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RESEARCH ARTICLE

EFFECT OF MEDICINAL HERB (*EMBLICA OFFICINALIS*) ON GROWTH PERFORMANCE, FECAL MICROBIOTA AND DIARRHEA PREVALENCE IN GROWING SHEEP

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ABSTRACT

Medicinal herbs are the source of bioactive compounds beneficialboth for human and animal health. Owing to that, an experiment was conducted to investigate the effects of the medicinal herb (*Emblica Officinalis)*on growth performance, fecal microbiota and diarrhea prevalencein sheep. A total of 48 growing sheep were randomly allocated to 4 treatments with 3 replications having 4 sheep in each replication in a completely randomized design. The treatments groups were: Control (T0) = Basal diet without *Emblica officinalis*, T1= Basal diet + 0.4%*Emblica officinalis*, T2= Basal diet + 0.6% *Emblica officinalis*; and T3= Basal diet + 0.8% *Emblica officinalis*. The present study revealed that, average daily gain was significantly improved ($P < 0.05$)in the *Emblica officinalis*supplemented groups T1, T2 and T3 with highest being observed in T2 compared to T0. While average daily feed intake and feed efficiency was improved in the *Emblica officinalis*added groups (T1, T2 and T3) but there were no significant differences ($P > 0.05$). In addition, it was observed that, *Emblica officinalis* supplementation suppresses the pathogenic *E. coli* and decreased the diarrhea prevalence in sheep. To sum up, medicinal herb (*Emblica officinalis*) could be supplemented and T2 could be preferred for sheep production.

INTRODUCTION

Modern society is very much concern about their health and nutrition. Major public health concern worldwide was the antibiotics use (before it was banned) in animal nutritionwhich resulted microbial resistance in human pathogens through consumption of animal products (Benko *et al.,* 2008). Consequently, the European Union (EU) decided that antibiotics use inlivestock as production enhancers would be banned from1 January 2006 (EU regulation no.1831/2003 of the EuropeanParliament and of the Council of 22 September 2003) (Jouany and Morgavi, 2007). With the restriction or ban of dietary antimicrobial agents, scientists must explore new ways to improve and protect the health status of farm animals as well as human society; to guarantee animal performance and to increase nutrient availability. In view of low residual contamination, low environmental pollution of natural raw materials, increasing number of studies are focusing on phytogenic products that comprise a wide variety of herbs, spices, or their extracts (Windisch *et al.,* 2008). Aromatic plantsor herbs and spices aremainly contain one or more predominant active components (secondary metabolites), which are responsible for certain biological effects. The active components or chemical substances include polyphenols, quinines, tannins, flavonols/flavonoids, alkaloids polypeptides and so on (Cowan *et al.,* 1999). Proper amount and proportions of herbs and spices with their bioactive components would not act just as appetite and digestion stimulants, but could also have impact on other physiological functions, to ensure good health and welfare of the animals (FrAnKIČ *et al.,* 2009). Ruminant's microbial ecosystem is composed of complex microbial populations; where numerous metabolites produced in rumen during microbial fermentation can affect the basic digestive and metabolic functions; and productivity of the animals (Bergen and Yokoyama, 1977). Some herbs additives are demonstrated to be growth-promoter (Basmacioglu *et al.,* 2004); antimicrobial (Si *et al.,* 2006) and antioxidant (Nakatani, 2000). The interactions between nutrition and disease resistance or immunity are diverse and particularly important for animal well-being and efficiency of production (Mao *et al.,* 2005).

Diarrhea in sheep is an important disease or disorder as it commonly appears in sheep especially in the early stage of life, causing high mortality; and subsequent production and economic loss (Son *et al.,* 2003). Treatment of diseased

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animals with antibiotics often leads to their growth retardation and is impractical. In addition, it can lead to selection of drug-resistant bacterial strains. While in case of humansome medicinal herbs are traditionally used for treating diarrhea (Brijesh *et al.,* 2006). *Emblicaofficinalis* (EO) (syn. *Phyllanthusemblica* L.) under family *Eupherbiacase* is one kind of medicinal herb used therapeutically in the human medicine (Treadway, 1994). The fruit of EO used for the treatment of a number of diseases (Chopra *et al.,* 1958); and is a constituent of many hepatoprotective formulations (De *et al.,* 1993). *Emblica officinalis* (EO) have antibacterial properties (Godbole and Pendse, 1960); modifies metal induced clastogenic effects and promote health and longevity (Dhir *et al.,* 1990); and increase defense against disease (Bhattacharya *et al.,* 1999). Due to the beneficial properties, people customarily use such types of medicinal plants or its derived preparations to combat different types of disorders like diarrhea; however, only few of them have been controlled clinically, studied chemically and biologically to identify their active constituents (Arun and Vareishang, 2007).

Although EO is traditionally used in human medicine for different health aspects (Treadway, 1994); to the best of our knowledge experimentally not widely tested and utilized in case of animals especiallyfor the small ruminants like sheep. We hypothesized that; *Emblica officinalis* (EO) would be beneficial for productive performance as well as would prevent disease and disorders by reducing pathogenic microbiota in case of sheep. But theeffect of bioactive components containing herbs and spices depend largely on the amountto be used in the diet. Because, small amount might have no effects; on the other hand, large amounts couldbe toxic for animals (FrAnKIČ *et al.,* 2009). Therefore, the present study was undertaken with different levels of EO (*Emblica officinalis*) to investigate its effects on growth responses, fecal microbiota and diarrhea prevalencein growing sheep.

MATERIAL AND METHODS

Experimental design, diet and sheep husbandry

A total of 48 growing sheep were randomly allotted to 4 treatments with 3 replications having 4 sheep in each replication in completely randomized design. The feeding trial was conducted at Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU) livestock farm for the period of 90 days. The average initial body weight of sheep (5±1.30 kg) did not differ significantly. The dietary treatments were: T0: Control, basal diet; T1: Basal diet + 0.4% *Emblica officinalis;* T2: Basal diet + 0.6% *Emblica officinalis;* T3: Basal diet + 0.8% *Emblica officinalis*. Sheep were provided green grass and concentrate mixture with *ad libitum* basis for 90 days of experimental period. The whole fruit of *Emblica officinalis* was dried at 60°C, ground and stored in air tight container. Then it was used as weight: weight basis with the basal diet by replacing same amount of concentrate mixture. The experimental diet and *Emblica officinal is* (EO) were analyzed by following the procedure described by AOAC International, 2000 (Official Methods of Analysis. 17th ed. AOAC Int., Washington, DC). The experimental diet feed ingredients and its chemical composition; and *Emblica officinalis* chemical constituents were shown in Table 1, Table 2 and Table 3.

The trial was carried out in a sheep house with separated pens where provided 0.65 m^2/sheep for proper movement and management. Each pen was equipped with a feeding and watering trough as required for sheep. All pens were located in the same house and the sheep were randomly allocated to different pens after measuring the body weight. The sheep house was equipped with good ventilation and there was sufficient light. Temperature and relative humidity in the sheep house was monitored and maintained regularly. The house was cleaned and manure was removed daily. The protocols for this experiment and use and care of sheep were carried out in accordance with the guidelines of the Animal Care and Use Committee of the Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur, Bangladesh.

Measurement of growth performance

Total feed intake (FI) and body weight (BW) were recorded by replicate at 30, 60 and 90 days of experimental period. From that data, finally calculated the average daily feed intake (ADFI), average daily gain (ADG), and feed efficiency (Gain: feed) per pen by period and for the entire experimental period.

Collection of fecal sample for microbial analysis

At the end of the feeding trial, three animals were randomly selected from each pen in order to perform microbial analysis. Selected animals were carefully handled for collecting the fecal sample to measure the microfloral count. Samples of feces were collected for determining gram-negative bacteria, *Escherichia coli,* and *Lactobacillus*. Approximately 1 g of fecal content was aseptically collected into a 2-mL safe-lock Eppendorf tube (Thermo Fisher Scientific Inc., Seoul, South Korea) and immediately preserved at −40°C for subsequent microbial analysis. After thawing, the cecal sample was serially diluted with 9 mL of 0.9% sterile saline (1:10 dilution), thoroughly mixed and cultured using the spread plate method. The culture media for gram-negative bacteria, *E. coli*, and *Lactobacillus* were Eosin Methylene Blue (EMB); MacConkey; Mann, Rogosa and Sharpe agar, respectively. Supernatant (100 µl) was smeared onto agar plate and incubated anaerobically at 37°C for 24 h. Viable counts of bacteria in the fecal samples were then conducted by plating serial 10-fold dilutions in duplicate on agar. Microbial colonies were immediately counted and microflora enumerations were expressed as log10 CFU/ml.

Measurement of diarrhea prevalence

Diarrhea prevalence was recorded daily. For each sheep showing diarrhea, the severity was assessed visually and characterized, by the same person, according to the following scale as: 0 = normal feces, 1 = pasty, 2 = liquid, 3 = with mucus and 4 = with blood (Kyriakis *et al.,* 1999). The total diarrhea score on a pen basis was calculated as the sum of the number of sheep in the pen with diarrhea multiplied by the days of observations and multiplied by the diarrhea scale observed in the majority of the pigs in the pen. Diarrhea scores were calculated by day (Cho *et al.,* 2012).

Statistical analysis

All data were subjected to analysis of variance (ANOVA) using the general linear model procedures (GLM) of the SAS Institute Inc. (SAS, 2003). The pen was used as the experimental unit to analyse growth performance, whereas individual sheep were used as the experimental unit for analysis of fecal microflora. Statistically significant effects were further analysed and means were compared using Duncan's multiple range tests when necessary. Probability value P <0.05 was considered as statistically significant.

RESULTS

Effect of the medicinal herb on growth performance of sheep

The effect of dietary EO *(Emblica Officinalis)* supplementation on the growth performance of sheep during 90 days of studywas shown in Table 4. The result of the present study revealed that, EO supplementation significantly improved (P <0.05) the average daily gain (ADG).

Table 1. Feed ingredients supplied to the growing sheep

Ingredient composition (% as mixed)	Dietary treatments			
	T0	T1	T2	T3
Corn grain	50.00	50.00	50.00	50.00
Soybean meal	20.00	20.00	20.00	20.00
Wheat bran	19.00	18.60	18.40	18.20
Whole soybean	7.00	7.00	7.00	7.00
Emblica officinalis	0.00	0.40	0.60	0.80
Limestone	1.50	1.50	1.50	1.50
Monocalcium phosphate	1.50	1.50	1.50	1.50
Salt	0.75	0.75	0.75	0.75
Vitamin–mineral premix[a]	0.25	0.25	0.25	0.25

Dietary treatments were: T0: Control, basal diet; T1: Basal diet + 0.4% *Emblica officinalis;* T2: Basal diet + 0.6% *Emblica officinalis;* T3: Basal diet + 0.8% *Emblica officinalis*.

[a]Premix contained 170 g/kg Ca and 1.2 g/kg P and supplied/kg of concentrate: 12 500 I.U. Vitamin A; 1500 I.U.; Vitamin D3; 30mg Vitamin E; 0.6 mg Co; 5mg Cu; 2mg I; 75mg Fe; 80 mg Mn; 0.3 mg Se; 100 mg Zn.

Table 2.Chemical composition of experimental diet provided for growing sheep

Chemical composition (% as fed basis)[a]	Dietary treatments			
	T0	T1	T2	T3
Dry matter	88.10	88.10	88.10	88.10
Crude ash	2.95	2.98	3.01	3.01
Crude protein	15.73	15.75	15.77	15.77
Crude fat	2.75	2.76	2.77	2.77
Calcium	1.01	1.01	1.01	1.01
Phosphorous	0.65	0.65	0.65	0.65
Net energy (MJ/kg)	7.69	7.69	7.69	7.69

Dietary treatments were: T0: Control, basal diet; T1: Basal diet + 0.4% *Emblica officinalis;* T2: Basal diet + 0.6% *Emblica officinalis;* T3: Basal diet + 0.8% *Emblica officinalis*.

[a]Calculated from NRC values (NRC, 1985).

Table 3. Average chemical composition of *Emblica officinalis* used for the growing sheep experiment

Components	Amount (%)
Dry matter	19.10
Crude ash	0.64
Crude protein	0.54
Crude fat	0.11
Calcium	0.04
Phosphorous	0.02

Table 4. Effect of dietary treatments on growth performance ofgrowing sheep

Parameters	Dietary treatments				SEM	P-value
	T0	T1	T2	T3		
IBW (kg)	5.23	5.13	5.23	5.13	1.30	1.000
ADG (g/d)	196.71[b]	219.60[a]	220.49[a]	219.93[a]	3.22	0.002
ADFI (g/d)	1079.45[b]	1103.16[ab]	1113.75[ab]	1109.45[ab]	8.09	0.103
FE (G:F)	0.19	0.20	0.20	0.20	0.05	0.996

IBW = Initial body weight; ADG = Average Daily gain; ADFI = Average Daily feed intake;

FE = Feed efficiency; G: F = Gain: Feed.

SEM = Standard error of mean.

[a,b]Means with different superscripts within the same row are significantly different (P <0.05).

Dietary treatments were: T0: Control, basal diet; T1: Basal diet + 0.4% *Emblica officinalis;* T2: Basal diet + 0.6% *Emblica officinalis;* T3: Basal diet + 0.8% *Emblica officinalis*.

The initial body weight of the sheep was similar among the dietary treatment groups. It was observed that, there was significant difference in ADG betweenthe EO supplemented groups (T1, T2 and T3) and control group (T0) (P <0.05). In addition to that, average daily feed intake (ADFI) and feed efficiency (FE = Gain: Feed) was improved in case of EO supplemented groups compared to control group but there was no significant differences among the dietary treatment groups (P >0.05).

Effect of the medicinal herb on fecal microbiota in sheep

The effect dietary treatments on fecal microbiota were shown in Figure 1. The result revealed that, there was negative impactof medicinal herb supplementationon the gram negative microbes and *E. coli*; and positive impact on the *Lactobacillus*counts.Therefore, it was observed that medicinal herb EO supplementation significantly suppress (P<0.05) the pathogenic *E. coli*in sheep. The nonpathogenic *Lactobacillus* count was comparatively higher in EO supplemented groups (T1, T2 and T3) but there were no significant differences (P >0.05).

Effect of the medicinal herb on diarrhea prevalence in sheep

The appearance of diarrhea of different dietary treatments in sheep was shown in Figure 2. The result of the current research indicated that, supplementation of the medicinal herb EO was effective for reducing the diarrhea in sheep. It was observed that, the diarrheal prevalence was significantly lower (P <0.05) in T2 and T3 followed by T0 and T1 during 30 days of experimental period. In addition, it was found that, medicinal herb EO significantly decreased the prevalence of diarrhea (P<0.05) compared to control during 60 and 90 days of experimental period.

DISCUSSION

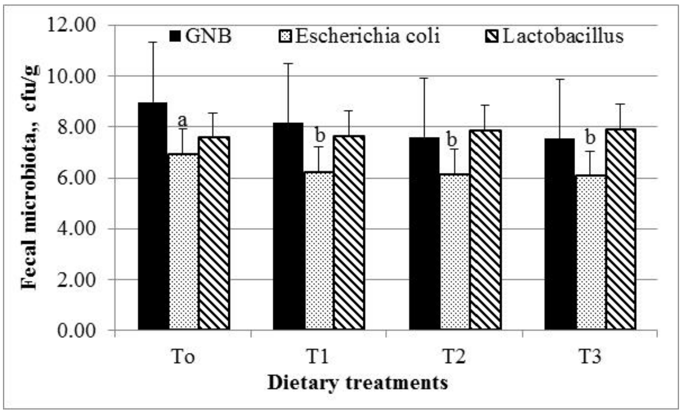
Growth promoting efficacy of medicinal herbs

In sheep production, body weight gain is very important factors for monitoring growth performance and nutritional status from an economic point of view (Ndlovu *et al.,* 2007). Consistent to the present findings, positive effect of plant supplements in nutrition of sheep stated by Butter *et al.* (1999). Herbal feed additives improved the body weight gain of lambs and calves in different researches (Hopkins *et al.,* 1995; Kudke *et al.,* 1999). Due to antimicrobial properties, different herbs had been examined as an alternative growth promoter (Cross *et al.,* 2002; Demir *et al.,* 2003). However, it was reported no differences in body weight gain in addition of herbs (Kim *et al.,* 2006).Among the dietary treatments, positive trend in feed intake and feed efficiency in EO supplemented group especially in T2 groupof the present study supported by the previous research (Mader and Brumm, 1987; Greathead, 2003; Hashemi and Davoodi, 2011). However, nonsignificant effect on feed intake and feed efficiency was reported with supplementation of medicinal herb oregano in sheep by Bampidis *et al*. (2005).

Herbs and spices have been introduced to ruminant nutrition because of the presence of bioactive compounds. Numerous metabolites produced in rumen during microbial fermentation affect the basic digestive and metabolic functions and productivity of the host (Greathead, 2003). There are numerous studies showing beneficial effects of herbs and spices on feed intake, rumen fermentation, health and productivity of ruminants (Wawrzynczak *et al.,* 2000; Cardozo *et al.,* 2006). Owing to the wide variety of bioactive components, different herbs and spices affect digestion processes differently. Curcuma, cayenne pepper, ginger, anis, mint, onions, fenugreek, and cumin enhance the synthesis of bile acids in the liver and their excretion in bile, whichbeneficially affects the digestion and absorption of lipids (FrAnKIČ *et al.,* 2009). Most of the herbs and spices stimulate the function of pancreatic enzymes and some increase the activity of digestive enzymes of gastric mucosa (Srinivasan, 2005). Besides the effect on bile synthesis and enzyme activity, extracts from herbs and spices accelerate the digestion and shorten the time of feed passage through the digestive tract (Platel and Srinivasan, 2001; Suresh and Srinivasan, 2007). According to believe in ancientmythology, *Emblica officinalis* (EO) is the first tree to be created in the universe, which contains tannins, alkaloids, phenolic compounds, essential amino acids and carbohydrates (Bhattacharya *et al.,* 1999; Khan, 2009). The plant secondary metabolites especially tannins can positively affect the protein digestion in ruminants (Waghorn *et al.,* 1997). The moderate amount of tannin can protect the feed proteins from ruminal degradation and increase the absorption of essential amino acids without compromising the intake and digestion (Waghorn *et al.,*1997); and activate the increase of microbial protein synthesis (Makkar *et al.,* 1995a); which are might be the beneficial impacts of EO in improving the growth performance in the current study. The EO containing phytochemicals canalso alter the pH in the gastrointestinal tract and modulate the rumen microflora, which ultimately helps to improve the growth performance of the animal (Hashemi and Davoodi, 2011).

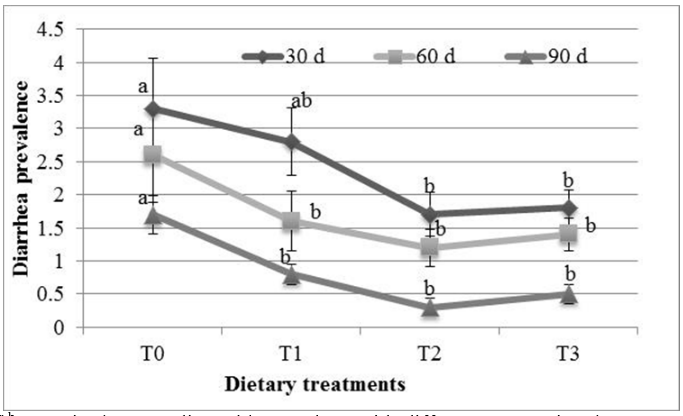
Antimicrobial action of medicinal herbs

Antimicrobial activity of certain plant extracts was shown against Gram- and Gram+ bacteria in several *in vitro* studies (Cowan, 1999; Prabuseenivasan *et al.,* 2006). In the present study it was found reduction of gram-negative bacteria in the EO supplemented group (Figure 1). Feed supplements with growth promoting activity beneficially influence the gastrointestinal ecosystem mostly through inhibition of pathogenic microorganism's and less exposing to the microbiological toxins (Windisch *et al.,* 2008). Helander *et al.* (1998) reported that the phenolics inhibit the growth of Gram-negative bacteria by disrupting the outer cell membrane. Plant secondary metabolites have small molecular weight which allows them to penetrate the inner membrane of Gram-negative bacteria (Nikaido, 1994). It was reported that surviving ability of microorganisms is depended on the changes in fatty acid composition and hydrophobicity (Mirzaei-Aghsaghali, 2012). Plant bioactive compounds have high affinity for lipids of bacterial cell membranes ascribed to their hydrophobic nature and their antibacterial properties are associated with their lipophilic character (Dorman and Deans, 2000). Pasqua *et al.* (2006) found a change in long chain fatty acid profile in the membranes of *E. coli* grown in the presence of herbs. Where it was also reported the increase of hydrophobicity of *E. coli* (test for measuring the ability of microbial attachment) in the presence of St John's wort or Chinese cinnamon (Mirzaei-Aghsaghali, 2012). Herbs and spices act as antimicrobial agents by changing the characteristics of cell membranes, and causing ion leakage, thus making microbes less virulent (Windisch *et al.,* 2008). Furthermore, some herbs and spices are able to increase the growth of beneficial bacteria. Nes and Skjelkvale, (1982) and Castillo *et al.* (2006) reported that the different herbs (garlic, nutmeg, cinnamaldehyde, capsicum and carvacrol) are able to enhancethe growth of *Lactobacilli*, which indicates that herbs have the ability to increase the beneficial bacteria.



GNB = Gram-negative bacteria; SEM = Standard error of mean.
[a,b]Means error bars with different superscripts letters within the similar column indicating significantly different (P <0.05).
Dietary treatments were: T0: Control, basal diet; T1: Basal diet + 0.4% *Emblica officinalis;* T2: Basal diet + 0.6% *Emblica officinalis;* T3: Basal diet + 0.8% *Emblica officinalis*.

Figure 1. Effect of dietary treatments on fecal microbiota (cfu/g) in growing sheep



[a,b]Meansin the same line with error bars with different superscripts letters are significantly different (P <0.05).
Dietary treatments were: T0: Control, basal diet; T1: Basal diet + 0.4% *Emblica officinalis;* T2: Basal diet + 0.6% *Emblica officinalis;* T3: Basal diet + 0.8% *Emblica officinalis*.

Figure 2.Effect of dietary treatments on diarrhea prevalence ingrowing sheep

Consistent to that, EO supplementation was observed to increase the number of beneficial *Lactobacillus* in the present study. FrAnKIČ *et al.* (2009) mentioned that, modulation of microbial population is happened attributable to the antimicrobial and prebiotic activity of the herbs and spices.

Moreover, Martin *et al*. (2003) reported that, herbs containing organic compounds can influence the intestinal microbiota by changing the intestinal environment. *E. coli* adhere to the small intestinal microvilli and produce enterotoxins that act locally on enterocytes (Mackinnon, 1998) which play an important role against diarrhea. Similar to that clue it was observed low diarrheal prevalence and suppression of *E.coli* count in the EO supplemented group in the present experiment (Figure 1 and Figure 2). The antimicrobial activity of plant secondary metabolites has been attributed to a number of terpenoid and phenolic compounds (Helander *et al.,* 1998; Chao *et al.,* 2000). It was opined that the plant secondary metabolites of EO helps in reduction of pathogenic bacteria and increase of beneficial bacteria in the present experiment. EO could be able act as antimicrobials due to phenolic compounds such as tannoids, tannins, embliacnin, penicluconin, penduncul agin, gallic acids, ellagic acids and tannic acids (Suryanarayana *et al.,* 2004). Plant derived tannins have been implicated for their inhibitory effect on microbial populations and enzymes activity in experiments (Makkar *et al.,* 1995b).

Disease prevention capability of medicinal herbs

Worldwide the use of herbal medicines obtained popularity for the maintenance of good health and have been found effective for the treatment of various disorders. Easy accessibility and affordability; and low cost of herbs compared to the allopathic medicines triggers to the herbal research as alternative methods to prevent disease and parasites in livestock production (Smidt and Brimer, 2005). Herbs and spices increase the absorption of essential nutrients which ensure disease resistance and improved growth performance (Windisch *et al.,*2008).Variousplant species is used in the World to prevent and treat diarrhea which are ethno-botanically different. The plant species are mainly belongs to the families: *Euphorbiaceae* (six species), *Compositae* (five species), *Rutaceae, Mimosaceae, Fabaceae* and *Anacardiaceae* (three species each one), *Verbenaceae, Connaraceae, Longa- niaceae, Burseraceae*, *Ascleapiadaceae, Cruciferae, Asteraceae, Zingiberaceae, Polygalaceae, Onagraceae*and *Combretraceae*(two species each one) and the rest of the families listed have only one species each one (Gutiérrez *et al.,* 2007). While *Emblica officinalis* belongs to the *Euphorbiaceae*family.

In support of reducing the prevalence of diarrhea by EO supplementation in the current research (Figure 2), some herbs additives are anti-diarrheal which were demonstrated to be antioxidnt (Nakatani, 2000), antimicrobial (Si *et al.,* 2006) due to the presence of phytogenic compounds. In addition, japanese-honeysuckle, houttuyniacordata thumb, laquer tree extract, yellow ginger and hoantchy root hadanti-diarrheal property protecting intestinal integrality; enhance resistance, reduceprevalence of diarrhea reported by previous researches(Jayaweera, 1982; Sing *et al.,* 2012). Furthermore, several studies have validated the use of antidiarrheal medicinal plants by investigating the biological activity of extracts of such plants, which have antispasmodic effects, delayed intestinal transit, suppress gut motility; and reduce the intraluminal fluid accumulation (Almeida *et al.,* 1995). While Yadav and Tangpu, (2007) also reported that, plant derived bioactive compoundsprevent the water adsorption into the gastrointestinal tract which helps to reduce the prevalence of diarrhea. *Emblica officinalis* (EO) composed of vitamin C (helps to regenerate vitamin E or tocopherol) and minerals (Mn and Zn); tannin, emblicanin and punigluconin (Treadway, 1994; Bhattacharya *et al.,* 1999; Waheed and Fatima, 2013)which might help in reducing the diarrhea prevalence in the present study. Especially the Zn and tannin contents of EO expected to be more effective in the current study in reducing diarrhea (Bhandari *et al.,* 2002; Bele*et al.,* 2009). In addition, Khosla and Sharma, (2012) reported that, the fruits of EO are widely used in the Ayurveda to increase defense against diseases attributable to its pharmacological effects.Experiments conducted at the Niwa Institute of Immunology in Japan have shown EO had potent scavenger of free radicals and superoxide dimutase(Treadway, 1994). Presence of different bioactive compounds and free radicals of EO might be the reason of improving the immunity and other physiological mechanism which concurrently improved the performance of sheep in the present study.

Application of medicinal herb *(Emblica officinalis)* for growth performance and prevention of diseases in small ruminants is a new but promising for the developing country like Bangladesh.Present result indicated that, supplementation of *Emblica officinalis* improves the growth performance, suppress the pathogenic microflora and decreases diarrhea prevalence where T2 (Basal feed+ 0.6% *Emblica officinalis*) group showed best performance. To sum up, *Emblica officinalis* could be supplemented in sheep nutrition for better performanceand health while higher addition expected to be more effective.Further detail research is required to establish medicinal herb use patterns, its impact on meat quality and the reasons for choice by livestock producers.

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