Effect of cutting interval on yield, chemical composition and Invitro digestibility of *Moringa oleifera.*

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A production report submitted by as per approved style and contents

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The Author

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Abstract

The present study has been conducted to evaluate the cutting interval of Moringa (Moringa oleifera) on nutritional composition and in vitro digestibility. After plantation the moringa leaves were harvested at 6 and 8 weeks cutting interval then it was dried, grind and analyzed the nutrient content. In this study, the fresh yield of Moringa was 1115.1 kg/hec & 1515.1kg/hec, DM yield 244.91 kg/hec & 395.77 kg/hec ; CP yield 46.80 kg/hec & 72.35 kg/hec respectively where $P < 0.05$ which was significant. The chemical composition of Moringa oleifera at 6 to 8 weeks cutting interval were DM 21.94% & 26.56%, moisture 78.06% & 73.44%, ash 8.24% & 6.68%, CP 19.11% & 18.28% OM 92.32% & 91.16% respectively. Finally the DM, ash and OM digestibility at 6 & 8 weeks cutting interval were 79.9% & 74.0% ; 1.86 % & 1.65% ; 99.57% & 99.52% respectively. Based on present findings it can be suggest that the nutritive value of moringa foliage in terms of IVDMD, IVOMD and chemical composition harvested at 8 week cutting interval is better than 6 week.

Chapter 1
Introduction

In both tropical and temperate climates, feed resources constitute a critical component of cattle production. Concentrated feed contains nutrients that pasture alone lacks. This is especially true when it comes to high-yielding animals. Plantbased feed, cereal, and cereal by-products are all sources of nutrients for livestock. Increased demand for meat, milk, and their products, fueled by an ever-increasing population, resulted in intensive livestock farming. Low and insufficient nutrient delivery in a high-forage based feed may cause a drop in cattle productivity in underdeveloped nations like Bangladesh (Suharti et al., 2011).As a result, new feed sources and technology must be introduced into cow production systems. Smallscale farmers have recently been adopting a range of concentrate feed components in cow production, including rice bran, maize meal, and concentrate mixtures made from these concentrate feedstuffs (Suharti et al., 2011). Researchers are attempting to identify alternative protein sources that could aid in increasing animal productivity (Wanapat et al., 2007). Many experts are working on improving and enhancing the nutritional content of by-products and local feeds such as cassava chip, rice straw, rice bran, soybean meal, and so on.In ruminant nutrition, adding microbial additions to the food, such as Saccharomyces cerevisiae culture, has become commonplace (Polyorach et al., 2012). In ruminant nutrition, the use of fermented concentrate feed is seen as a way to improve animal performance. The most important goal of animal nutritionists is to manipulate the rumen

eco-system in order to optimize animal performance (Patra et al., 2010). These chemicals have the ability to alter in vitro rumen fermentation parameters such as acetate concentration, propionate and butyrate concentration, methane generation, and the CH4: VFA ratio (Busquet et al., 2005). Feed shortages are one of the world's most critical issues, and they pose a threat to ruminant livestock productivity in many developing countries.In this sense, forage legume browses appear promising in overcoming feed source limits because they may be farmed on a small scale and provide more protein than grasses (Soltan et al., 2012). Even though these legumes are effective as feed alternatives to lowquality diets, their bioactive components have limited nutritional value for animals (Cieslak et al., 2013). Moringa is well-known for its nutritional and medicinal benefits (Soliva et al., 2005). Because several sections of the moringa tree have been discovered to have numerous industrial and therapeutic purposes, it has earned the nickname "tree of life" or "miracle tree" (Soliva et al., 2005; FAO, 2014; Shah et al., 2016).Because of their excellent balanced amino acid composition and high digestible protein content, moringa leaves have drawn the attention of ruminant nutritionists as a source of protein (Babiker et al., 2017). It is being evaluated as a protein source for ruminants as an alternative to soybean meal and rapeseed meal (Soliva et al., 2005). Leaves have also been demonstrated to boost the growth performance of growing lambs, milk output, and composition of sheep and goats when fed as a protein supplement (Babiker et al., 2017). Moringa leaves, on the other hand, are not recommended as a source of rumen-protected protein due to their high ruminal degradability (Soliva et al., 2005). Furthermore, the leaves contain roughly 200g/kg DM crud protein (CP), making it a poor undegradable protein supplement for ruminants (Kakengi et al., 2005) when compared to other shrubs such as leucaena leaves (which contain CP ranging from 270 to 350g/kg DM) (Soltan et al., 2017). In addition, antifertility, cardiotonic, anticancer, anti-

anthelmintic, anti-tubercular, antispasmodic, abortifacient, nantilithic, anti-inflammatory, and antimicrobial phytochemicals of high efficacy were found in moringa leaves and other components of the moringa tree (Sholapur and Patil 2013; Wang et al., 2016). In order to describe moringa tree feeding value for ruminants, a closer look on the possible effects of its bioactive compounds on ruminal fermentation as well as animal health are discussed in this report. Though, Bangladesh has available Moringa oleifera tree, still are not utilized as ruminant feed. Moreover, Moringa foliage has not been evaluated in terms of nutritional characterization at different cutting interval and on invitro digestibility. Therefore, this study was undertaken only goal to know the impact of different cutting interval on biomass production chemical composition and invitro digestibility of Moringa.

Objectives of the study:

1. To know the chemical composition of Moringa Oleifera.
2. To determine invitro digestibility of different states of moringa inorder to use them in ration of animals.

Chapter 2

Review of the literature

On both raw and defatted seeds of Moringa oleifera (Drumstick), which is frequently utilized as a nutritional and therapeutic plant in Nigeria, proximate, mineral analyses, and anti-nutrient compositions were carried out. Various criteria were used to determine the nutrients and anti-nutrients. The triplicate determinations' mean and standard error of means were determined. Defatting Moringa oleifera seeds boosted fibre, carbohydrate, vitamins B and C, iron, and zinc content while considerably lowering calcium, potassium, and phosphate levels, according to the findings. The results also demonstrated that defatting Moringa oleifera reduced tannin, alkaloids, saponin, phytate, and oxalate levels while increasing cyanogenic glycosides levels to levels below those deemed hazardous to humans and livestock. (Anhwange et al., 2004; Siddhuraju & Becker, 2003). As a result, the defatted cake might be utilized to boost the nutritional value of other foods. The moisture content of the raw sample (9.97 0.09%) was significantly greater than that of the defatted sample (9.400.10%). Raw sample protein concentration (35.970.19%) was substantially greater than defatted sample protein content (17.130.13%). The crude fat content of the raw sample was significantly greater (38.670.03%) than the crude fat content of the defatted sample (8.590.18%). The raw and defatted samples had crude fibre levels of 2.870.03 percent and 3.330.08%, respectively. The fibre content of the defatted sample was comparable to that of the raw sample. The raw and defatted samples had ash concentrations of 3.870.09% and 3.470.07%, respectively. The ash content of the defatted sample is comparable to that of the raw sample. The carbohydrate content of the raw sample was 8.670.12 percent, while the defatted sample had 57.770.12 percent (Advances in Life Science and Technology).

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Moringa:

Moringa oleifera, often known as the drumstick tree, the miracle tree, the ben oil tree, or the horseradish tree, is a fast-growing, drought-resistant plant in the Moringaceae family. Because its food is high in protein, minerals, and vitamins, it is known as the "Miracle Tree." Because of its therapeutic characteristics and health advantages, it has been utilized for millennia. Antifungal, antiviral, antidepressant, and anti-inflammatory activities are also present. Moringa stenopetala with Moringa oleifera in India, it's known as sahjan, muga, munga, muringakkai, muringakkaya, munnakaya, nuggekai, sajane dauta, saragavo, shevaga, drumstick, horse radish tree, and other names. Moringa, like any other perennial multi-cut fodder crop, may offer green food for cattle. It's a fast-growing, deep-rooted plant that can withstand drought. Soft leaves and a non-woody stem make up Moringa crop feed. It's nutrient-dense, tasty, and has a lovely scent. It has the capability to produce a large amount of biomass and has the potential to be the plant of the future for providing year-round green food for animals. It is known to be free of any anti-nutritional elements and to have a low tannin level. It has a high biological value and substantial potential for adoption as a human and ruminant feed when compared to other traditional feedstuffs.

Origin and Nature:

Moringa originated in sub-Himalayan tracts of the Indian sub-continent. It is a fast growing, evergreen, deciduous medium sized perennial tree of about 10 m to 12 m height. The bark has whitish-grey colour and is surrounded by thick cork. Young shoots have purplish or greenish-white bark. Flowers are yellowish creamy white and sweet smelling. The matured fruit is a hanging capsule of 20-45 cm size having 15 to 20 dark brown globular seeds of 1 to 1.2 cm diameter.

Nutrient composition:

For dairy cattle, moringa fodder offers a significant source of nutrients. Aside from protein and minerals, it's also high in pro-vitamin A, vitamin B, vitamin C, and vitamin E, as well as carotenoids and sulfur-containing amino acids like cysteine and methionine. Dry Matter (16.63 percent), Crude Protein (15.82 percent), Ether Extract (2.35 percent), Crude Fibre (35.54 percent), Total Ash (7.61 percent), Silica (1.02 percent), Calcium (0.8 percent), Phosphorus (0.28 percent), Magnesium (0.51 percent), Potassium (1.43 percent), Sodium (0.24 percent), Copper (8.78 ppm), Zinc (18.05 ppm), Manganese (35.57 ppm).

Moringa oleifera contain different bioactive constituents at differents Part of Moringa. According to Berkovich et al. (2013), Shah et al. (2016), Saini et al. (2016) and ElDesoky et al., (2017). The *Moringa olifera* contain several components as follows:

Leaves	9,12,15-Octadecatrienoic acid, Rhamanose, Pterygospermin, Isothiocyanates. 4-(4'-O-acetyl-a-Lrhamnopyranosyloxy)benzyl isothiocyanate, Glycoside niazirin, niazirinin and three mustard oil glycosides, 4-[4'-O-acetyl- α -Lrhamnosyloxy) benzyl] isothiocyanate, niaziminin, vitamins (A, B and E,ascorbic acid), Folates, 2,6-dihexadecanoate, tetraacetyl-D-xylonic nitrile, phytol and isobenzofuran-1-one 3- acetic acid, flavonol glycosides (glucosides, rutinosides, malonyl glucosides), quercetin (kaempferol), amino acids (Arginine, Histidine, Lysine, Tryptophan, Phenylanaline, Methionine Threonine, Leucine, Isoleucine, Valine), Oxalic acid, and minerals (Fe, Ca,Cu, Mg, P,

	S),Omega-3 and omega-6 polyunsaturated fatty acids.
Seeds	Riseofulvin, dechlorogriseofulvin, 8-dihydroramulosin and mullein, Crude protein, Crude fat, carbohydrate, methionine, cysteine, 4-(α-L-rhamnopyranosyloxy) benzylglucosinolate, benzylglucosinolate, moringyne, mono-palmitic, di-oleic triglyceride, folates, amino acids (Arginine, Histidine, Lysine, Tryptophan, Phenylanaline, Methionine Threonine, Leucine, Isoleucine, Valine), Oxalic acid, minerals (Fe, Ca, Cu, Mg, P, S), linoleic acid, linolenic acid and oleic acid.
Roots	4-(α-L-rhamnopyranosyloxy)-benzylglucosinolate and benzylglucosinolate, glucotropaeolin, Folates.
Flowers	D-mannose, D-glucose, protein, ascorbic acid, polysaccharide, Carotenoids (all-E-luteoxanthin13-Z-lutein,all-E-zeaxanthin,and 15-Z-b-carotene), Omega-3 and omega-6 polyunsaturated fatty acids.
Pods	Nitriles, isothiocyanate, thiocarbanates, 0-[2'-hydroxy-3'-(2''-heptenyloxy)] propylundecanoate 0-ethyl-4-[(α-1-rhamnosyloxy)-benzyl] carbamate, methyl-phydroxybenzoate and β-sitosterol, Carotenoids (all-E-luteoxanthin, 13-Z -lutein, allE-zeaxanthin,and15-Z-b-carotene), Omega-3 and omega-6 polyunsaturated fatty acids.
Bark	4-(α-L-rhamnopyranosyloxy)-benzylglcosinolate.
Stem	4-hydroxymellein, vanillin, β-sitosterone, octacosanic acid and β-sitosterol.

Gum	L-arabinose, D-galactose, D-glucuronic acid, L-rhamnose, D-mannose, Dxylose and leucoanthocyanin.

Chapter 3
Methods and Materials

3.1. Sampling Collection:

Moringa oleifera were collected from Hathazari research and farm based campus, Chattogram Vetrinary and Animal Sciences University. Samples collected were wrapped in a polythene bag and properly labeled before transporting to the laboratory for further analysis.

3.2.Sample Preparation

The fresh samples were dried at room temperature and then grounded into powder using a laboratory grinder to reduce particle size and then kept in plastic containers with properly sealed caps and leveled.

Photo 1: Preparation of sample for chemical analysis

3.3 *In-vitro* dry matter and organic matter digestibility

In-vitro dry matter and organic matter digestibility of the moringa foliage samples were measured according to the technique of Menke and Steingass (1988) with some modifications by Blümmel and Ørskov (1993) and Makkar *et al*. (1995), where the feed samples in the syringes were incubated in a thermostatically controlled water bath instead of using a rotary incubator.

3.3.1 Preparation of samples for analyses

Approximately 500 mg of a sample in triplicate (6 and 8 weeks cutting intervals) was weighed and placed in 100 ml calibrated glass syringes (FORTUNA® Hiberle Labortechnik, Germany). After the samples were transferred, the pistons of the syringes were lubricated with vaseline and inserted into the syringes. Buffered rumen medium was added into the pre-warmed (39 °C) syringes. Blanks (syringe with buffered rumen medium, without sample) in 3 replicates in different syringes were also incubated.

Measuring pH after 24h In-vitro digestion

Estimation of In-vitro gas production

3.3.2. Preparation of buffered solution

The media was prepared following the method described by Menke and Steingass (1988). The rumen fluid was collected from 8 month age sheep. The rumen content was collected into a pre-warmed thermos flask. The rumen content was strained and filtered through four layers of muslin cloth into another flask. Throughout the process, the rumen fluid was flushed continuously with CO_2 gas. The buffer medium was prepared according to Makker *et al.* (1995). The solutions were poured into a flask following the sequence of 474.0 ml distilled water; 0.12 ml trace element solution; 237.0 ml buffer solution; 237.0 ml main element solution; and 1.2 ml resazurin

solution, and all of them was mixed using a magnetic stirrer and kept warm at 39 °C in a water bath. CO_2 gas was bubbled in throughout the preparation. Five hundred ml of rumen fluid was added when the indicator changed to colorless. The ratio of rumen fluid to buffer medium was kept at 1:2 (v/v). The bubbling of CO_2 was continued after the rumen fluid was poured into it. In 15 minutes time, the CO_2 was bubbled in the submerged tube and then it was raised during filling of the syringes. A 40 ml of the incubation medium was dispensed into each bottle and incubated in a water bath at 39°C. The procedure was repeated twice.

3.3.3 *In-vitro* dry matter (IVDM) and organic matter (IVOM) digestibility

Moringa's dry matter (dm) and organic matter (om) were determined by drying it at 105°c for 20-24 hours and ashing it at 550°c for 6 hours, respectively. The obtained % dm and om were used to calculate the substrate's initial dm (dmi) and initial om (omi) in grams. After the designated incubation period, fermenta samples from each serum bottle were drained into dried, pre-weighed nylon bags and knotted using nylon thread, then splashed with flowing water for 15 minutes or until the turbidity of the water caused by washing dissipated. After that, the approach of van soest and robertson (1985) for determining actual digestibility was used, which involved refluxing the incubated residues for 1 hour and then filtered in pre-tarred crucibles to recover the based on incubated samples minus oven dried samples and the ivom was estimated using incubated samples minus the residue of ash.

3.3.4. Proximate analysis of Moringa leaf

Dry matter: When heated to 105 degrees Celsius, dry matter is defined as the sample's constant weight .The amount of moisture in a feed sample was determined by heating it in an oven to a fixed weight for a length of time during which the amount of moisture was considered, and the residual residue was considered the dry matter .When storing feed components, moisture determination is critical since the safe moisture limit for storing feed materials for future use is 10-12 percent. Feed stuffs having more than 12 percent moisture may develop molds, fungus, bacteria, or even catch fire due to the intense fermentation process.

Procedure:

1. The crucible was dried and cooked in a 105°C oven before being weighed out in a balance.

2. Around 10gm of prepared material was weighed into a crucible that had been previously weighted.

3. The crucible containing the sample was held at 105°C for a period of 24 hours, or until no more weight loss occurred.

4. After achieving a constant weight, the crucible was taken from the oven with a metal tong and cooled in a desicator; otherwise, moisture from the ambient air would be absorbed by the dry sample, increasing the dry matter weight and causing inaccuracy.

5. After obtaining a steady weight, the final weight was obtained, and the percentage of dm was determined as follows:

%DM = (weight of DM ÷ weight of the sample) ×100

Ash:

The inorganic, organic, and mineral components of the sample are included in the ash, which is collected after 5 hours of ignition at 550-600 °C. It gives an indicator of the sample's total mineral content.

Procedure:

1. The crucible was dried in a muffle furnace, then cooled in a desicator before being weighed in a scale.

2. A 2 gram sample was obtained and weighted into a previously weighted crucible, which was then exploded on the electric heaters.

3. The crucible containing the sample was placed inside the muffle furnace and fired for 5 hours at 600°C.

4. After 5 hours the crucible was removed from the muffle furnance with the help of metal tong and was cooled in desicator and finally weight out the crucible with the contents. The percentage of ash was calculated by the following formula:

% Ash = {weight of ash ÷ (weight of sample × DM contents of the sample)}

Crude fiber:

The indigestible carbohydrate component found in non-plants is referred to as fibre. It gets its name from the fact that it has a fibrous structure naturally .The insoluble residue of an acid hydrolysis followed by an alkaline one is crude fibre. True cellulose and insoluble lignin are found in this residue.

Procedure:

1. Firstly taking 2 gm of sample by using digital weight machine in the beaker.

2. Then take 125 ml of 1.25% sulphuric acid solution into the beaker and boiling it at 70 ℃ temperature for 30 minutes and filtering it properly.

3. Then take 125 ml of 1.25% of sodium hydroxide solution into the beaker and boiling them at 70 ℃ temperature for 30 minutes by using therm burner and again filtering it properly.

4. Then taking the residue in the crucible and keeping it into oven at 105 ℃ for overnight.

5. Then take the weight of that crucible after cooling it in the desicator and this weight is the weight of crucible and fibre.

6. Then keeping that crucible in the muffle furnace at 600 ℃ temperature for 3-4 hours and again take weight of the crucible and ash. We can calculate the crude fibre by using the following formula:

%CF = {(weight of the crucible with fibre - weight of the crucible with ash) ÷

Weight of the sample} ×100

Crude Protine Estimation:

Digestion :

The purpose of digestion step was to break down the structure and chemical bonds of feed substance to ionic structure. As a result in digestion procedure protein ane other forms of nitrogen were broken down and convert to ammonia.

1.1 gm of feed sample was weighted accurately.

2.0.5g of digestion mixture was added.

3. 200 ml of concentrate sulphuric acid was added.

4.The digestion flask was placed on kjeldahl digestion set.

5.Heat was gradually increased and the flask was removed and cooled them.

Distillation :

It involves separation of ammonia nitrogen from the digestion.This is accompanied by raising pH with sodium hydroxide. This changes the ammonium into ammonia and nitrogen is separated by distilling the ammonia and collecting the distilled in a suitable tropping medium. Collection of ammonia is usually done by absorption into a solution of 2% boric acid.

1.20 ml distill water was added.

2.Then content was transferred to the distallation flusk.

Titration :

Determination of amount of the nitrogen on the condensate flask can be accompanied by several method. The most common method is titration of ammonia with standard solution of HCl in the presence of mixture indication. This dis

4. Statistical analysis

The analysis of variance was done on the data on the yield, and proximate analysis, fiber components, IVDMD, IVOMD of moringa tree using the one way ANOVA in the SAS 9.2 software (2007). The differences in the means were compared by Duncan'smultiple range tests at 5% level ($P<0.05$).

Chapter 4
Results and Discussions

4.1 Yield of Moringa at different cutting interval

Table 4.1 shows the impacts of cutting interval on fresh biomass yield, CP yield and DM yield and chemical composition of Moringa Olifera. The fresh yield of each harvest at 6 weeks and 8 weeks of cutting intervals was 1115.1 (kg/hec) and 1515.1 (kg/hec), respectively. The fresh total foliage increased significantly ($P<0.05$) as the harvesting period increased. At 6 weeks and 8 weeks of cutting intervals, the estimated total yields of dry matter of each harvest were 244.91 (kg/hec) and 395.77 (kg/hec), respectively, with a P value of 0.009, which rose very considerably ($P<0.05$) with the increase of harvesting intervals. The yield of CP for each harvest of 6 weeks and 8 weeks of cutting interval was 46.80 kg/hec and 72.35 kg/hec, respectively, with a P value of 0.01 and a significant increase ($P<0.05$) with increasing harvesting intervals. According to Fadiyimu et al. (2011), in the dry season the treatment response was quite different and that the highest yields were obtained with the 12 weeks harvest interval at 100 cm cutting level. The DM yield of moringa obtained was comparable to the DM production of Calliandra calothyrsus (17 t ha–1 y–1) and Gliricidia sepium (17.7 t ha–1 y–1) as reported by Catchpoole and Blair (1990) and higher than the DM yield of Sesbania grandiflora (13.93 t ha–1 y–1) cited in Sánchez et al. (2006b). These data suggest moringa has the potential for higher fodder productivity compared to other fodder trees.

Table 4. 1: Yield of Moringa oleifera at different cutting intervals (Mean ±SE; n = 4)

Variables	Cutting interval (weeks)		P value	Level of significance
	6	8		
Fresh yield (Kg/hec)	1115.1	1515.1	0.029	*
DM yield (Kg/hec)	244.91	395.77	0.009	**
CP yield (Kg/hec)	46.80	72.35	0.01	*

4.2. Nutrient composition

The effects of different cutting intervals on the chemical composition of moringa tree are presented in Table 4.2. The highest DM content of all fractions was obtained at 8 week interval which was 26.56% whereas the lowest DM content of all fractions was recorded at 6 week interval which was 21.94% and the P value was 0.08 (P>0.05) which was not significant. The DM content in different fractions of moringa varied from 110.4 (Mendieta-Aracia et al., 2013) to 460.0 g kg–1 (Aregheore, 2002). Mendieta-Aracia et al. (2013) found 110.4 and 203.8 g kg–1 dry matter content in fine and coarse fractions respectively in 45 day old fresh foliage. Sánchez et al. (2006b) observed that the dry matter content of fresh foliage increased from 164 to 228 g kg–1 in plants aged 45 and 75 days, respectively. The highest DM content (460.0 g kg–1) of the moringa foliage was reported by Aregheore (2002). The variations in DM can be explained by cutting frequency, stage of maturity, succulence of materials, and the ratio of different fractions.

The percentage of CP at 6 weeks and 8 weeks cutting interval were 19.11 and 18.28 and P value was 0.73.So the CP content of moringa oleifera showed no significant (P>0.05) differences

among the treatments. The range of CP content of different fractions of moringa was found to be similar to that reported by Makkar and Becker (1996 and 997), Manh *et al*. (2005), Sánchez *et al*. (2006b), Soliva *et al*. (2005) and Mendieta-Araica *et al*. (2013). Moreover, the CP content of different plant fractions remained unchanged with the maturity up to 8 weeks. Sánchez *et al*. (2006b) reported a similar result.

The ash content of the total moringa oleifera tree was significantly (P<0.05) higher at 8 weeks than at 6 weeks.The P value is 0.003 which is P < 0.045 and the result is significant.

The OM matter content of moringa oleifera was significant because the OM is higher at 6 weeks cutting interval (93.32) than 8 weeks cutting interval (91.16) and the p value is 0.05.

Table 4. 2. Chemical composition of *Moringa oleifera* tree at different cutting intervals (Mean ±SE; n = 4)

Variables	Cutting interval (weeks)		P value	Level of significance
	6	8		
DM (%)	21.94	26.56	0.08	NS
Moisture(%)	78.06	73.44	0.05	NS
Ash (%)	6.68^{b}	8.24^{a}	0.003	**
CP(%)	19.11	18.28	0.73	NS
OM (%)	93.32^{a}	91.16^{b}	0.045	*

^{a,b,c} Means in the same row and in each treatment with different superscripts differ significantly among cutting interval at P<0.05 level; n= observation numbers.

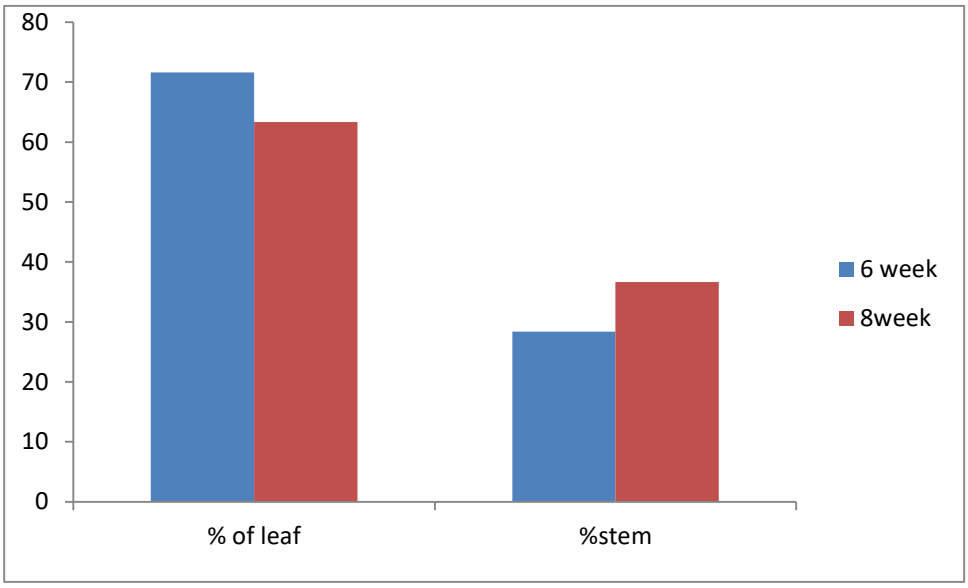

FIG 1: Proportion of leaf and stem at 6 week and 8week of Age of Moringa

4.3 Proportion of Leaf and Stem

The proportion of leaf and stem percent is shown Fig 1. Leaf percentage of Moringa at 6 week age cutting was significantly higher than 8 weeks age whereas, the stem percentage of 8 week age was higher than 6 week age. The production of leaf and stem in tree forage is somewhat more closely related to temperature and particularly to rainfall, which influences forage quality and alter leaf to stem ratios (Buxton and False, 1994).

4.4 Dry Matter and Organic Matter and ash digestibility

There was no significant difference on DM, OM and ash digestibility at 6 and 8 weeks cutting interval but tended to highest DM digestibility was observed in 8 weeks cutting interval (74.0%). Similarly, at 6 weeks cutting interval the ash and OM digestibility was higher 1.86% and 99.57 % respectively than 8 week age which were 1.65% and 99.52 respectively (Table 4.3). The in-vitro dry matter digestibility of the moringa foliage in this study was higher (772.10 to 801.78 g kg–1 DM) than that reported by Sánchez et al. (2006b) (658.2 to 659.2 g kg–1 DM).The IVDMD values othe moringa foliage is higher than those (447.0; 472.0 g kg–1 DM), respectively, reported by Sallam et al., (2008) and Rootheart (1999) for alfalfa hay and Leucaena diversifolia. Aderinola and Binuomote

(2014) was found that in-vitro organic matter digestibility was higher in moringa foliage than Blighia sapida and Gliricidia sepium that are brows plant are used as feed for ruminants

Table 4.3: Invitro digestibility of Moringa oleifera tree at different cutting intervals (Mean ±SE; n = 4)

Variables	Cutting interval (weeks)		P value	Level of significance
	6	8		
DM digestibility (%)	73.9	74.0	0.96	NS
Ash digestibility (%)	1.86	1.65	0.68	NS
OM digestibility (%)	99.57	99.52	0.63	NS

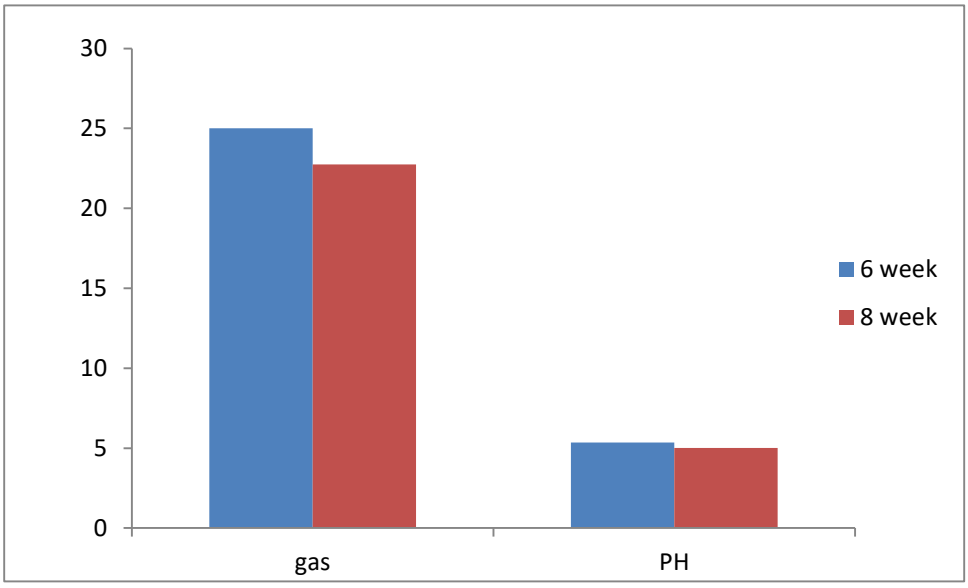

Fig 2. In-vitro gas production and PH at 6 and 8 week cuttimg interval of moringa

4.4 Invitro gas production and pH

The invitro gas production of moringa at 6week age were higher than at 8week age whereas the pH at 6 and 8 week age were almost similar.

Limitations:

1. It gives no indication of palatability, toxicity value of feed.
2. It does not measure vitamins.
3. Estimation of crude fiber does not cover all structural carbohydrates (lignin and hemicelluloses).

Chapter 5

Conclusion

In conclusion, every part of Moringa oleifera, nearly all parts of this tree are full of several bioactive components with different activities, thus we can speculate that moringa affect the ruminant production by various mechanism of actions. (e.g. Antimicrobial and antioxidant), thus it can be used in the development of promising Natural feed additives for ruminants. The nutritive value in terms of IVDMD and IVOMD of whole foliage was almost similar at 6 and 8 week cutting interval. CP content of total foliage was similar for all the cutting periods. DM, CP and OM yield were significantly higher at 8 weeks than 6 weeks. OM and DM digestibility were almost similar. The present findings suggest that the nutritive value of moringa foliage in terms of IVDMD, IVOMD, and yield harvested at 8 week cutting interval is better than 6 week in hill area of Bangladesh.

Chapter 6

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Chapter 7
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