree of animal adaptation to diet from food. In the condition a variety of symptoms is also seen (Primefacts, 2006). The article classified the clinical sign based on severity such as in mild cases, animals who are slightly impaired have decreased appetite, and can become quiet and depressed. The rumen's muscle contractions slow down, and abdominal pain can develop. Diarrhea also represents a typical symptom of mild acidosis. Next, in severe cases, an animal that is most severely affected is clearly ill. Profound scouring of brown, smelly faeces is noticeable. When grain poisoning worsens, so does the heart and rate of respiration increases, while body temperature remains normal or is lower than average.

2.4 Diagnosis

Clinicians should be informed with clinical history (e.g. age, medical records and clinical signs) and farm history to assess the cause of the diarrhea (Yong and Yoon, 2014). They also stated that examination through microscopy (for *C. parvum* and Coccidia), bacterial culture (for *Salmonella* spp., *E. coli*, and *C. perfringens*), and PCR (for BRV and BCoV) are generally examined in the fecal sample. According to Holschbach & Peek (2018), for adult hemorrhagic enteritis, the differential list includes mainly winter dysentery and bovine viral diarrhea virus infection; in calves, depending on age, such a presentation requires consideration of many viruses (rotavirus, coronavirus), protozoa (*Cryptosporidium*, *Eimeria*), and bacterial causes

(*Escherichia coli*, *Clostridium perfringens*). Identifying an agent in pathologic material does not preclude the possibility that other agents may also contribute to the disease (Naylor, 2002). Hence, once the pathogenic organism is isolated, its morphology, growth patterns such as aerobic and anaerobic growth, hemolysis patterns, and staining may further characterise it.

2.4.1 Bacterial isolation

Culturing of fecal bacteria is a commonly used laboratory method to isolate and classify bacterial pathogens in feces and intestinal contents, *Salmonella* Spp., *E. coli* K99 +, and *C. perfringens* are major enterogenic bovine pathogens (Ferrarezi et al., 2008; Izzo et al., 2011). To avoid any cross-contamination or lack of viability, either rectal swabs or rectal stimulation should collect the feces directly from diarrheal calves. When collected, the fecal samples should be placed in a container of transport medium or special stores in a cooler or on ice prior submission to a diagnostic laboratory. Most diagnostic labs use enrichment mediums, such as tetrathionate or selenite broth to increase the chances of *Salmonella* development and then plate these enriched samples on specific media such as brilliant green or xylose lysine desoxycholate agar (Waltman, 2000).

Muktar et al (2015) studied that microscopy examination of *E.coli* will revealed gram negative rods, with non-persistent cell arrangement either by using EMB agar or MacConkey agar (or both) when inoculated with feces. Usually, identification of atypical *E.coli* is based on characteristic morphology on MacConkey agar, biochemical characteristic and also slide agglutination test with rabbit antiserum. Based on the literature Feng (2002), the outcome from MacConkey agar is deep red colonies organism which is lactose positive causing medium's pH to be drop and lead to darkening of medium while for EMB agar, it will provide black colonies with greenish-black metallic sheen.

For clostridia, cooked meat broth or thioglycollate broth media can be used after collecting the sample, it should be aerobically incubated. Gram staining will result gram positive spore forming rods. In addition, biochemical analysis is needed to differentiate between species such as cultivation onto egg yolk agar for lecithinase and lipase activity. *C. perfringens* also identified through Nagler test and CAMP test.

However, the major disadvantage of fecal culture include the fact that shedding can be intermittent, even in true infections (surely when one considers the sensitivity of bacterial culture) and that, faced with an ongoing outbreak, one may sometimes find clinically normal calves and adults who shed the organism but never show any clinical signs (Mohler et al., 2009). Nielsen (2013) reported the overall pattern is that subclinically or persistently infected cattle shed small numbers of pathogens, whereas chronically ill or severely infected livestock may excrete higher numbers in feces.

2.4.2 Molecular diagnosis (Bacteria)

One of newer diagnostic method detecting Salmonella are based on the identification of the bacteria 's genetic material, i.e. polymerase chain reaction (PCR) techniques (Munoz et al., 2010; Lotsfrom et al., 2010). This method generally is more sensitive and accurate compare to culture but yet still have weakness as subsequent serotyping not always possible (Nielse, 2013). Detection of *invA* gene of salmonella in feces appear to be successful method through the usage of pooled salmonella enrichment broth culture of bovine feces (Singer et al., 2006). In calves and goats, Congo red binding test can be used for detecting their virulence which have ability produce haemolysin, adherence assay and cell invasion test and detection of *inv A* gene using PCR (Mohamed and Dapgh, 2007).

Diagnosis of *E.coli* mostly depends on phenotypic differentiation of pathogenic strains from nonpathogenic flora via bioassays or immunoassay for toxins and fimbriae. According to Louie (2000), polymerase chain reaction tends to be popular for their specificity and speed compared to culture based methods. In addition, Oliver (2005) agreed that this method have access detection and identification of “viable but non incurable” cells that are metabolically active but non dividing. ELISA test, colony immunoblots, direct immunofluorescence microscopy of filters, as well as immunocapture techniques using beads used for detection of *E.coli* (De Boer and Heuvelink, 2000).

C. perfringens toxins were identified through quantitative culture followed by genotyping. Several techniques including an enzyme linked immunosorbent assay (ELISA) that detect CPA, CPB, ETX, and *C. perfringens* (Uzal and Songer, 2018). Study reported by Baums et al (2004), stated that gene probes and multiplex PCR assays were used for detection of toxins in affected animals with *C. perfringens*.

2.4.3 Serological diagnosis (Bacteria)

An antigen capturing ELISA is one of the methods used for detection of *E. coli*, colibacillosis as it provide rapid test result and procedure detecting pathogen on sample based on antibody (Lequin, 2005). Tube method, microtiter plate method, and membrane-bound method are one of example used for Ag-ELISA method (Fenner, 2011). This commercial Ag-ELISA kit also available for detecting BRV-A, BCoV, *E. coli* K99+, and/or *C. parvum* in fecal samples as it delivers rapid turnaround, pulg in and play capability, high throughput testing and portability. According to Cho et al (2010), isolation/culture or nucleic-acid based assays tend to have high analysis of sensitivity compared to Ag- ELISA kits. So, it is important to collect the fresh feces from acute diarrheic animals.

Davies (2008) stated that using serology detection in salmonella may be useful but it involved herd basis. There is no serological testing being used use detecting individual carrier animals (Hansen et al., 2006). Enzyme linked immunosorbent assay (ELISA), immunoelectrophoresis, latex agglutination and immunodiffusion commonly used as diagnostic method for enterotoxigenic of *c. perfringens* (EL-idrissi and Ward, 1992).

2.4.4 Virus isolation

According to Popow and Aberle (2011), virus isolation test still commonly used and known to be gold standard detecting viral pathogens in specimens although there is modern diagnostic tools such as PCR and ELISA. Cell culture technique used to isolate virus as well as virus propagation for vaccine production or further virus characterization procedures (Ribes *et al.*, 2002). Several cell lines such as Madin Darby Bovine Kidney [MDBK], human rectal tumor HRT-18, and African green monkey kidney MA104 cells are used for certain viruses because of variations in viral susceptibility of the different cells (Amer and Almajhdi, 2011; Walker *et al.*, 2012). If there is cases involving virus that do not grow in cells *in vitro* (many case of enteric pathogen), embryonating eggs and laboratory animals are also used for isolating and propagating viruses hence viability of target viruses in specimen is important for virus isolation (Schielke *et al.*, 2011).

Electron microscopy (EM) commonly used for virus identification and detection based on morphological characteristic. Brand et al (1998) stated there are two types of EM which are direct EM and immuno-electron microscopy (IEM). To perform this procedure, it needs two different staining techniques (positive and negative staining) to visualize the target. Direct EM is not a specific test as this technique is performed to simply visualize viruses in samples and is not considered to be a sensitive procedure (Mukhtar et al, 2016). Detection of common enteric

pathogens in ruminants such as BNoV, Nebovirus, BRV, BToV, and BCoV is difficult isolate in cell culture, but these pathogens can be differentiated according to their unique morphology (both shape and size) under an electron microscope (Duckmanton *et al.*, 1998)

2.4.5 Fecal floatation and direct microscopy

These methods are commonly used to diagnose and examine the parasite eggs and ova. Ballweber (2006) studied that the principal of fecal flotation is simply based on the density difference between a flotation solution (≥ 1.24) and oocysts (1.05~1.24). A centrifugation step is commonly included in the testing procedure to increase detection sensitivity since centrifugation concentrates the target for easy viewing under a microscope. Acid fast staining usually used for detection of *C.parvum* (Muccio *et al.*, 2004). The modified Kinyoun acid-fast stain is different than Ziehl-Neelsen modified acid-fast stain as it consist of more concentrated fuchsin dye and lipid solvent, and does not require heating the reagents used for staining (Magi *et al.*, 2006; Treuer and Haydel, 2011). The modified acid-fast staining widely used in detection of *C. parvum* in feces however the sensitivity is low because this procedure involves 500,000 per 1g of feces to confirm the presence of *C. parvum* (Balatbat *et al.*, 1996).

2.5 Treatment

2.5.1 Principles of Treatment of Infectious Enteritis in Neonatal Ruminants

Infectious enteritis causes diarrhea and related to losses of fluids and electrolytes. Fluid therapy is an essential part of infectious enteritis treatment (Heller & Chigerwe, 2017). Oral

fluid therapy can be highly efficient and cost-effective in treating animals with enteritis and diarrhea, if initiated early in the disease phase. According to Smith (2009), oral electrolyte should be depends on sodium composition, pH buffering capacity, energy content, and osmolarity. Physical examination findings and diagnostic outcomes can be used to guide decisions on treatment, and some published algorithms are available to support clinicians in the decision process (Trefz *et al.*, 2012).

Based on the literature by Berchtold (2009), Initial treatment of shock with intravenous fluid replacement may be suggested in patients seriously affected. For example, a standard shock fluid therapy plan is to include intravenous fluids of 90 mL / kg with a maximum rate of 40 to 50 mL / kg / h. In addition, signs of appropriate response include improved mentation and activity, reduced skin tent or eyeball recession, improved suckle response, reduced capillary refill time and improved peripheral perfusion due to distal extremity warming. Signs of fluid overload include wet cough, harsh lung sound, elevated respiratory rate and edema.

Usage of nonsteroidal anti-inflammatory drugs (NSAIDs; eg, flunixin meglumine) in Pyrexia and inflammation condition can be considered for monitoring. It was confirmed that flunixin meglumine (1,1 mg / kg intravenously) or meloxicam (0,5 mg / kg intravenously or subcutaneously) improved results in calves with non-specific diarrhea (Barnett *et al.*, 2003; Todd *et al.*, 2010). Antimicrobial prophylactic therapy has been shown to raise the risk of diarrhea in neonatal calves (Berge, 2009). Non-steroidal anti-inflammatory drug therapy with meloxicam has proven effective in improving food intake and weight gain in diarrhoeic calves (Philips *et al.*, 2003; Todd *et al.*, 2010).

2.5.2 Salmonellosis

Treatment of salmonellosis in calves is aimed at replacing losses of fluids and electrolytes, reducing inflammatory cascades through the use of non-steroidal anti-inflammatory drugs (NSAIDs), and the use of antimicrobials in a sensible manner (Smith, 2002; Constable, 2008). Thus, providing a safe, dry, thermoneutral and nutritious climate help enhances performance. Mohler et al (2009) reported that calves that are incapable of maintaining sternal recumbency require intravenous fluid care. In the correction of dehydration and acidosis, saline-based fluids containing alkalinizing agents, such as sodium bicarbonate, aid. Potent antimicrobial therapy is prescribed early in the course of the infection (Wray, 2000; Dueger, 2003). Resistance to antimicrobials is normal in serotypes of virulent salmonella associated with disease outbreaks. Ideally, antimicrobial selection should be based on the findings of susceptibility testing using a salmonella isolate obtained at necropsy from the tissues of calves. Usually, broad-spectrum antimicrobials are used before availability results of susceptibility test (Bell *et al.*, 2004; McGuirk, 2008). Salmonella is susceptible to tetracyclines, ampicillins, and amoxicillins is variable, while penicillin, erythromycin, and tylosin are most likely to be resistance (Smith, 2015). Fecteau (2003) documented that similarly, extra-label use of ceftiofur at 5 mg / kg has been shown in an experimental challenge study to attenuate the severity of clinical disease and minimize fecal Salmonella shedding. NSAIDs prevent endotoxin-induced inflammation by blocking the arachidonate cyclo-oxygenase pathway, thereby reducing the production of thromboxanes and prostaglandins (Rang *et al.*, 2001; MacKay, 2002). Moreover, extralabel use of flunixin meglumine (2.2 mg / kg intravenously) and meloxicam (0.5 mg / kg; intravenously or subcutaneously) was reported to increase outcome and decrease morbidity in non-specific diarrhea calves (Barnett *et al.*, 2003; Todd *et al.*, 2007). Flunixin meglumine is currently the

only NSAID approved for use in cattle for the treatment of endotoxemia and pyrexia in the United States (Smith, 2008).

2.5.3 Colibacillosis

A study carried out by Constable et al (1992) stated that antimicrobials are not recommended in calves with diarrhoea and no systemic illness (normal appetite and no fever). However, parental antibiotics can be helpful if administered early but not without rehydration. Since there is no time for sensitivity testing, the initial option should be a bactericidal drug with a high likelihood of effectiveness against gram-negative organisms (Bashahun and Amina, 2017). Administration IV of large amounts of balanced electrolyte solutions over several hours is necessary to correct hypovolemia and to ensure sufficient peripheral perfusion of the tissue. Hence, glucocorticoids have also been recommended for treating septicemia, although their benefits for sepsis treatment are less well known (Gruenberg, 2014). A case study was reported by Jesse et al (2016), described the initial treatment for septicaemic colibacillosis were administration of intramuscularly (IM) antibiotic pen-strep (1mL/25 kg), and anti-inflammatory flunixin meglumine (1.1mg/kg). Dehydration was treated by intravenously administering lactated Ringers (LR) solution and 20% intravenously glucose saline (G20). On the other hand, the treatment for severe enteric colibacillosis reported by Jesse et al (2016), the dehydration was corrected by intravenous infusion of Lactated Ringer's solution administered for three days. Oxytetracycline 20mg/kg was injected intramuscularly once as broad-spectrum antibiotic to treat *E.coli*. Flunixin meglumine 2.2mg / kg was given intravenously as analgesic, anti-inflammatory, and anti-pyrexia TID for three days. For two days, 10mL of Kaolin-Pectin was given orally BID to solidify the loose feces.

2.5.4 Rotavirus and Coronavirus

The primary treatment for viral diarrhoea in young animals is oral and/or parenteral rehydration therapy. A buffer with solution used to treat sick and deprived calves as the purpose is to balance metabolic acidosis condition (Farm Health Online, 2018). In viral diseases, antibiotics are not recommended, but are occasionally used in severely infected animals suspected of having a secondary bacterial infection in addition to the viral disease. Non-steroidal anti-inflammatory drugs (NSAIDs) may be beneficial for some cases to reduce pain (Todd et al., 2010).

2.5.5 Cryptosporidiosis

There is no appropriate treatment used in ruminants to treat cryptosporidiosis (Navarre and Pugh, 2002). Halofuginone has positive effect in *Cryptosporidium parvum* calves with diarrhea. Halofuginone is documented to decrease oocyte shedding and the diarrhea severity. Oral dose of 0.1mg / kg BW per day will minimize oocyte excretion for 7 days (Klein, 2008). Moreover, Decoquinat, 2.5 mg / kg, may be effective against cryptosporidiosis in kids and goats. In young animals, cryptosporidiosis should be treated with fluid therapy and an acid-base balance correction (Navarre and Pugh, 2002; Matthews, 2009).

2.5.6 Coccidiosis

Coccidiostats are used for this treatment. Trimetoprim+Sulfadoxine (16-24 mg / kg) can be used intramuscularly in lambs and kids for three days (Ozmen et al., 2004) whereas Amprolium (10 mg / kg BW) for 5 days or 65 mg / kg BW for one dose in calves (Radostits et

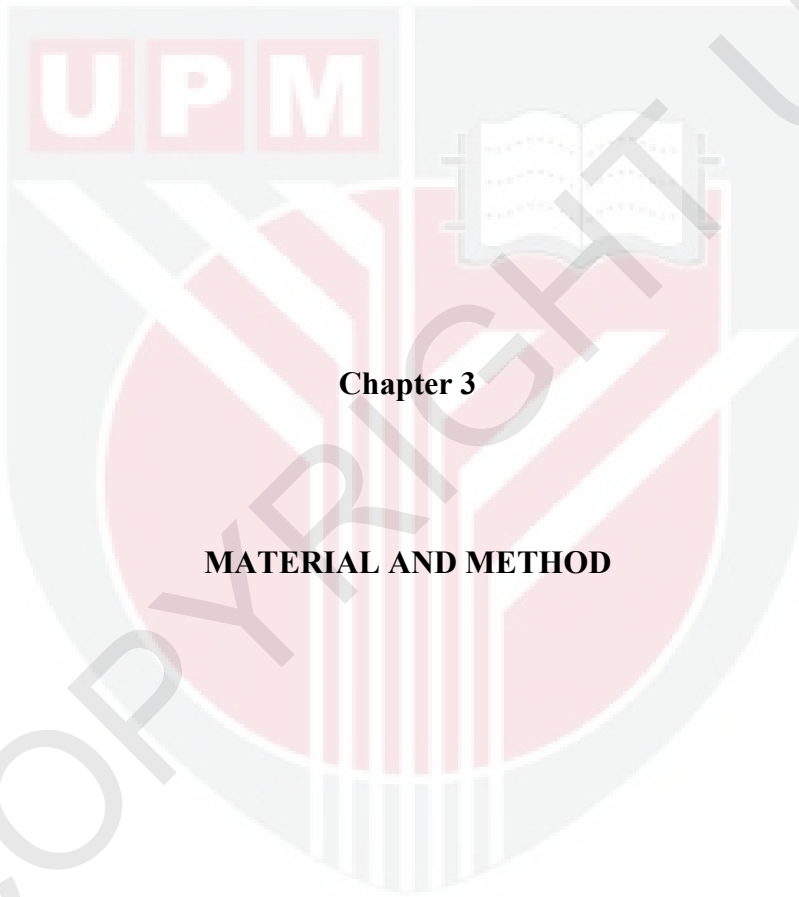
al., 2008). In addition, coccidiocidal treatments also include diclazuril and toltrazuril (Matthews, 2009). Ghanem et al (2008), proposed toltrazuril will be more effective in E than sulphadimine and amprolium. Vitamin C in lambs with coccidiosis, vitamin C administration is suggested to be useful in conjunction with the classical treatment (Sahinduran et al., 2006).

2.5.7 Grain overload

If overload is extreme, consideration should be given to slaughtering for salvage; it may well be the most economical option in feeders near the end of their feeding period. Mortality is high in animals seriously affected, unless aggressive therapeutic steps are initiated early. Removal of rumen content and replacement with intake taken from healthy animals is needed in such animals (Gruenberg, 2015).

2.6 Prevention

Effective handling and administration of the colostrum in ruminants are instrumental in avoiding neonatal diarrhea (Berge et al., 2008). A correlation between insufficient colostrum intake and an increased risk of diarrhea in neonates is questioned by a few clinicians. Supplementing calves with oral colostrum past the traditional 24 hours after birth reduces diarrhea and diarrheal treatments in pre-weaned calves (Berge *et al.*, 2009). According to Chirgewe et al (2008), to ensure sufficient transfer of passive immunity, a minimum of 150 to 200 g of immunoglobulin G (IgG) in colostrum or a colostrum replacer should be fed to calves within the first 24 hours. The concentration of IgG in colostrum can be measured with a hydrometer or a Brix refractometer before feeding calves. Vaccination of the dams with a K99 *E coli*, rotavirus, coronavirus product before parturition may reduce the diarrhea associated with that pathogen. Vaccination is of varying effectiveness for other diarrheal agents (Wilson et al., 2015).



Chapter 3

MATERIAL AND METHOD

3.1 Case selection (Clinical case)

Information was obtained from patient medical records and logbooks of small ruminant and large ruminant from year 2013 until 2017, where patients with diarrhea problems were selected. A table was created to using Microsoft Excel Worksheet for data collection. Relevant available data were tabulated into the table. Data that were selected and recorded are such as patient signalment, diagnosis, treatment, and revisit.

3.2 Statistical Methods

Data of common diarrhea problem in ruminants, clinical signs, common treatment plan and any follow up being done will be analyzed and summarized to obtain the distribution using bar graphs or pie charts. These data are analyzed to compare whether there is any difference in the management of different clinical cases of diseases involving respiratory system in ruminants

1	Month/year	Location	Case Number	ID/ Markings	History	Species	Breed	Age	sex	management	T	P	R	BCS
2	30/1/2013	Baghwan singh, Teras jemang	0014/13	Binjy	owner claimed the calf diarrhea one month ago and drink little amount of milk. PE: BAR, pink CRT <2 sec, dried scab on knee joint. Ddx: BVD, colibacillosis, coccidiosis	Bovine	FRI X	1 and 1/2 mo	F	semi intensive	39.2	NT	NT	NT
3	5/3/2013	En Jaswant, Semenyih	0028/13	Minnie	The cow managed semi intensive and allow to graze, also feed with pellet diet. 4 days ago, owner noticed the cow had diarrhea (watery feces) but the appetite is good. Milk production dropped and the cow's activities reduced. Shooting diarrhea observed during examination. PE: dirty coat, emaciated, pink mm, fecal stain at perineum area, shooting diarrhea, left mucopurulent discharge. Enlargement of pre scapular LN. Ddx: Johne's disease, helminthiasis, salmonellosis	Bovine	FRI- SAH	adult	F	semi intensive	38.4	64	32	1.5 out of
4	18/3/2013	En jaswant, Semenyih	0080/13	Kuning	2 weeks ago, adult cattle had watery diarrhea. Kuning still have watery feces and lost weight. Milk yield drop from 10l/day to 2 l/day. All other 4	Bovine	FRI- SAH	adult	F	semi intensive	NT	NT	NT	2 out of
5	19/3/2013	En Baghwan, Teras jemang	0083/13		metacarpal and prescapular and LN enlargement ~4-5 cm. FNA on swollen area ~ greenish pus					semi intensive	NT	72	72	2 out of
6	25/3/2013	TPU, UPM	0103/13	T140	Noticed diarrhea at yesterday evening. No treatment given. Feed with grass. Dewormed and vaccinated last 2 weeks. Recurrent diarrhea (3rd episode). Started scourban 2 days ago, once noticed diarrhea. Given 3rd	Bovine	FRI-SAH	7mo	F	semi intensive	38.6	NT	NT	2 out of

Figure 1 - Microsoft Excel Worksheet data tabulation

and to determine the efficacy and effectiveness of the treatment plan through follow-up of cases.

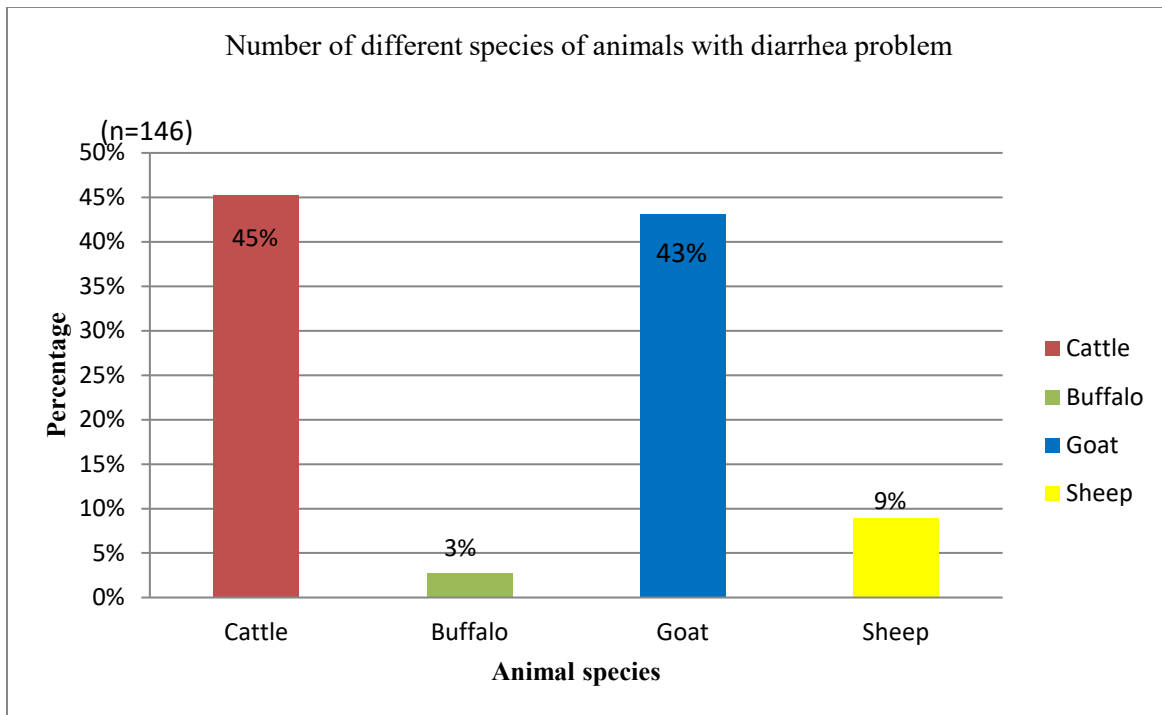


Chapter 4

RESULT

4.1 Species of large and small ruminants with diarrhea problem

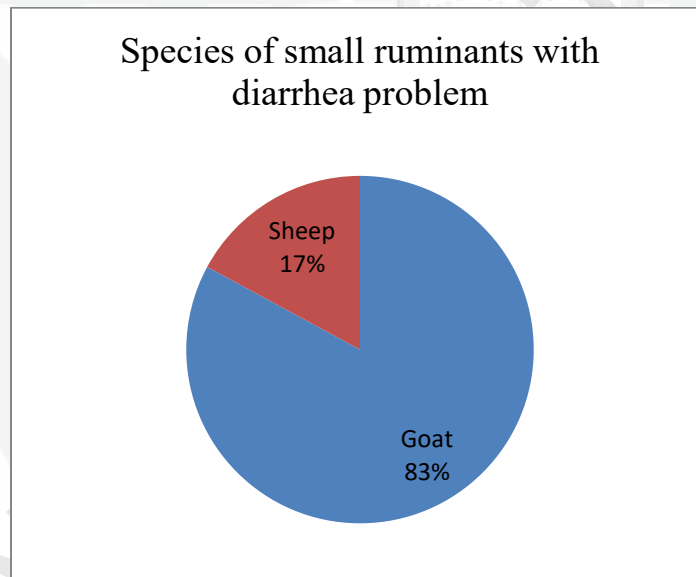
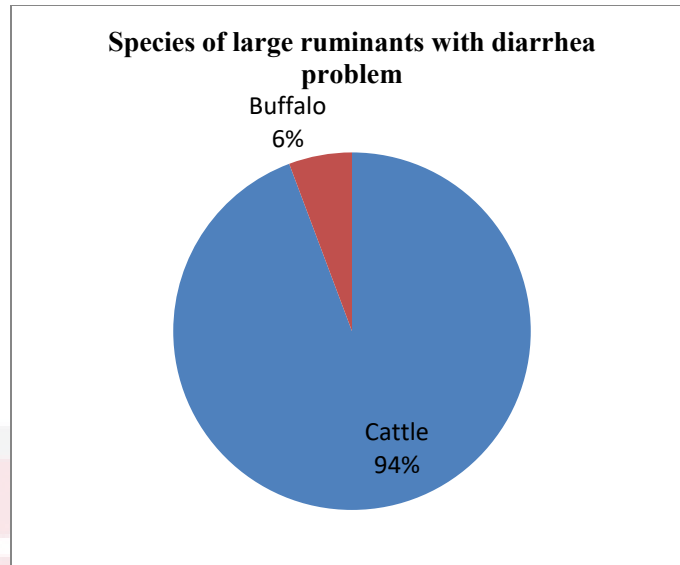
Figure 1: Number of diarrhea cases among different species from year 2013 to 2019



Overall, there are total of 146 cases of ruminant animals reported between year 2013 and 2019. As shown in the distribution graph above, survey data revealed that 45% of 146 reported cases belong to the bovine group which indicates the highest number of diarrhea throughout 7 years, followed by the caprine group (43%) and ovine group (9%). From 146 of reported diarrhea cases, only 3% was among the *Bulbalus spp.*

4.1.1 Percentage species of large and small ruminants with diarrhea problem

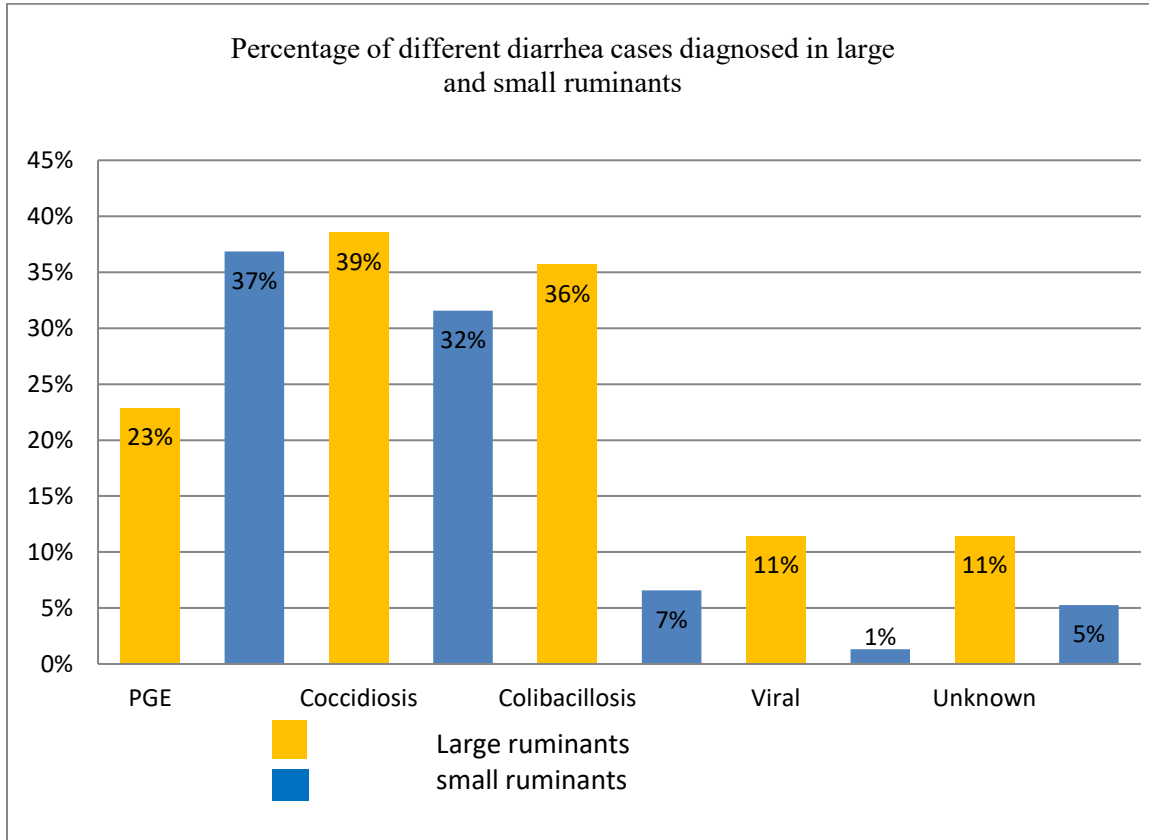
Figure 2.1: Number of diarrhea cases among different species from year 2013 to 2019



As shown in the pie chart above, survey data revealed that 94% of 70 reported cases belong to the bovine group which indicates the highest number of diarrhea throughout 7 years, followed by the *Bulbalus spp.* (6%) for large ruminants. While for small ruminants, caprine group (83%). From 76 of reported diarrhea cases, only 17% was among the ovine group.

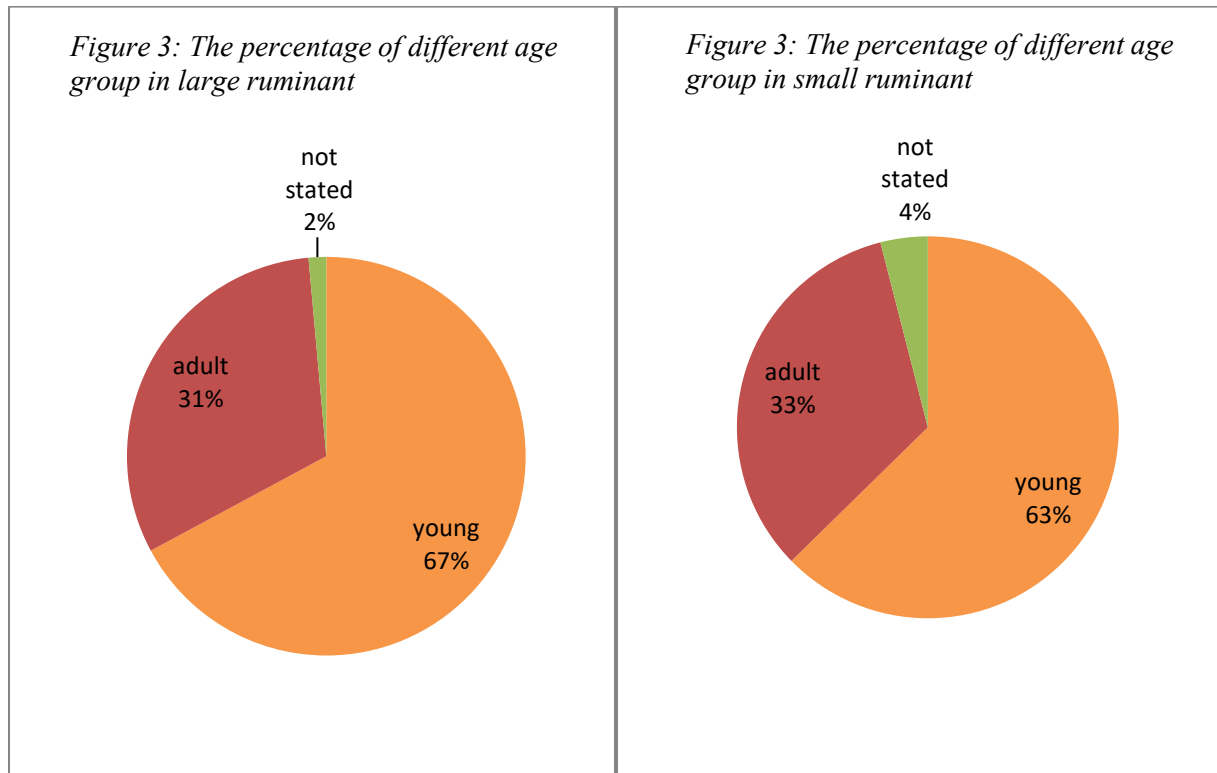
4.2 Type of diarrhea problem diagnosed from selected farms in Klang Valley

Figure 1.1: The number of animals that are diagnosed with different types of diarrhea from selected farms in Klang Valley between year 2013 to 2019.



The graph shows the percentages of large and small ruminants that were diagnosed with different diarrhea problem between year 2013 to 2019 from selected farms in Klang Valley. Coccidiosis is the highest diarrhea cases being reported in both large and small ruminant with 39 percent out of 70 animals and 32 percent out of 76 animals reported respectively

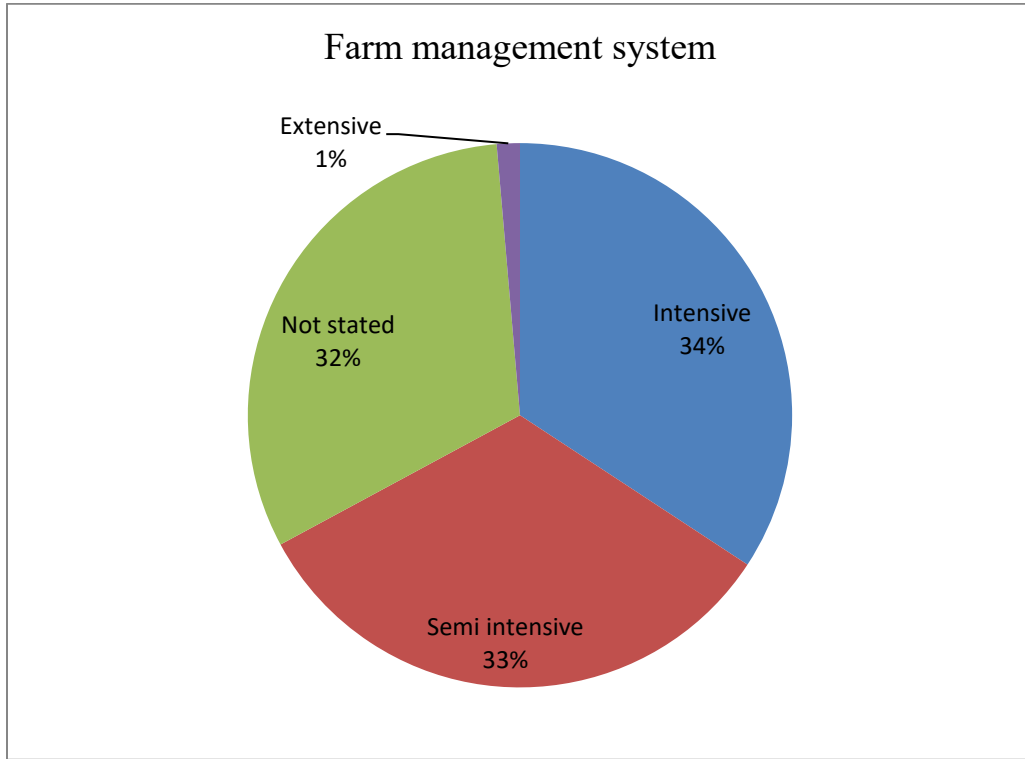
4.3 Age group of large and small ruminant with diarrhea problem



As shown in Figure 3, 67 percent of the reported diarrhea cases in large ruminants are among young animals which is below than 2 years old and only 31 percent are from the adult group age of 3 years old and above. Thus, about 2 percent from the chart are not stated. Meanwhile, Figure 4 shows that out of a total of 76 animals categorized as small ruminant, 33 percent that have diarrhea cases belongs to the adult age group and 63 percent were among the young age groups of goats and sheep. Hence, about 4 percent in small ruminants' cases was not stated for the age.

4.4 Type of management system practiced in selected farms in Klang Valley

Figure 5: The number of animals that are reared in different types of management systems from selected farms in Klang Valley between year 2013 to 2019



Based on the pie chart above, out of 146 animals including large and small ruminants that were reported with diarrhea problem, 34% of the animals are from farms that practice intensive farming system. 33% of the total numbers of animals are raised in semi-intensive management, and the remaining 1% are reared extensively. However, 32% of the total numbers of animals was not stated in term of their management. Further divisions of different types of management system based on species are as shown in bar graph below.

Figure 6: The number of animals that are reared in different types of management systems from selected large ruminant farms in Klang Valley between year 2013 to 2019.

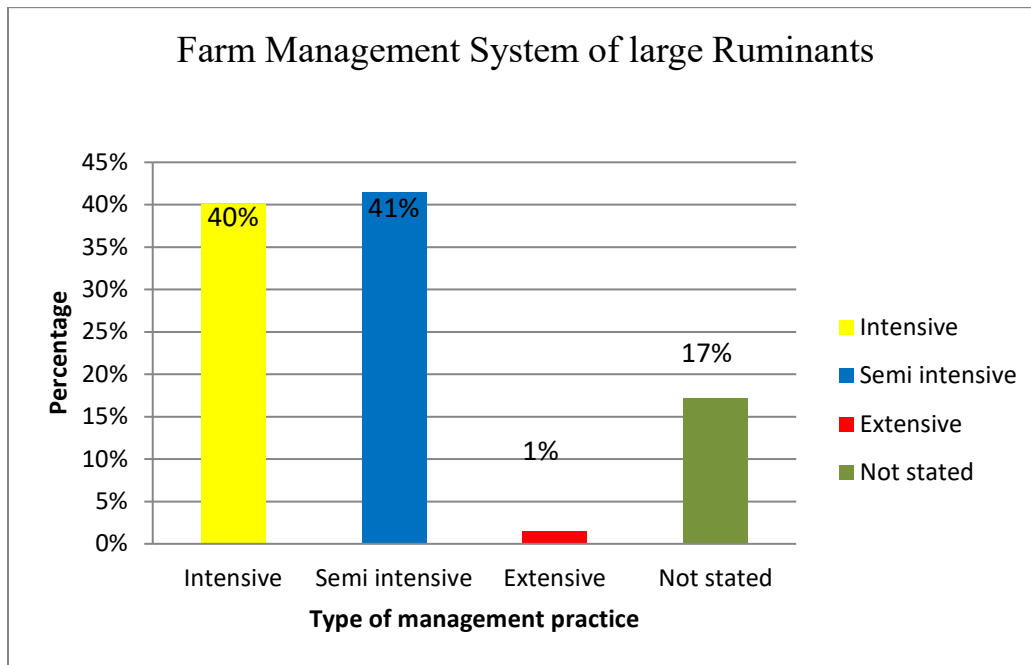
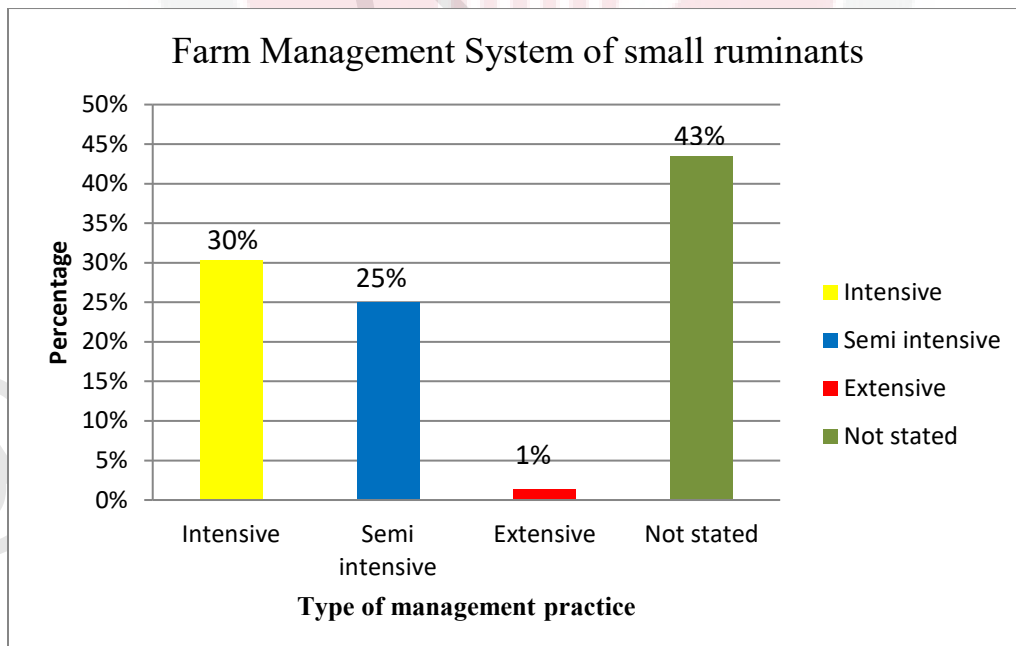


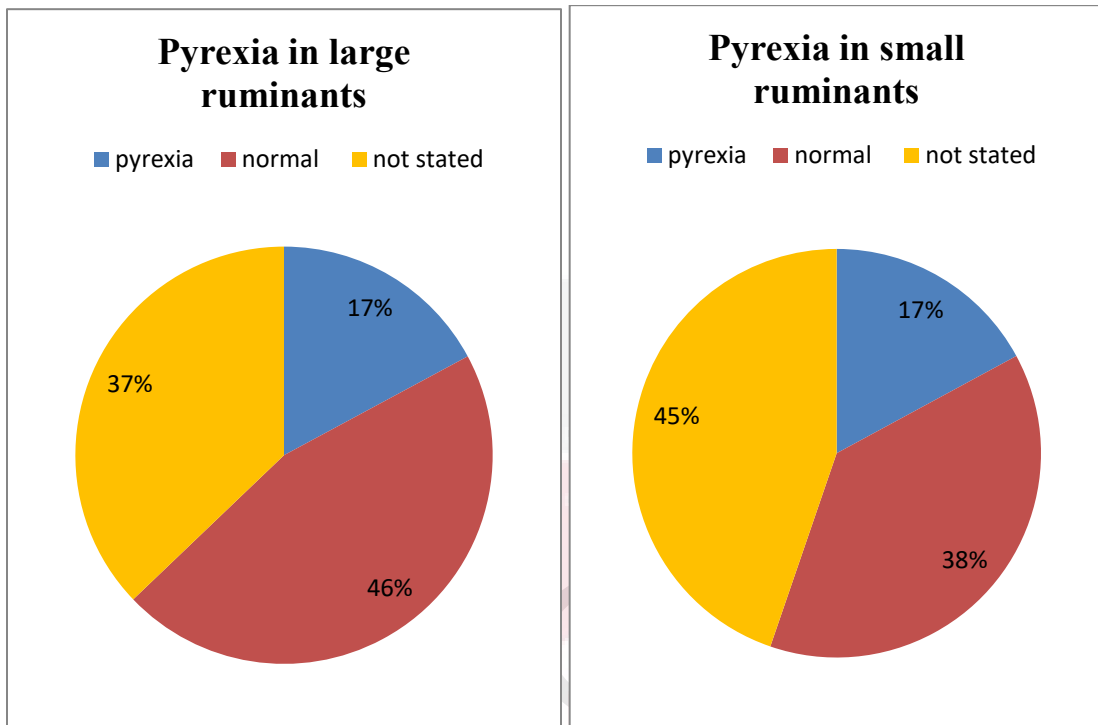
Figure 7: The number of animals that are reared in different types of management systems from selected small ruminant farms in Klang Valley between year 2013 to 2019



Different types of farming management system are further divided into 2 categories as shown in Figure 6 and Figure 7. Figure 6 shows a bar graph of farm management systems in large ruminant with the highest percentage (41%) of diarrhea cases diagnosed in farms practicing semi intensive system and 40 percent are from intensive farms. About 1 percent of diarrhea cases practicing extensive farm while 17 percent is not stated. Similarly, figure 7 illustrates that the highest percentage (43%) of reported diarrhea cases in small ruminant farms that are not stated either it is intensive, semi or extensive farm. Out of 76 small ruminant, 30 percent of reported diarrhea cases diagnosed in intensive farming system followed by (25%) in farms practicing semi intensive system. On the other hand, (1%) of diarrhea cases still being reported in extensive farming system.

4.5 Presence of pyrexia as a clinical sign in diarrhea cases

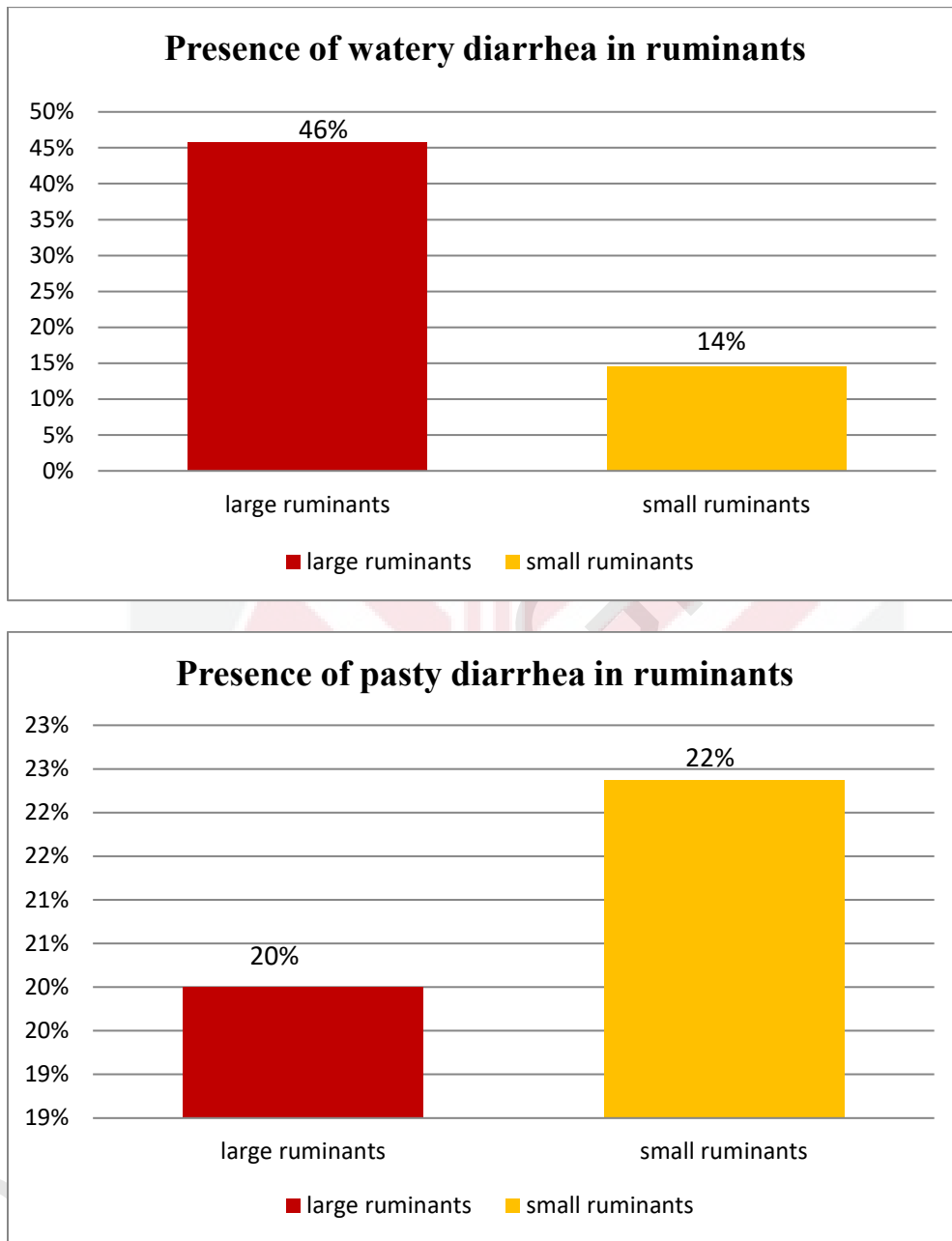
Figure 8: Number of diarrhea cases in large and small ruminant with pyrexia



In this study, it was observed that (17%) of large and small ruminant animals reported with diarrhea showed pyrexia. Majority of the diarrhea cases in large ruminant, about 46 percent of animals are showing normal temperature during physical examination followed by (37%) of the reported cases, the temperature of are not taken. In small ruminants, 38 percent out of 76 reported cases exhibit normal temperature while the remaining 45 percent of diarrhea cases are not stated.

4.6 Different form of feces as a clinical sign in diarrhea cases

Figure 9: Number of diarrhea cases in large and small ruminant with different form of feces



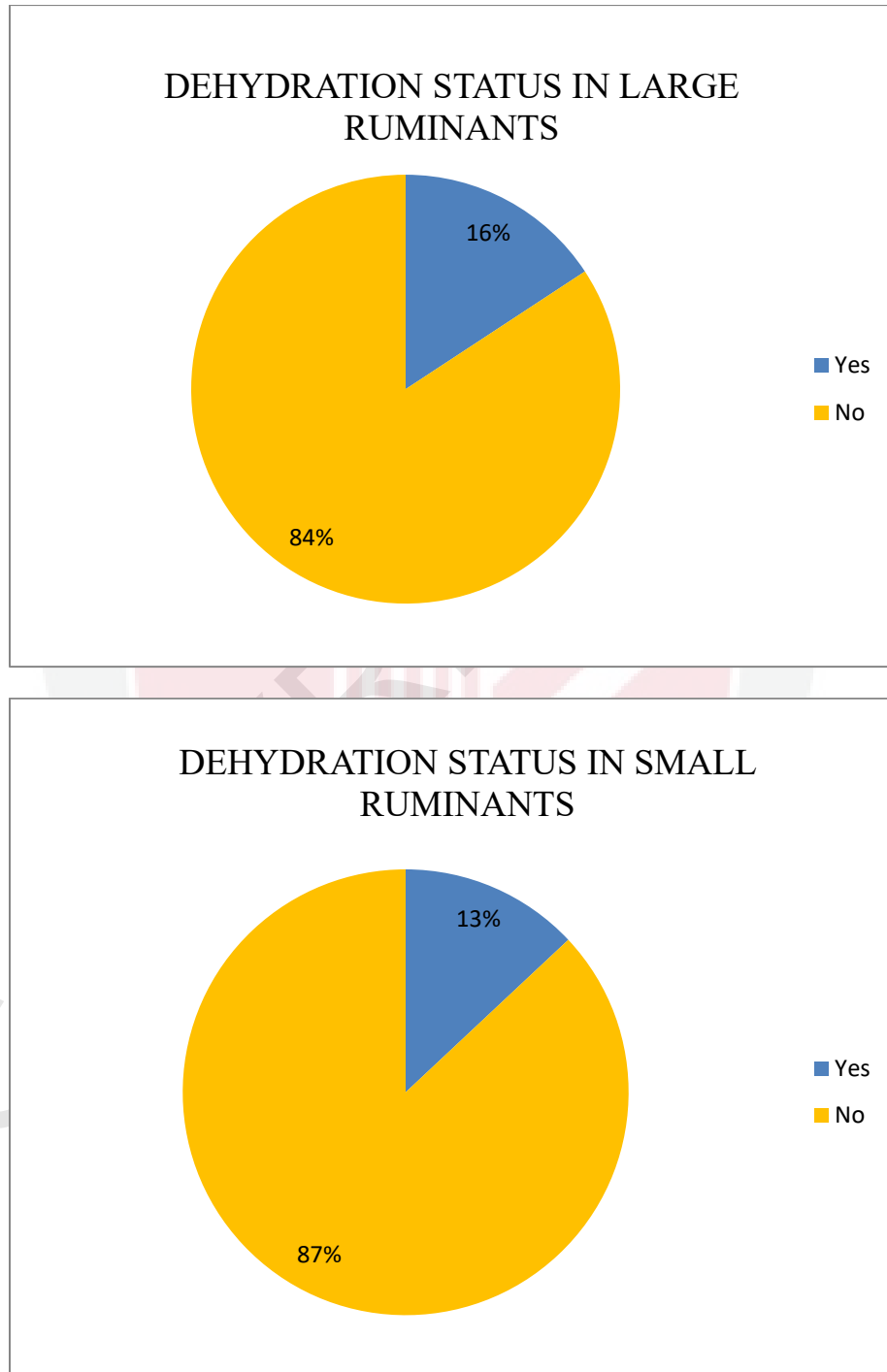
Different form of feces in diarrhea problem in ruminants indicates severity of the infection and it can be in the form of well formed, watery or pasty diarrhea. In large ruminants, about 46

percent out of 70 reported cases appear to have watery/shooting diarrhea according to the history recorded by the owner. Next, 14 percent out of the total 76 reported cases in small ruminant showing watery diarrhea in the farm. However, the condition changes as (22%) of diarrhea cases in small ruminants are reported to have pasty diarrhea. Thus, large ruminants are seemed to have reduce cases in the form of pasty diarrhea which only appear 20 percent out of 70 reported cases.



4.7 Dehydration status as a clinical sign in diarrhea cases

Figure 10: Number of diarrhea cases in large and small ruminant with dehydration status

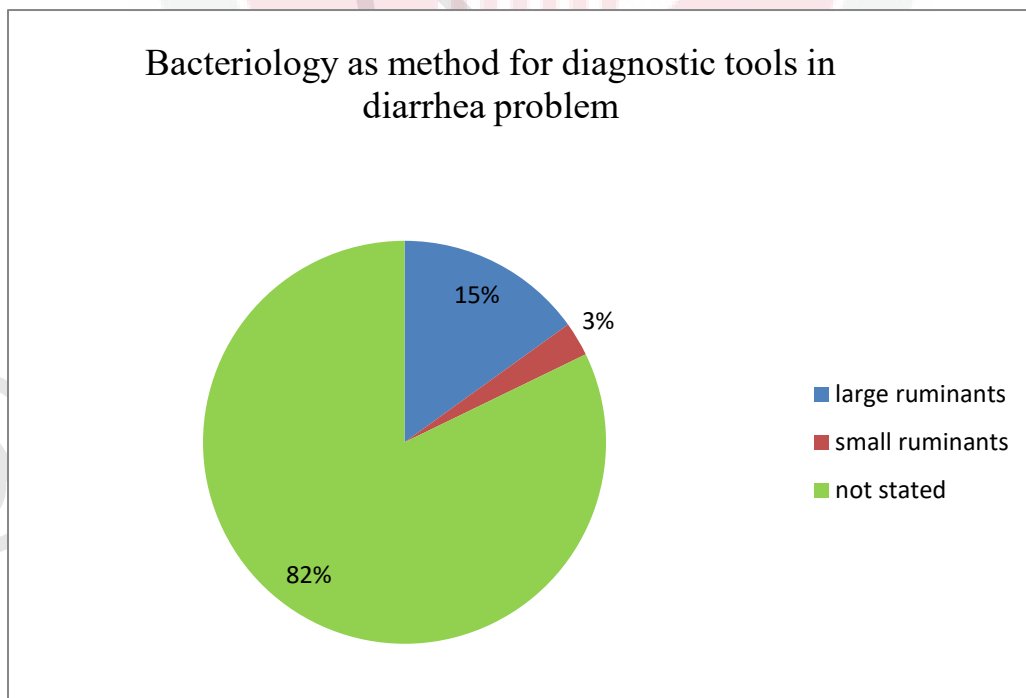
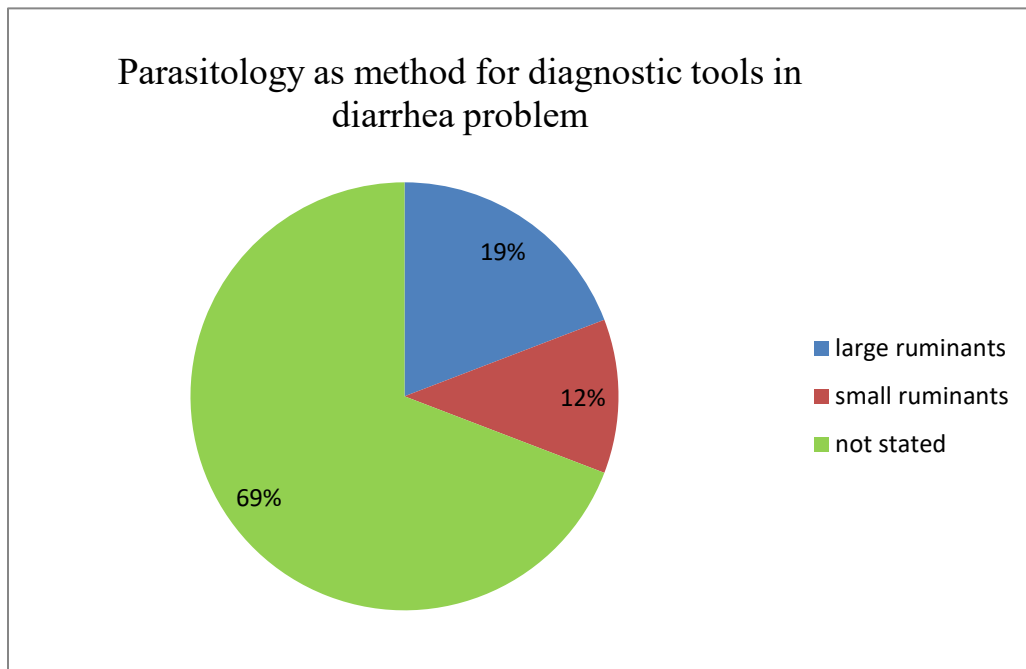


Based on the pie chart in Figure 10, 16 percent of 70 reported diarrhea cases in large ruminants were presented with dehydration. The remaining 84 percent were not presented with any abnormal hydration status. Figure above shows that 13 percent of small ruminants appear to have more than 5% dehydration during examination. Meanwhile, there is (87%) absent cases of dehydration status was documented in small ruminant with diarrhea problem.



4.8 Fecal sample (parasitology and bacteriology) as part of diagnostic tool in diarrhea cases.

Figure 11: The percentage of number of cases as fecal sample being done as part of the diagnostic tool in diagnosing diarrhea problem

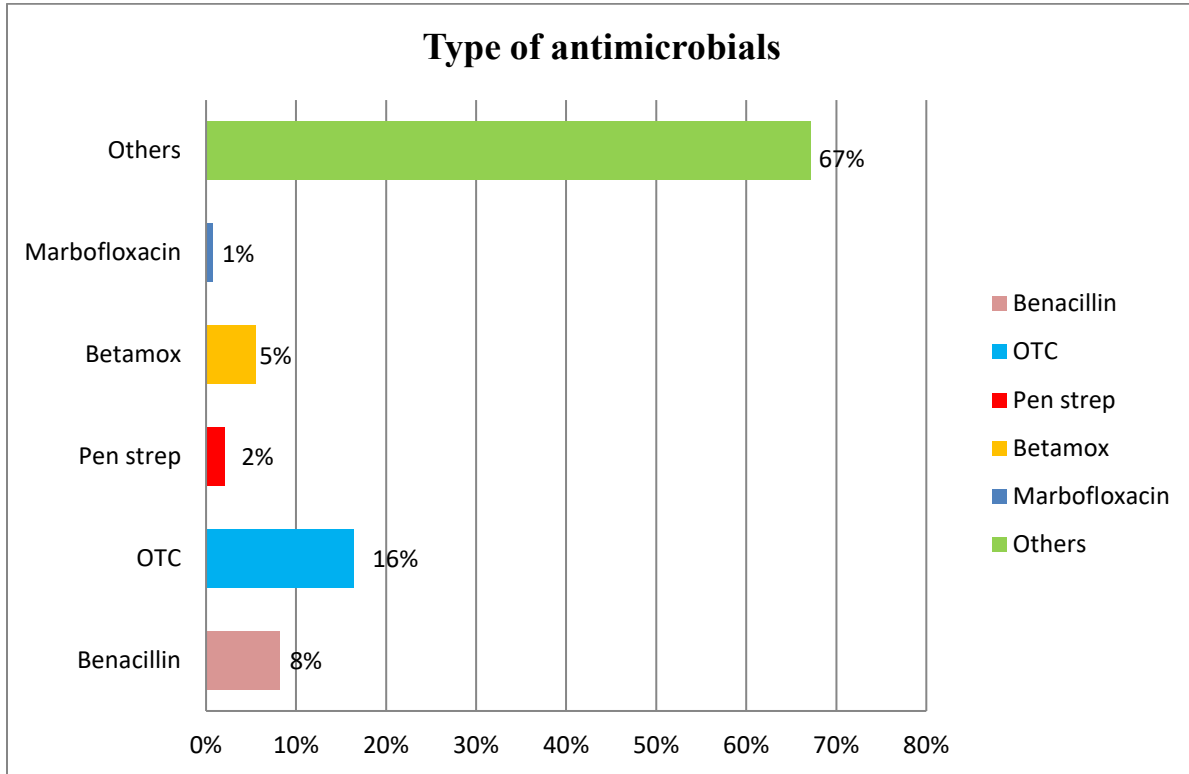


Based on the pie chart above, 19 percent of 70 total number in large ruminants were being diagnosed further for parasitology while (12%) out of 76 small ruminants fecal samples were taken for parasitology lab. Meanwhile, 15 percent of the reported diarrhea in large ruminants cases were diagnosed further for bacteria and small number (3%) of collected feces in small ruminants diarrhea cases were send for bacteriology. Majority of both diarrhea cases in small and large ruminants showed that (69%) and (82%) was not stated to have further diagnosis to identify the causes agents.



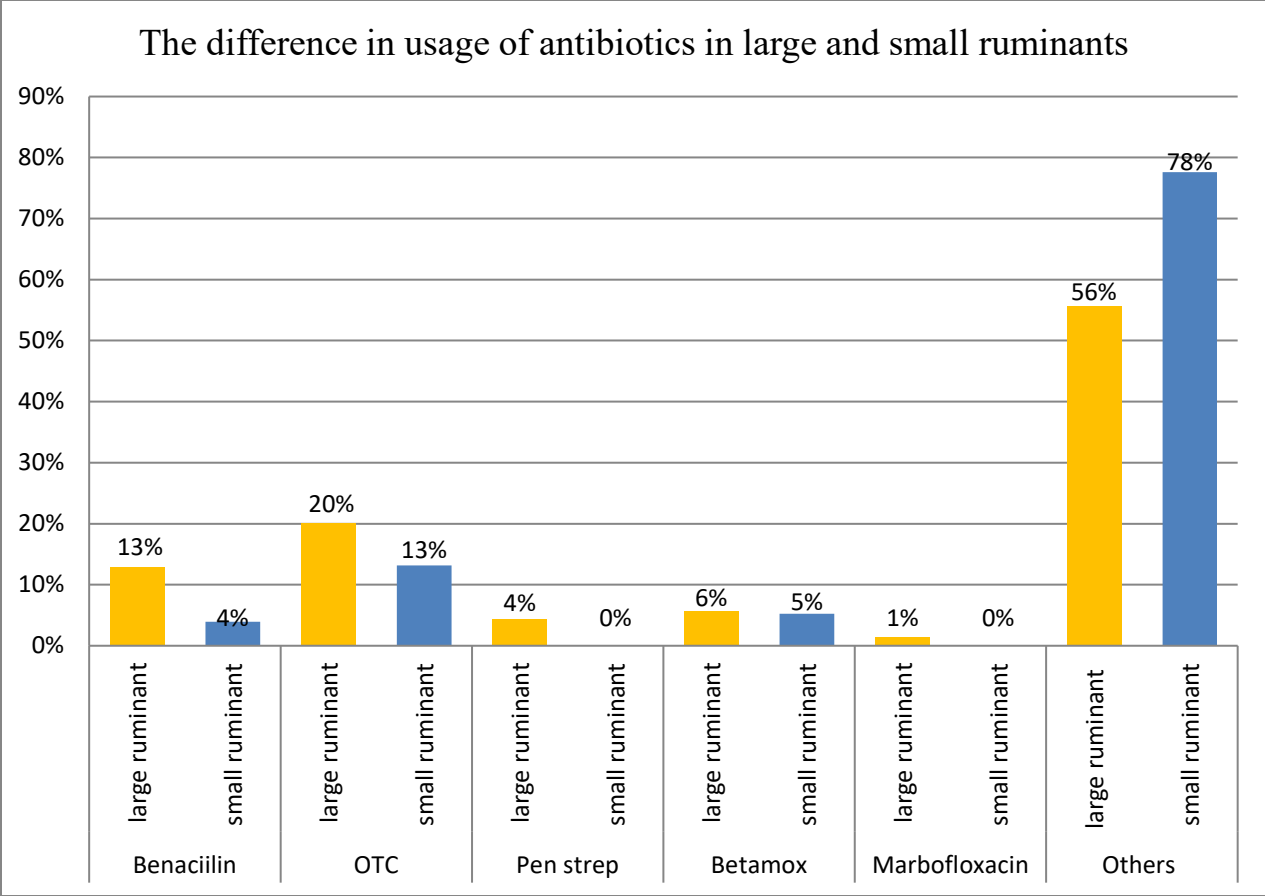
4.9 Types of antibiotic commonly use in treatment of diarrhea

Figure 12: Number of different antibiotics commonly used to treat diarrhea in large ruminants and small ruminants from selected farms in Klang Valley between year 2013 to 2019



As shown in the bar chart above (Figure 12), the type of antimicrobial drug that is most commonly used to treat diarrhea is Oxytetracycline with the percentage of 16 percent of 146 animals. However, 67 percent of the diseased animals receive others treatment than antimicrobial treatment as part of the recovery regime such as fluid therapy, vitamin and supplement. 8 percent of animal with diarrhea cases received Benacillin for treatment. Other antimicrobials such as Betamox, Pen strep (Penicillin-Streptomycin) and Marbofloxacin are among the rarely chosen as treatment option for treating diarrhea problem.

Figure 13: Number of different antibiotics commonly used to treat diarrhea in large ruminants and small ruminants from selected farms in Klang Valley between year 2013 to 2019



Based on the graph chart in Figure 13, we can observe that most of antibiotics in both large ruminants (20 percent) and small ruminants (13 percent) used is oxytetracycline. 13 percent of large ruminants out of 70 reported cases are treated with Benacillin, and another 10 percent are being treated with Pen Strep and Betamox. Meanwhile, about 70 percent out of 76 total number of small ruminants being treated with other treatments rather than using antibiotic drugs.

4.9 Use of anti-inflammatory drug in treatment of diarrhea cases

Figure 14: The percentage of anti-inflammatory drug being use in treating diarrhea among large ruminant from selected farms in Klang Valley

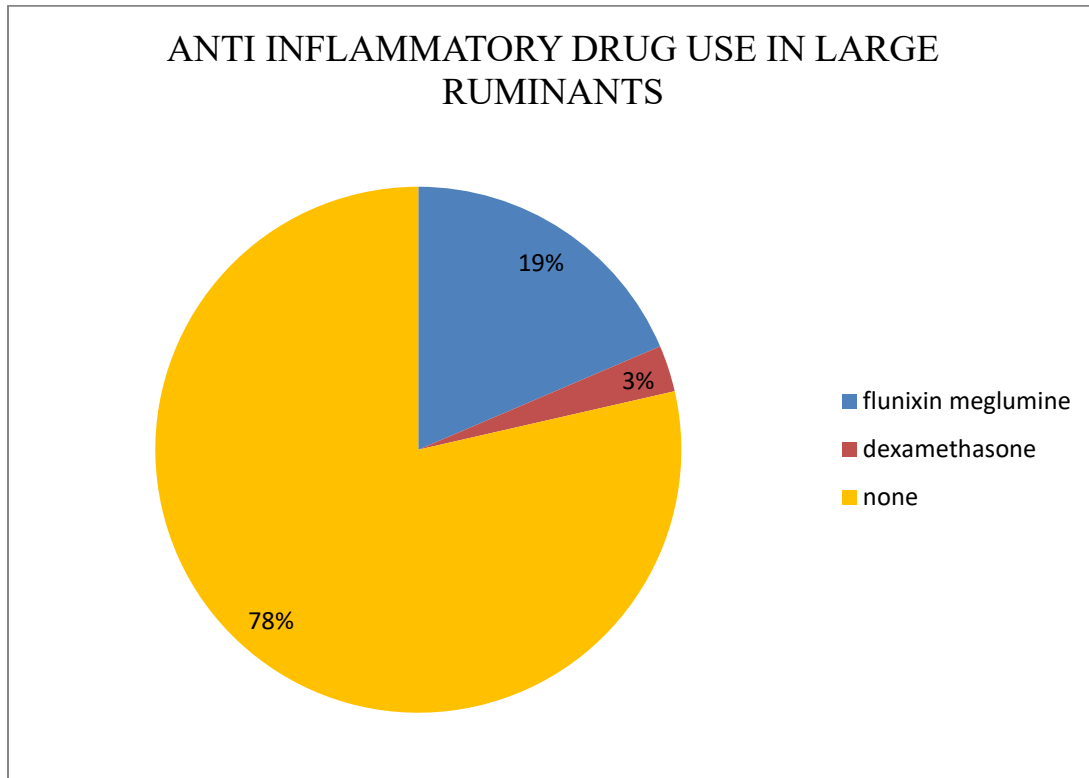


Figure 14 shows a pie chart that represents the percentage of anti-inflammatory drug being use in treating diarrhea among large ruminants from selected farms in Klang Valley. From 70 cattle and buffalo group that were diagnosed with diarrhea, 19 percent were given Flunixin meglumine (NSAIDs) as part of the treatment regime. Meanwhile, 78 percent did not receive anti-inflammatory drug for treatment. There was only 3 percent that receives Dexamethasone (steroid) as another drug option for anti-inflammation.

Figure 15: The percentage of anti-inflammatory drug being use in treating diarrhea among small ruminant from selected farms in Klang Valley

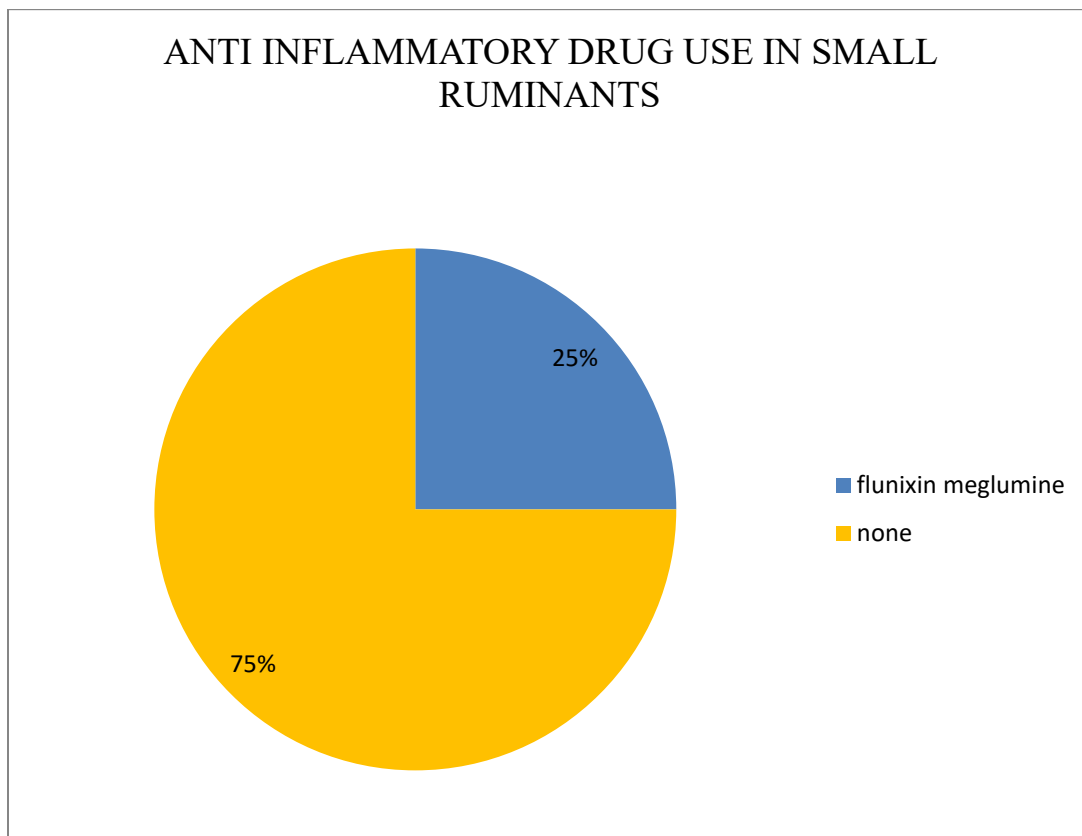


Figure 15 shows a pie chart that represents the percentage of anti-inflammatory drug being use in treating diarrhea among small ruminants from selected farms in Klang Valley. Out of 76 goats and sheeps that were diagnosed with diarrhea, 25 percent were given Flunixin meglumine as part of the treatment regime. Meanwhile, 75 percent did not receive anti-inflammatory drug for treatment

4.10 Use of vitamins in treatment of diarrhea cases

Figure 16: The percentage of vitamins being use in treating diarrhea among large and small ruminant from selected farms in Klang Valley

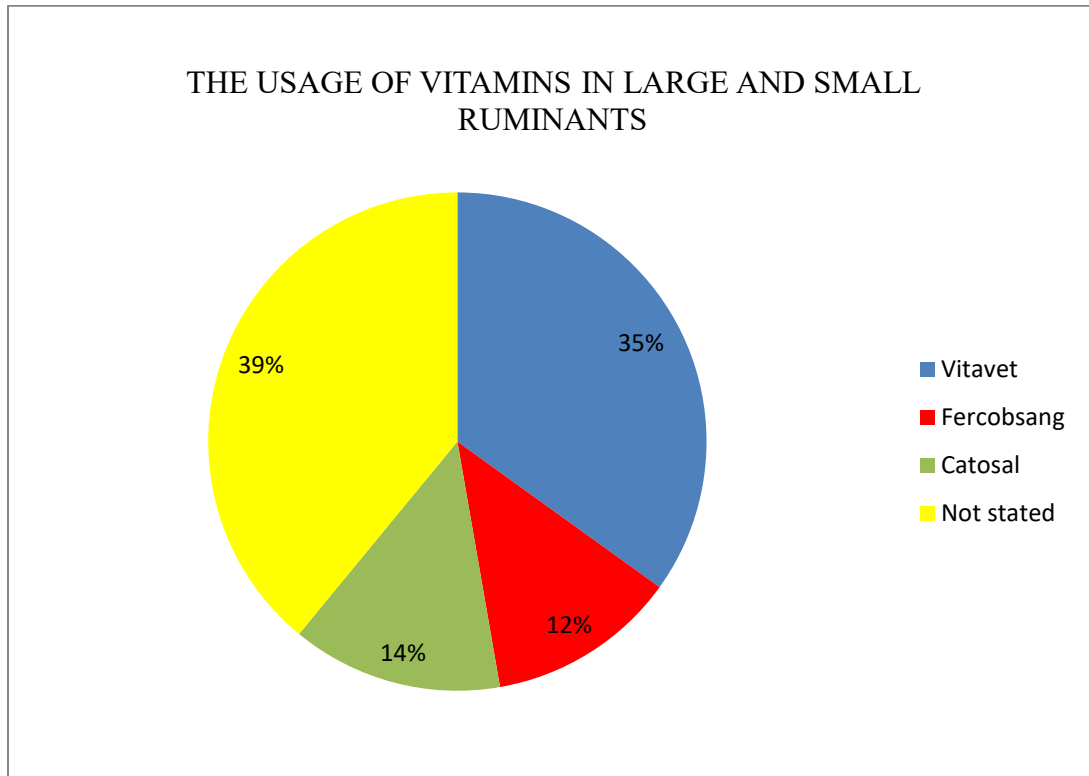
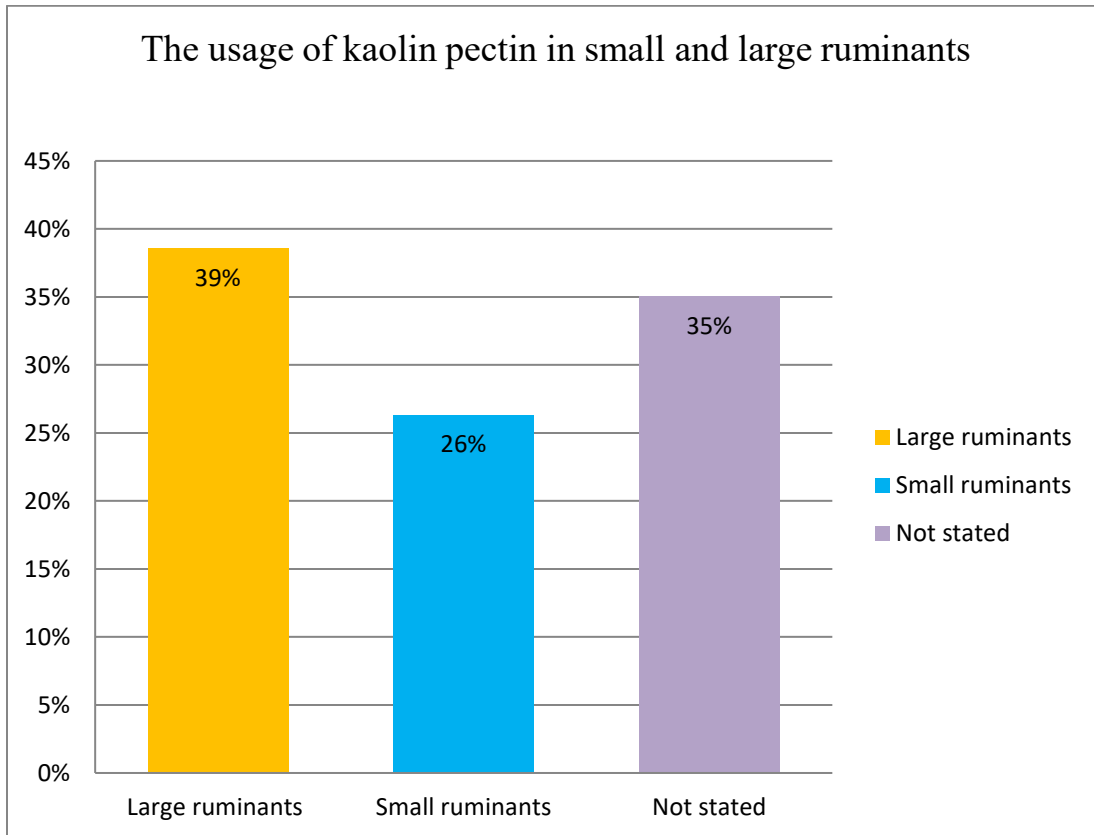


Figure 16 shows a pie chart that represents the percentage of vitamins being use in treating diarrhea among large and small ruminants from selected farms in Klang Valley. About 35 percent out of 146 reported cases being treated using Vitavet followed by 12 percent being treated with Fercobsang. Hence, Catosal are reported being used in small amount (14%) in both small and large ruminants. However, out of 146 reported cases, 39 percent was not stated for treating the animals with vitamins.

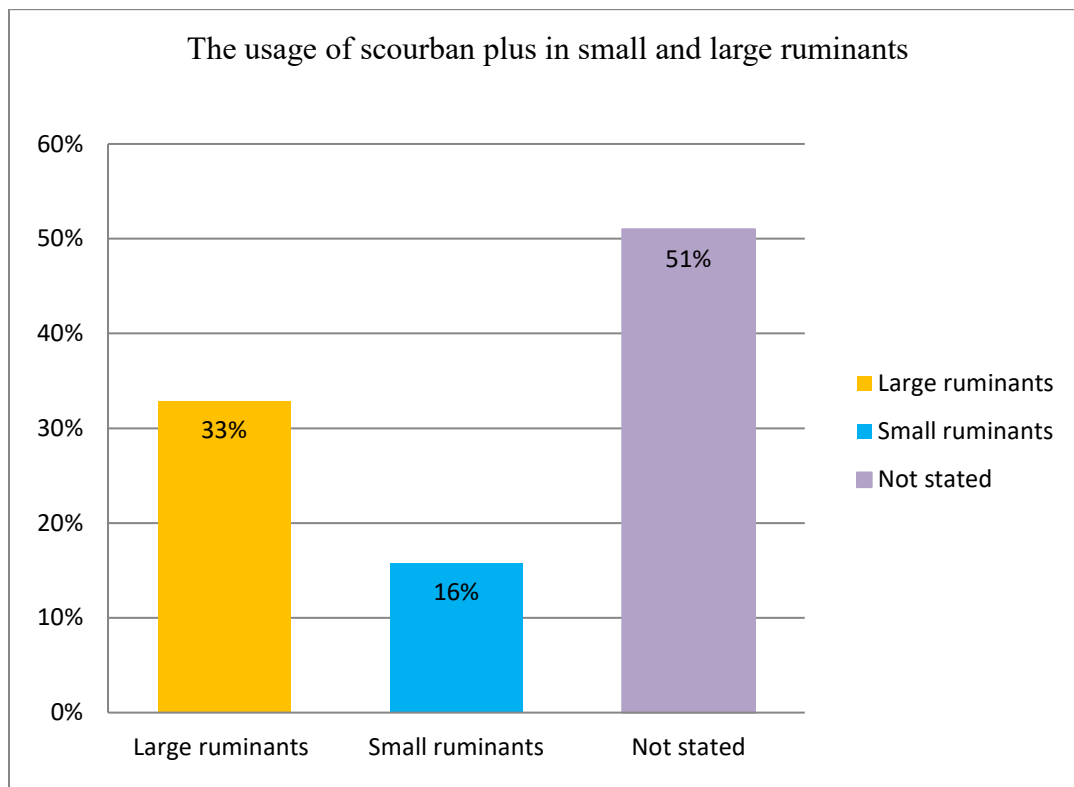
4.11 Use of anti diarrheals in treatment of diarrhea cases

Figure 17: The percentage of Kaolin pectin being use in treating diarrhea among large and small ruminant from selected farms in Klang Valley



Based on the graph chart in Figure 17, we can observe that most of anti diarrheals in large ruminants (39 percent) out of 70 reported cases was being treated with kaolin pectin. Hence, about 26 percent was reported in 76 in small ruminants cases are mostly use kaolin pectin to eliminate diarrhea problem. However, (35%) from the total 146 reported cases was not stated.

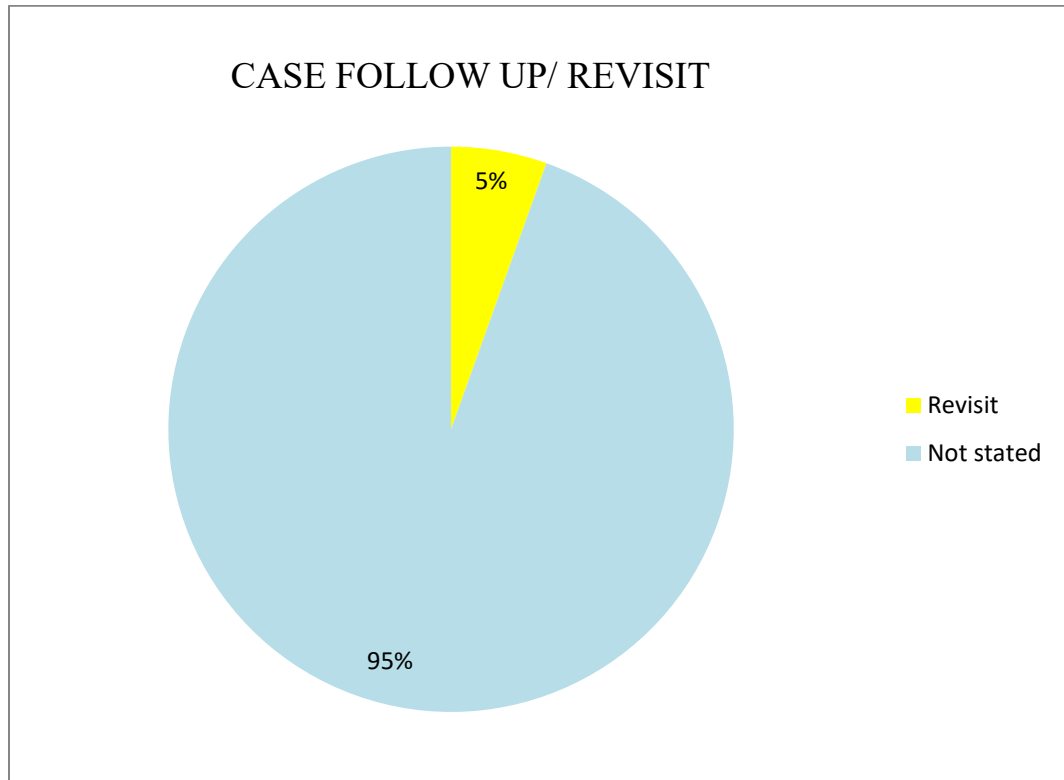
Figure 18: The percentage of Scourban plus being use in treating diarrhea among large and small ruminant from selected farms in Klang Valley



Based on the graph chart in Figure 18, we can observe that most of anti diarrheals in large ruminants (33 percent) out of 70 reported cases was being treated with Scourban plus. Hence, about 16 percent was reported in 76 in small ruminants cases are mostly use Scourban plus to eliminate diarrhea problem. However, (51%) from the total 146 reported cases was not stated for using antidiarrheals.

4.12 Case follow-up / Revisit

Figure 19: The number of diarrhea cases that were or weren't followed up after the first farm visit



Based on the graph shown in Figure 19, 5 percent which equivalent to 8 diagnosed diarrhea were revisited after the first-time farm visit to follow up the animals' condition and progress. Meanwhile, the remaining 95 percent of 138 diarrhea disease cases were not revisited after the first-time farm visit.

Chapter 5

DISCUSSION

Diseases involving gastrointestinal system in ruminants are considered as one of the most important diseases in ruminant livestock industry. In this study, the majority clinical cases reported involving diarrhea are among large ruminants where bovine recorded 45% followed by caprine 43% and lastly ovine with 9%. The least reported rare in buffalo (*Bulbalus sp.*) with only 3% during past 7 years of this study period. This was documented by Svensson et al (2003), mentioned that diarrhea is one of the most commonly recorded diseases in calves up to 3 months old. It has been estimated that 75% of early calf mortality in dairy herds is caused by acute diarrhoea in the pre-weaning period, as well as widely recorded disease in young animals and is still a major cause of productivity and economic loss to cattle, as well as a cause of high morbidity and mortality in the cattle industry throughout the world (Uhde et al., 2008; Bartels et al., 2010). Meanwhile in small ruminant such as goat and sheep, neonatal diarrhoea is a common problem with not very well known causes (Snodgrass et al., 1977). This condition has been attributed to a number of factors such as dietary deficiency, faulty management and infectious agents (Durham et al., 1979). More often, diarrhea becomes one of the most clinically important conditions related to gastrointestinal disease in both ruminants according to the study and findings. However, the data in this study can be debated as the numbers of animals involved in this study are more to large ruminants especially bovine group. There is also limited numbers buffalo farms in Peninsular Malaysia and this can be the reason as contributing factors towards limited number of cases reported in this buffalo species.

Findings in this study showed that the young animals aged less than 2 years old has the highest percentage affected with clinical diarrhea in small and large ruminants. Ghanem et al. (2012) mentioned that there is some predisposing factors cause enteritis. Newborn calves and lambs with immunoglobulin deficiency are more vulnerable than adults. Next, multiple stresses such as transportation, food and water deprivation, or weaning can cause the animal to become immunosuppressed, leading to enteritis and causing diarrhea. Another studies also stated that lack of immunoglobulins in the colostrum and poor intake of colostrum and insufficient absorption of intestinal immunoglobulins make very young calves vulnerable to infection (Groutides and Michell, 1990). There are many causes that can lead to diarrhea in ruminants where the infectious causative agents are such as bacteria, virus and parasites and one of the main non-infectious predisposing causes are the housing or management practice. Farm management practices in Malaysia are normally intensive, semi-intensive, or extensive management system. Based on the result obtained from this study, majority ruminant farms in Klang Valley practices intensive followed by semi intensive farming management system. Additional factors linked to diarrhea include breed (Lundborg et al., 2005; Svensson and Liberg, 2006; Svensson et al., 2006), putting indoor calf pens against an outer wall compared to pens isolated from outer walls (Lundborg et al., 2005), holding grouped calves on a slatted concrete floor against other floors, housing in freestalls compared to tiestalls, purchasing calves (Gulliksen et al., 2009), and calf stocking density (Bendali et al., 1999).

There are various types of diarrhea problems involving the gastrointestinal system in large ruminants and small ruminants. In this study, out of 146 reported cases of diarrhea from selected farms in Klang Valley past 7 years period, the highest percentage of cases recorded are coccidiosis and the higher number of coccidiosis cases was reported in cattle and goats

compared to other infectious causes. This was recorded by Radostits et al (2008), stated that coccidiosis is a parasitic protozoan (*Eimeria* genus) disease causes diarrhoea in calves, lambs, and kids. Hence, coccidiosis occurs uniformly in young animals between 3 weeks and 6 months of age, causing major economic losses, but often in cattle aged 1 year or older (Radostits et al., 2008; Ballweber, 2009). The disease occurs in animals that are kept in crowded and contaminated pens.

In this study, it was observed that fecal sample procedure was performed not more than half of the clinical cases recorded past 7 years. Fecal sample was taken and examined examined by microscopy (for *C. parvum* and *Coccidia*), bacterial culturing (for *Salmonella spp.*, *E. coli*, and *C. perfringens*) and this is in accord with Yong and Yoon, (2014). Fecal sample was used to identify parasite eggs and oocyst using modified McMaster technique. The findings showed that most of the reported case can be due to strongyles (PGE) or coccidiosis. Other than that, fecal sample were also send to bacteriology analyses for isolation and identification of the causative agent causing diarrhea. Majority of the percentage stated that there is no any further diagnosis was taken as it might due to the subclinical infection or due to revisit cases.

In this study, it was observed that majority of ruminant animals reported with diarrhea showed presence clinical signs of pyrexia, watery or pasty diarrhea and presence dehydration status. Clinical presentation can range from mild diarrhea without systemic disease to serious, acute diarrhea associated with severe dehydration, significant acid-base and electrolyte balance disruption, and death (Gruenberg, 2014). In infants the infection with rotavirus is usually characterized by watery diarrhea and severe dehydration whilst adult infection is often subclinical (Malik *et al.*, 2005; Ramani and Kang 2007). In *clostridium perfringens* type A, clinical signs include pasty feces, which may progress to hemorrhagic diarrhea, accompanied

by a painful distended abomasum (Heller and Chirgewe, 2018). Basically, there is various of clinical sign exhibited by the animals depends on the agents, location and severity.

In this study, we found that the common antibiotic of choice of the veterinarians treating diarrhea cases in both large and small ruminants is Oxytetracycline. According to Constable (2003), several trials of various antibiotics (including ampicillin, chlortetracycline, furazolidone, neomycin, oxytetracycline, and streptomycin) were performed in the 1960s and 1970s to avoid diarrhoea in calves. In a survey conducted in 2007, about 60% of dairy farms in the United States fed medicated milk substitutes to preweaned heifer calves, most typically a mixture of oxytetracycline and neomycin (USDA, 2002). To ensure the effectiveness of the choice of antimicrobial drugs being used, the disease must be diagnosed and treat earlier using correct dosage of the drug, route of administration and duration (Lorenz *et. al.*, 2011). Sadiq *et al.* (2018) also added stating that to curb the risk of AMR, the choice usage of anti-microbial drug, dosage and duration must be based on the severity of the disease.

The uses of anti-inflammatory drugs as a choice in the therapeutic plan of diarrhea problem. This will helps n the reduction of inflammatory process, pain and pyrexia (fever) in the affected animals (Lorenz *et. al.*, 2011). In this study, we observed that the most common choice of NSAIDs among veterinarians to treat diarrhea for ruminants are Flunixin meglumine and the findings is in accord with Barnett et al (2003), stated that Flunixin meglumine has been shown to decrease the incidence and total number of treatments in calves with bloody diarrhoea in combination with antibiotic treatment and may be a valuable nonantibiotic treatment option. In this study, it was observed that only small percentage of clinical diarrhea cases were treated using steroid dexamethasone drug.

The uses of anti diarrheals such as kaolin pectin and scourban plus also provide greater improvement in treating the diarrhea animals. In this study, we found that higher percentage of these anti diarrheal products were used in large ruminants. According to Subramaniam and Kim (2015), clays (kaolin) minimize the passage time of foods in the digestive tract and thereby improve the absorption of nutrients. Clays also cause changes in intestinal mucosa (increased villus height to depth crypt ratio) and increase surface area for digestion of nutrients.

Revisit of clinical cases would be one of the important parts in the clinical management involving clinical cases of diarrhea in ruminants. Constant follow-up via scheduled revisit of the clinical cases will lead to a proper monitoring and evaluation of treated animals and this aid to determine the disease progression and effectiveness of the therapeutic plan (Jesse *et. al.*, 2018). The practice of constant revisit will allow identifying the ineffective treatments that need to be switched to other alternatives immediately where this will help in the welfare of the affected animals by preventing the infection getting worse and will help to intervene in the development of AMR. The findings from this study showed that only very minimal clinical cases (5%) have been followed up via revisit and there is a huge gap (95%) in not following the clinical cases. Therefore, it is recommended that the veterinarians to strictly follow-up the clinical cases via constant schedule revisit of clinical cases for welfare of the affected animals and close monitoring on the therapeutic regime and to avoid excessive usage of drugs and curb the progressive development of AMR.

Chapter 6

CONCLUSION AND RECOMMENDATION

In conclusion, from this study the data on common gastrointestinal system diseases related to diarrhea and its clinical signs, common drug usage for treatment, and further follow-up plan after first farm visit were tabulated and analyzed. Therefore, the objectives of this study were achieved where the common diarrhea cases reported among small and large ruminants from 2013 to 2019 reported from in selected ruminant farms in from Klang Valley were identified, the common treatment regime and follow up cases practices involving towards particular diarrhea problem in small and large ruminant were categorized and analyzed. The findings from this study gave additional information and this will assist field veterinarians on improving the clinical management of this diarrhea involving small and large ruminants in future.

In future studies, it is recommended to perform sampling by expanding the area for data collection. Apart from that, to ease in the data collection, it is good to advice all veterinarians and farmers to keep a good records of farm animals and treatment records. In addition, the basic physical examination findings (such as temperature, pulse and respiratory), severity of the clinical diarrhea, dehydration status need to be recorded either it is mild, moderate or severe cases of diarrhea. This will help veterinarians to have final decision making as well as to have a better treatment plan according to different severity of clinical condition and prognosis in the future.

Chapter 7

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