## ABSTRACT

The study was conducted to compare the effect of ginger and sodium bi-carbonate on body weight and ruminal fluid condition of sheep. One year old twelve rams having average 12-15kg body weight were distributed into four treatments group with three replication and one ram per each replication in a completely randomized design. The sheep reared 2 months into research shed of Chattogram Veterinary and Animal Sciences University. They offered four different diets; Control (no sodium bicarbonate or ginger powder), T1(1.5 g ginger powder /kg diet), T2(1.5 g sodium bicarbonate powder /kg diet), and T3 (ginger powder 1.5 g + sodium bicarbonate powder 1.5 g/kg diet). Body weight was recorded every fifteen days interval through digital weigh scale. The rumen fluid collected through stomach tube after 1 hour of feeding at the morning after recording body weight of the sheep. Immediately after collection of rumen fluid, went to laboratory for measurement of pH, protozoa, protozoal motility, and other physical properties such as colour, odor, consistency of rumen fluid. Among three times collection of rumen fluid, the final pH washightest in T0 group (control group) which was 5.65 and lowest pH in T3 group (combined diet group) which was 5.23 found. In four treatment group, the odor and consistency of rumen fluid were same which were slightly pungent and viscous in three times. Final colour of rumen fluid was olive green in all treatment group. In final collection of fluid, protozoa ishightest in T3 group (combined diet group) and lowest in T0 group (control group).In final weight, lowest body weight was 15.51 kg which found in T0 group and highest body weight was 19.69 kg which found in T1 group. After the analysis of result, we can clearly state that, the combination of sodium bicarbonate and ginger gives best result from other three treatments. The control group gives worst result in all parameters of ruminal fluid as well as growth performance. It was determined that feeding a mixture of 1.5 g/kg sodium bicarbonate and ginger diets will result in overall superior rumen function than providing 1.5 g/kg sodium bicarbonate or ginger diets separately.


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**Keywords**: Sodium bicarbonate, Ginger, Sheep, Rumen fluid, Protozoa.

# CHAPTER I

## INTRODUCTION

Sheep is one of the significant animal types among all small ruminant which is broadly conveyed all through the world (Ahmed et al., 2018). In 2008, the worldwide sheep population remains at 1078.2 million head among of them 19% found in Asia and Africa (FAO, 2008). World sheep population during the period 1961 is 980 million head and in 2000 is 1060 million head. World sheep population during the period 1961-2000 was expanded exclusively by 6.22%. In the meantime, this population during a similar period, in Asia was expanded by 78.3% (Skapetas B and Kalaitzidou M, 2017). Sheep rearing is increasing nowadays in Banglades. Bangladesh has 1.9 million sheep as of now in 2019 (M. Uddin et al., 2019). They are utilized principally for meat (Ahmed et al., 2018). Countries with a long tradition of consuming sheep and goat meat also consume many products, such as hams, sausages and pates, or other processed products. Many of these products correspond to ancient methods of preserving meat at a time when there was no other way of preserving than curing with salts, air drying or smoking (A. Teixeira et al., 2020). As sheep farming needn't bother with a lot space, the landless and peripheral ranchers are raising sheep for extra pay age (S.S. Islam et al., 2020). Moreover, the sheep are considered as tame creatures having capacity of half-yearly lambing and different births (Bhuiyan, 2006). In addition, sheep is milder than goat meat which effectively processes (Ahmed et al., 2018). Sheep don't need a ton of feed and the most significant thing is they don't have a specific feed propensity (S.S. Islam et al., 2020).

Gingers (*Zingiber officinale* Roscoe) are fresh or dried rhizomes of the family Gingeraceae (Yue Yin et.al., 2019). Ginger may be known to exhibit great antioxidant activity as demonstrated in cell culture (Chaiyakunapruket al., 2006). Ginger is a good source of essential micronutrients**,** such as potassium, magnesium, copper, manganese and silicon.potassium and manganese help to strengthenthe resistance to diseases and protect the heart, blood vessels and the inner wall of the urinarytract**.** Small amounts of vitamins A, E and some vitamins Band C were also found in ginger rhizomes (Adel and Prakash, 2010). Preliminary studieshave shown that nine compounds found in ginger can bind to the serotoninreceptor, which may affect the gastrointestinal function

(Botsoglou et al., 2002). In vitro experimental studies have shown that ginger extract can control the amount of free radicals and lipid peroxidation (Al-Amin et al., 2006). The uniquesmell and taste of ginger is caused by the mixture of gingerone,shagaols and gingerol.The volatile oil of accountsfor1% to 3% of the weight of fresh ginger (Rivlin, 2001). Spices and flavors are referred to have medical advantages like craving and processing energizers, anti-microbial activity, calming activity, hostile to oxidative activity and immunostimulant work on creatures when utilized as feed additive (Faniyi et al., 2016). Ginger can manipulate the rumen microbial fermentation (M. Soroor and M. Moeini, 2014). Rumen microbial population can be controlled by adding ginger as food additives to eliminate or reduce rumen ciliated protozoa (fauna loss),reduce protein degradation and methane production (T. Faniyi et al., 2016). Recently, many researchers have shifted their attention to the use of ginger extracts/ dials dueto their great potential as alternatives to antibiotics for to manipulate ruminant nutrition and growth. Many studiesconducted by different researchers use extracts / flours of certain herbs and spicescombined with various techniques to manipulate the microbial ecosystem of the rumento increase the productivity of ruminants (Geraci et al., 2012, Patra andSaxena, 2010, Benchaar et al., 2008a, Calsamiglia et al., 2007, Jayasena and Jo, 2013).

The addition of ginger powder in sheep resulted in a decrease in total volatile fatty acid (VFA) concentration, but no change in fatty acid compositions, acetate-to-propionate ratio, pH, or ammonia-N concentration (Zhang et al., 2011). Suggested that after 20 days of feeding, the effect of ginger powder in sheep diet lowered overall VFA concentration and that ruminal microorganisms may have adapted and built up a resistance to it (T. Ikyume et al., 2020).

The significant increase in daily body weight gain and final body weight of broilers fed ginger and garlic supports the findings of Demir et al., 2003; Ademola et al., 2005; Javendel et al., 2008) who used herbal plants (ginger and garlic) as growth promoters in broiler diets and saw a significant increase in body weight gain and feed conversion ratio (V. Oleforuh-Okoleh et al., 2014). In comparison to the control group, those who consumed more ginger powder in their diets had lower percentages of abdominal fat, liver, and gizzard (S. Eltazi, 2014). The activity of ginger, which has been documented to have lipid lowering effects, may be responsible for the reduction in the proportion of belly fat in meals supplemented with ginger powder (Sharma et al., 1996).

The ruminal environment of sheep is a complicated, unique environment made out of basically anaerobic microscopic organisms, protozoa, anaerobic parasites, methanogenic archaea and phages. (Mizrahi, 2013). The ruminal microorganisms are created for the most part by three gatherings of anaerobes; by microbes, protozoa and organisms. The population of each gathering and their species are straight forwardly impacted by the kind of feed stuff gave to the ruminant host (Tiago valenty et al., 2016). These microorganisms connect with one another and have an advantageous connection with the host, giving energy from the breakdown of plant cell divider sugars that are generally unpalatable by people (Mizrahi, 2013). The rumen microbes are the most plentiful and assorted gathering of microorganisms in the rumen environment. Overall, they have a huge number of enzymatic exercises (i.e., amylases, cellulases, proteases, lipases) that complete absorption of starch, plant cell dividers, proteins and lipids in the rumen (Sharon A. Huws, 2018). Protozoa can contribute with the greater part of the rumen microbial mass (Van Soest, 1994). Nonetheless, the stream out of the rumen protozoa isn't relative to its number in the rumen. Protozoa are held on account of biomass specifically in the rumen (Williams et al., 2008). Protozoa utilize insoluble proteins as opposed to solvable proteins, while microscopic organisms didn't utilize alkali for amino acid combination (Dijkstra et al., 1998).

**Objectives:**

1. To investigate the dietary effect of ginger and sodium bi-carbonate on growth performance of sheep.
2. To determine the influence of ginger and sodium bi-carbonate on ruminal environment.

# CHAPTER II

# MATERIALS AND METHODS

## 2.1. Experimental site:

The experiment was carried out at Chattogram Veterinary and Animal Sciences University (CVASU) from May to September, 2021.

## 2.2. Collection and preparation of ginger powder:

The ginger bulbs were obtained in good condition from a local store. Then the ginger bulbs were washed, sliced and sun dried. The bulbs were dried in the oven at a $105^0$ C. The plant materials were ground after drying with the assistance of an electric grinding machine (Panasonic MX-AC555).

## 2.3. Experimental animals and diet:

In this study, twelve (12) yearling rams of mixed breeds with an average weight of 12-15 kg were divided into four groups and assigned to four (4) treatment groups, with each animal serving as a replicate. The rams were purchased from a local farm. They had to stay in quarantine for two weeks. During the quarantine period, the animals were given Ivermectin which was used to treat them for ectoparasites and endoparasites. The four experimental diets (Table 1) were Control (basal diet), T1 (basal + ginger powder), and ginger was included in the diet at a rate of 1.5 g/kg; T2 (basal + Na bicarbonate is included in the diet at a rate of 1.5 g/kg diet); T3 (basal + 1.5g/kg ginger + 1.5g/kg Na bicarbonate).

**2.4.Table 1: Composition of experimental diets (Kg)**

| Ingredients | T0 | T1 | T2 | T3 |
|---|---|---|---|---|
| Maize | 20 | 20 | 20 | 20 |
| Rice polish | 14 | 14 | 14 | 14 |
| Wheat bran | 40 | 40 | 40 | 40 |
| Soybean meal | 25 | 25 | 25 | 25 |
| salt | 0.25 | 0.25 | 0.25 | 0.25 |
| Vit-mineral premix | 0.25 | 0.25 | 0.25 | 0.25 |
| DCP | 0.5 | 0.5 | 0.5 | 0.5 |
| Ginger Powder | - | 0.15 | - | 0.15 |
| Na2CO3 | - | - | 0.15 | 0.15 |
| Total | 100 | 100 | 100 | 100 |

**2.5. Data Collection:**

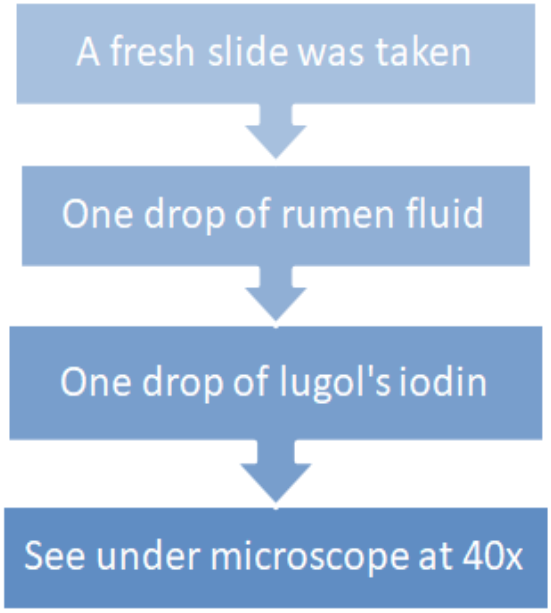
After 21 days later, the rumen fluid was collected by stomach tube insertion. The colour, consistancy, odour, pH, protozoal motility, protozoal count were seen immediately after collection of rumen fluid. The rumen fluid was collected for three times and seen these parameters.

The colour, consistancy were detected by eye and odour was detected by directly. The pH of rumen fluid was detected by portable pH machine.

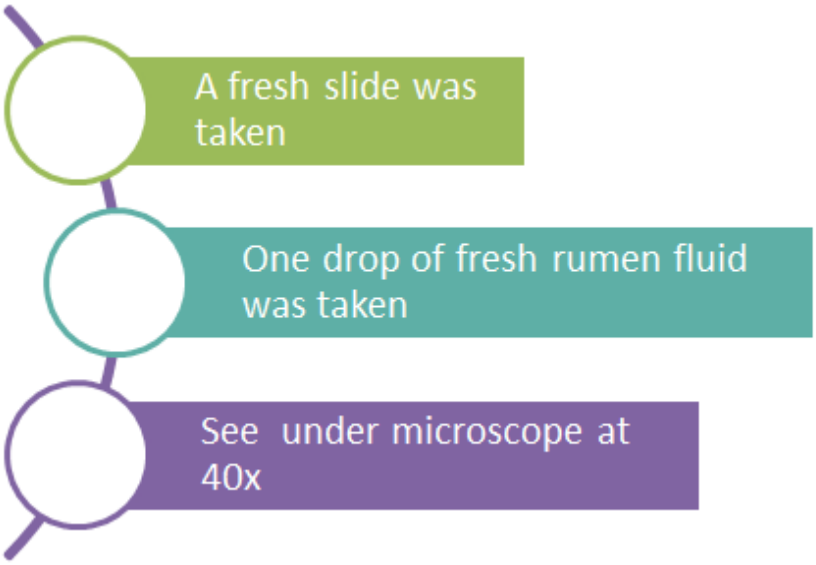
**2.6. Data analysis:** All the data were inserted and complied using Microsoft excel 2013 and descriptive statistics were analyzed using STATA 13.

**2.7. Laboratory analysis:** In lab, we had done different laboratory test of ruminal fluid such as pH test, rumen protozoa motility test, rumen protozoal count by lugol'siodin.

**2.7.1.Enumeration of protozoa:**



### 2.7.2. Determination of protozoal motility:




### 2.8. Growth performance:

The body weight was first taken at the day of purchase. The average body weight 12-15 kg. After that, frequently three times body wight is taken. The body weight was taken by a digital hanging weigh scale. The balance was hanging by a rope and the balance had to zero mode. Then the animal hung with the hook by a bag. Then gave time to fixed the balance ,at a time it shows the weight of the animal.

# CHAPTER III

# RESULTS

## 3.1. Growth performance of sheep fed diet containing ginger

Table 2 shows the growth performance features of sheep supplemented concentrate diets containing Na bicarbonate and ginger powder, as well as their combination. When compared to the control group, the daily weight change in the herb combination increased. In final weight, lowest body weight was 15.51 which found in T0 group and highest body weight was 19.69 which found in T1 group.

### 3.1.1 Table 2: Growth performance parameters of sheep

| | **Treatment group** | | | |
|---|---|---|---|---|
| **Parameters** | **T0 group (Mean±SE)** | **T1 group (Mean±SE)** | **T2 group (Mean±SE)** | **T3 group (Mean±SE)** |
| **Initial weight** | 11.18±0.82 | 14.25± 0.42 | 13.49± 0.75 | 12.89± 0 .26 |
| **15$^{th}$ day weight** | 12.41 ± 0.59 | 16.06± 0.32 | 15.36± 0.85 | 14.64 ± 0.29 |
| **30$^{th}$ day weight** | 14.24±0.39 | 18.44± 0.39 | 17.53±0.79 | 16.87±0.33 |
| **45$^{th}$ day weight** | 15.14±0.32 | 18.98±0.43 | 17.60±0.51 | 17.60±0.49 |
| **60$^{th}$ day (final day) weight** | 15.51±0.30 | 19.69±0.48 | 18.26±0.19 | 18.07±0.74 |

T0= basal diet, T1= basal diet+1.5gm/kg diet, T2 = basal diet + Na bicarbonate 1.5 g/kg diet); T3= basal diet+ 1.5g/kg ginger + 1.5g/kg Na bicarbonate), SE= Standard Error

### 3.2. Physical examination of rumen liquor

#### 3.2.1.Colour:

Visualization revealed the type of rumen liquor in control group, T1, T2 and T3 group. When rumen liquor from sheep with T1 diet,T2 group and T3 group was compared to that of control group, it was same at first collection which is olive green. At second collection, the colour of rumen liquor was different from before. The colour was yellowish green which was normal. The colour was same in control group, T1 group, T2 group and T3 group. At the time of third collection, the colour was same as before that was olive green.

#### 3.2.2. Consistency:

The consistency of rumen liquor was viscous in control group, T1 group, T2 group and T3 group at first rumen liquor collection. After 15 days later, 2nd time rumen liquor collected and the consistency was same which is viscous. 3rd time collected liquor also same as before which was viscous and it was normal in sheep.

| **Variables** | **Treatments** | **1st collection** | **2nd collection** | **3rd collection** |
|---|---|---|---|---|
| Colour | Control | Olive green | Yellowish green | Olive green |
| | T1 | Olive green | Yellowish green | Olive green |
| | T2 | Olive green | Yellowish green | Olive green |
| | T3 | Olive green | Yellowish green | Olive green |
| Consistency | Control | Viscous | Viscous | Viscous |
| | T1 | Viscous | Viscous | Viscous |
| | T2 | Viscous | Viscous | Viscous |
| | T3 | Viscous | Viscous | Viscous |
| | Control | Slightly pungent | Slightly pungent | Slightly pungent |
| | T1 | Slightly pungent | Slightly pungent | Slightly pungent |

| | | | | |
|---|---|---|---|---|
| Odour | T2 | Slightly pungent | Slightly pungent | Slightly pungent |
| | T3 | Slightly pungent | Slightly pungent | Slightly pungent |

**3.2.3.Odour:**

The odor of rumen liquor was slightly pungent of control group, T1 group, T2 group and T3 group. Three times collected the rumen liquor and all time the four treatments group were same as before which is slightly pungent.

**3.2.4. Table 3: Rumen fluid parameters**

**3.3. Ruminal Fluid pH:**

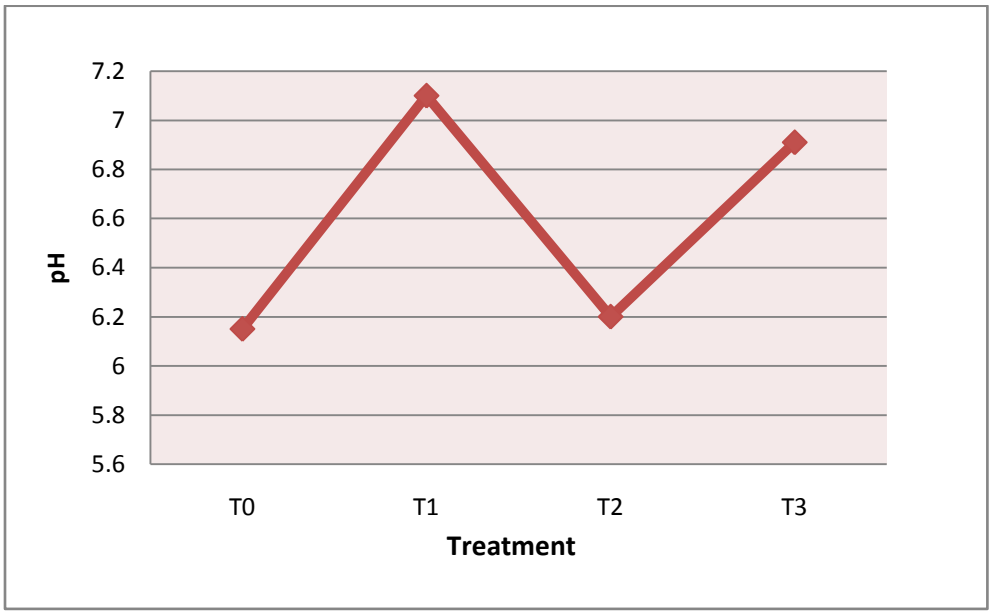



**Fig.3.3.1. Ruminal fluid pH at 3rd week**

T0= basal diet, T1= basal diet+1.5gm/kg diet, T2 = basal diet + Na bicarbonate 1.5 g/kg diet); T3= basal diet+ 1.5g/kg ginger + 1.5g/kg Na bicarbonate).

Here the diagram shows the pH of 1st collection of rumen fluid after 15 days of diet. Here, the pH of control group is 6.15, ginger group is 7.1, sodium bicarbonate group is 6.2, combined diet group is 6.91. At first collection, pH high in T1 group which is alkaline in nature compare then other group. In control group, pH is lower then other group which is acidic in nature.

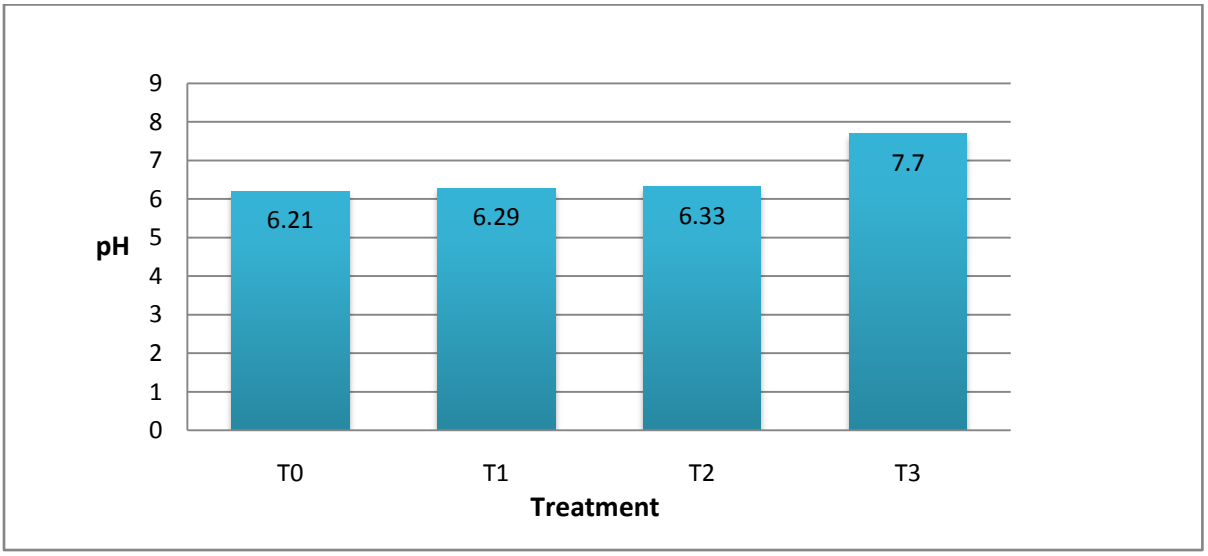



**Fig.3.3.2. Ruminal fluid pH at 5th week**

T0= basal diet, T1= basal diet+1.5gm/kg diet, T2 = basal diet + Na bicarbonate 1.5 g/kg diet); T3= basal diet+ 1.5g/kg ginger + 1.5g/kg Na bicarbonate).

In 2nd collection, control group=6.21, ginger group =6.29, sodium bicarbonate group=6.33, combined diet group=7.7. Here, Higher pH seen in combined diet group (T3) which is alkaline in nature compare then other group. Lower pH seen in control group compare then others. Wanapat et al. (2013) found that beef cattle treated with a combination of garlic, lemon, and peppermint had a higher ph. A modest increase in pH in sheep was also found by Zhang et al. (2011).

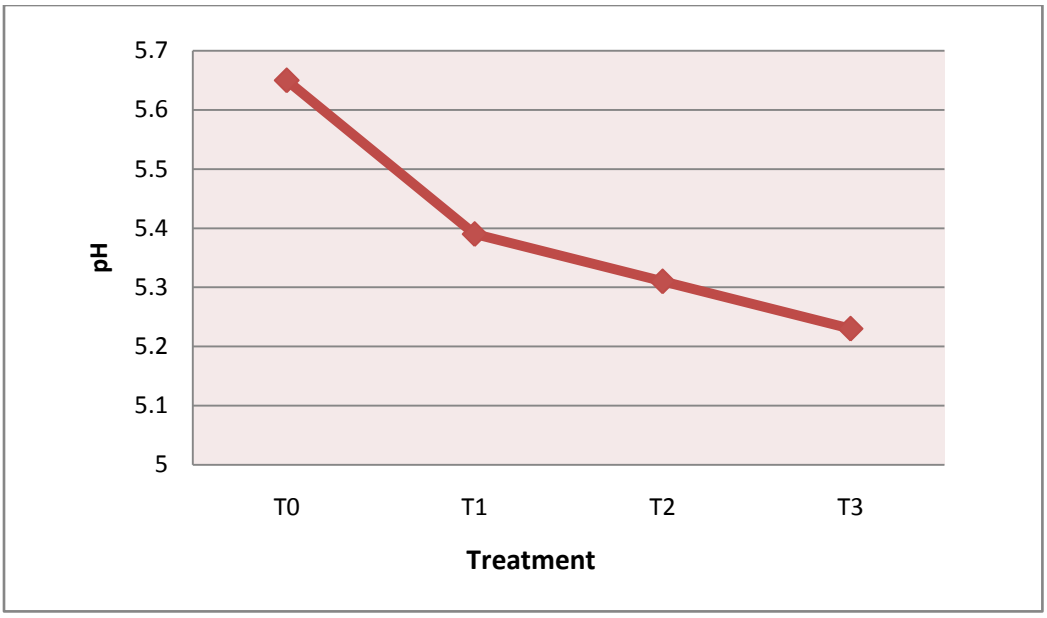



**Fig.3.3.3. Ruminal fluid pH at 9th week**

T0= basal diet, T1= basal diet+1.5gm/kg diet, T2 = basal diet + Na bicarbonate 1.5 g/kg diet); T3= basal diet+ 1.5g/kg ginger + 1.5g/kg Na bicarbonate)

In 3rd collection, control group=5.65, ginger group=5.39, sodium bicarbonate group=5.31, combined diet group=5.23. Here, the pH is acidic in nature in all group. But most lower pH is seen in combined diet group (T3) and higher pH is seen in control group compare then others which is acidic in nature.

### 3.4. Activity of rumen protozoa:

The motility of protozoa detect the ruminal environment of ruminant. The motility of protozoa detect by microscope from fresh rumen liquor. In first collection , the motility of protozoa is very rapid (++++) in all group except combined diet group (NaGP) which is moderately motile (+++). In 2nd collection, the motility of protozoa was same as before. In 3rd collection, the protozoal motility is very rapid (++++) in all group except control group which is moderately motile (+++) in nature.

### 3.4.1. Table 4: Protozoal motility of rumen liquor in treatment groups

| Parameter | Treatment | 3rd week of rearing | 5th week of rearing | 9th week of rearing |
|---|---|---|---|---|
| Protozoal motility | Control | Very motile (++++) | Very motile (++++) | Moderately motile (+++) |
| | T1 | Very motile (++++) | Very motile (++++) | Very motile (++++) |
| | T2 | Very motile (++++) | Very motile (++++) | Very motile (++++) |
| | T3 | Moderately motile (+++) | Moderately motile (+++) | Very motile (++++) |

### 3.5.Protozoal count of rumen liquor:

Protozoal count were seen in cells/ml under microscope for four focus. Fresh rumen liquor in slide then lugolsiodin add one drop and see under microscope and count protozoa in four focus. The protozoa was lower in first and second collection then 3rd one. In first collection, protozoa was comparatively high in T2 group then others. In second collection, protozoa was higher in combined diet group (T3) then others and comparatively lower in control group. In 3rd collection, protozoa was high in combined group(T3) then others and lower in control group.

### 3.5.1.Table 5: Protozoal count in rumen liquor

| Parameter | Treatment | 1st collection | 2nd collection | 3rd collection |
|---|---|---|---|---|
| Protozoal count (X10^5 cell ml-1) | Control | 10 | 68 | 110 |
| | T1 | 10 | 110 | 107 |
| | T2 | 30 | 69 | 125 |
| | T3 | 20 | 121 | 152 |

## CHAPTERIV

## DISCUSSION

Growth parameters such as daily weight changes, feed intake, and feed conversion ratio could be used to assess the animal's performance. Results discovered that there are significant variations in frame weight of rams between treatments (Table 2). The rams' weights ranged 11.74 to 20.66 kg on the give up of the experiment. The combined effect of the ginger and Na-bicarbonate when administered in feed it is visible in the improved daily changes in sheep in the combined group (T3). The weight of sheep increased seen in ginger powder group (T1). In control group, the weight of sheep not so increased as other treatments group. In T2 group, weight also increased then before but not as combined group(T3). Table (2) indicated that until the third week of the investigation, there were no significant variations in the initial weight of sheep, but that there was a significant increase in the weights of sheep in the sixth week of the study. These findings are consistent with those of Al- Jubouri (2012), who observed no significant variations in body weight when varying percentages of Ginger roots were introduced to the diet of dairy cows. When it came to the weight of the lambs from birth to weaning, the table revealed that the weight of the lambs who had ginger added to their diet began to increase the body weight gradually, especially with the treatment with sodium bicarbonate (R. Ammar and M. Al-Hafz, 2019). The non-significant increases in body weight in this study are similar with previous findings in sheep and goats exposed to ginger and Na-bicarbonate powder, respectively (Muhammad et al., 2016; Ikyume et al., 2017).

The rumen pH is an important element in rumen health, microbial stability, and shift, as well as a requirement for proper microbial proliferation. The pH can be used to anticipate the type of diet supplied to animals, as well as the rate of fermentation, depending on the degree of increase or reduction. The ideal pH for fiber digestion is between 5.8 and 6.0. (Kolver and De Veth, 2002). in the second therapy, as opposed to the third treatment, which is dependent on the first. The use of concentrated feed resulted in a higher concentration of acidity and a lower pH of the rumen, as evidenced by the fact that T1 had a lower pH value than the other treatments, while operating T2 had a much higher pH value. The change in output fermentation rumen as a result of improving the conditions of the rumen using this mixture to the ration, and a reflection positively in activity of microorganisms within the rumen, may be due to the change in pH in T3 despite

the addition of mixture sodium bicarbonates and ginger which could be due to the change in output fermentation rumen as a result of improving the conditions of the rumen using this mixture to the ration, and an increase in the activity of microorganisms in the rumen, which may lead to an increase in the concentration of organic acids, which are the principal cause of the rumen's low pH (M. Tayeb et. al, 2020). My result also agreed with this.Wanapat et al. (2013) found that beef cattle treated with a combination of garlic, lemon, and peppermint had a higher ph. A modest increase in pH in sheep was also found by Zhang et al. (2011). In goats and lambs treated with ginger products, however, pH was lowered (Hodjatpan et al.,2010; Ikyume et al.,2017). Lower pH causes fibrolytic activity to diminish, which is caused by microbes' inability to maintain pH inside their cells (Chiba, 2014). Herbs contain antibacterial characteristics and can be used to change the rumen's energy or protein utilization (Kamel, 2001).

Newbold et al. (1991) showed that adding sodium bicarbonate (25, 50, and 75 g/day) to corn silage diets increased the protozoa population relative to the control treatment. It was most likely owing to sodium bicarbonate's ability to keep the rumen pH in the right range for protozoa activity, as there is a strong link between daily minimum pH and rumen protozoa population. Philippeau et al. (2017) found that lowering the rumen pH to less than six caused a considerable reduction in the rumen protozoa population. Santra et al. (2003) also found that increasing the amount of sodium bicarbonate in the high concentrate diets had no significant effect on the rumen protozoa population of lambs, but that adding sodium bicarbonate and ginger to the diet increased the rumen protozoa population in general. In compared to our findings, I agreed with this. In contrast to our findings, Montao et al. (1999) found that adding sodium bicarbonate to the steer's diet resulted in an increase in rumen pH and a considerable drop in protozoa population.

## LIMITATIONS

No such facility found in lab to determine the bacteria of ruminal fluid. We could not grow the bacterial colony due to insufficient facility and poor storage system. As a result, we could not count the bacteria of ruminal fluid and could not see the load of bacteria in rumen.

# CHAPTER V

## CONCLUSION

The experiment confirmed that the impact of feeding sodium bicarbonate and ginger to sheep to govern rumen fermentation, microbial populationsand overall performance may be higher if the two are blended at decrease amounts. The aggregate of 1.5 g/kg of sodium bicarbonate and 1.5 g/kg of ginger gave a higher rumen modifier impact than feeding sodium bicarbonate and ginger 1.5 gm/kg singly. Further studies can range the stages of aggregate.

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## BIOGRAPHY

I am FarjanaAkter, daughter of Late Haji AhamedKabir and Khurshida Begum was born on February 25, 1998 at Jahanpur,Fatikchari. I passed Secondary School Certificate examination from Jamal khan Kusum Kumari Girls high School in 2013 (GPA-5.00) followed by Higher Secondary Certificate examination from Chattogram College in 2015 (G.PA-5.00). She is now enrolled in year-long internship programme for completion of Doctor of Veterinary Medicine (DVM) degree in CVASU, Chattogram, Bangladesh. She has immense interest to work as a veterinary practitioner.

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