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Evaluating the Degradability of the Guava and Jack Fruit Leaves Using *In sacco* Technique and Three-step Techniques

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Abstract: The aim of this research was to evaluate the digestibility of the Guava (*Psidium guajava* l.) and Jack fruit (*Artocarpus heterophyllus* Lamk) leaves, using in *saaco* (nylon bag) technique and a three-step techniques on microbial in the rumen. Three dairy cattle of 4-5 years old with an average BW of 475.5±20 kg each one fitted with a permanent rumen were used. The results have shown ruminal Dry matter and crude protein disappearances increased with rumen incubation time for all feedstuffs. Dry matter degradability in the rumen of Guava (*Psidium guajava* l.) were significantly higher ($p<0.05$) than Jack fruit (*Artocarpus heterophyllus* Lamk) respectively. The loss of DM by washing of Guava leaves was higher than Jack fruit. Similarly, the loss of CP by washing of Jack fruit was higher than guava leaves and degradability of water insoluble fraction Guava leaves was higher than Jack fruit. The results have illustrate with the intention of degradability in the rumen degradability of jack fruit were lower ($p<0.05$) than guava. Crude protein digestion in the intestinal of jack fruit was higher ($p<0.05$) than guava leaves. The proportion of CP digestion in the intestinal of guava were significantly higher ($p<0.05$) than jack fruit. Moreover, CP digestion in total tract of guava was higher ($p<0.05$) than that of Jack fruit. These results indicate that two locally leaves as alternative feed resources such as guava could substitution the alternative feedstuffs etc.

Key words: Guava leaves, Jack fruit, nylon bag, protein digestion

INTRODUCTION

Several methods of feeding supplements and their usefulness for the animals farming system in the tropical countries are indicated by good management especially; feed resources that are a better source of nutrients than straw. These depend on the mode of feeding, the access to other feeds and the type and level of desired production. The Jack fruit (*Artocarpus heterophyllus* Lamk) and Guava (*Psidium guajava l.*) are locally leaves that various parts including (leaves, pods, kernel, seeds and edible twigs). The use of tree products such as flowers, seeds and pods varies with the season and availability of other feeds. In some communities of North-East of Thailand, for example, the choice of trees varies with the species of animal-a case of adjusting feeds and animals. The leaves of *Psidium guajava* l. and *Artocarpus heterophyllus* Lamk, commonly known as guava and jack fruit, are fresh or dried and stored to feed the animals. The guava and jack fruit has been reported rich in tannins are also used as human food in times of treatment for health. Farmers adopt conservation methods wherever they are found useful (Leng, 1990; Paengkoum, 2010; Paengkoum and Traiyakun, 2011).

On the quantity of Protein Degraded in the Rumen (RDP) resolves measure of rumen Undegraded Dietary Protein (UDP), commonly referred to as escape protein. Escape protein together with the microbial protein consist of the majority of the protein digested in the small intestine. Current protein evaluation systems requires quantification of the above two fraction and their digestibility values in the small intestine to determine the make available of protein or amino acids to the animal. Currently protein evaluation system require quantification of the above two fraction. Presently the main of nylon bag method is widely used for determine the percentage of the undegraded dietary protein in the rumen.

The aimed of this paper was to evaluate digestibility what affect the digestive of Jack fruit (*Artocarpus heterophyllus* Lamk) and Guava *(Psidium guajava* l.*)* to evaluate potential of the guava leaves as alternative ruminant feed and to compare guava with tropical trees. The parameters to be measured consisting of fresh and dry matter yield, nutritive value, protein source and digestibility of the supplementary compared with a different leaves.

MATERIALS AND METHODS

Sample preparation: Two protein foliages in dry form namely Guava (*Psidium guajava* l.*)* and Jack fruit (*Artocarpus heterophyllus* Lamk) leaves were harvested

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at about 5-6 years old. Two Thai leaves were collected from Suranaree University of Technology presently about part of cattle farm. Samples of concerning 15-20 cm from the growing points of the plant life were cut and oven dried at 70°C for 48-52 hr, ground through 2 mm screen put during a sieve and Two Thai leaves such as jack fruit and guava were separated to 6 groups such as 1) and 2) treated with the dairy cows at No. 1, 2 and 3, three replications all of this experimental work and treated in ruminal with 16 hours on typical supplementary, in that order for guava and jack fruit were chemically analyzed and stored up pending chemical analyses, *in vitro* technique study specifically nylon bag and mobile bag studies and using a Three-step technique for estimate intestinal digestion.

Animals, diets and feeding methods: Three female dairy cows (Holstein Friesian) of 4-5 years old and with an average Body Weight (BW) of 475.5±20 kg were used in this experiment. Each of cattle was housed kept in individual pens and allowed an alteration period of 3 weeks to adapt to the experimental conditions, each fitted with permanent rumen cannulae were affecting for ruminal digestibility on 16 hrs tests to used in the experimentation and every one of cattle were kept in individual pens (3 x 5 m). Each dairy cattle was feed a maintained diet (1.5% body weight) consisted 70 fresh grass from SUT farm's pasture *(Brachiaria mutica)* of 10% crude protein, 1.77% fat and 27% crude fiber and 30% commercial concentrated supplements. The roughage was offered to the particular dairy cattle *ad libitum* twice daily at 0830 and 1530 h. Drinking water was freely available.

Measurement of feed degradation using nylon bag technique: The nylon bag technique for characterization of feeds in the rumen has been widely adopted to evaluate the rate and extent of degradation in the rumen by attempted to mimic the microbial rumen degradation processes. This technique is simple to handle, do not require sophisticated equipment and useful biological tool for *in vivo* (*in sacco*) animal nutrition studies.

The principle behind the technique is that a samples of identified weight contained in bags (6 x 12 cm) made from polyester cloth with pore size of 45 µm (Orskov and McDonald, 1979) were each filled with approximately 5 g of the test sample or nylon filter cloth are tightly sealed, all samples were prepared in duplicates and incubated in the rumen of fistulae animal for a range of times, after the specified incubation periods, the bag were removed from the rumen, immediately washed by hand washing for 10 min and finally dried in an oven at 60°C for 48 hr. For the control, bags without incubation (0 hr) were washed and dried in similar condition. The bags were weighted and tested following the procedure described by Orskov and McDonald (1979) and subsequent determination of the degradation defeat of the different feed component for each incubation time measured. The reflux of feed particles from the bag without breakdown by rumen microbes is referred as washing loss are used to correct with loss of material from the bags is caused by the microbial degradation of the sample within the incubated bag. By incubating samples for a range of times degradation' curve can be drawn which is characteristic of the material being incubated and of the rumen environment in which the bag is incubated. Typical degradation curves and calculation can be generated in any PC that can fit with non-linear model animal, bag pore size and samples preparation are among important factors, which may affect the results. To calculate feed disappearance and degradability parameters, the following two equations are used:

$$\text{Disappearance} = (SB-B) \times DM1 - (RB-B) \times DM2/(B-B) \times DM) \quad (1)$$

Where:
SB = Wt of original feed + bag
RB = Wt of residue + bag
B = Wt of empty bag
DM1 = Dry matter of original feed
DM2 = Dry matter of residue sample

The data designed for ruminal and intestinal degradation of DM and CP were fitted to the exponential equation following procedure described by Orskov and McDonald (1979):

$$Pt = a + b\,(1-e^{-ct}) \quad (2)$$

Where:
Pt = The degradation loss at time t (%)
c = The degradation rate constant, similarly, a rate constant of disappearance of fraction B (h^{-1})
a = The zero time intercept of the fitted curve (%)
b = The asymptote of the curve and would be reached if the time was infinite
a + b = Potential degradability
t = time of incubation (h)

The Effective Degradability (ED) of DM and CP were, therefore, calculated using the following equation (Orskov and McDonald, 1979):

$$*E = a + (b)\,(c)/(c+k)$$

Where k is the solid outflow rate from the rumen obtain from the previous experiment (0.05/hr).

Intestinal digestibility using a three-step technique: The data on digestion of dried ruminal residue samples from bag were used to measure intestinal

disappearance using a Three-step technique *in vitro* procedure provide an alternative to the use of intestinally cannulated animals for estimating digestion of protein in ruminant with the intention of described as a result of Calsamiglia and Stern (1995). Weight samples in the direction of contain 15 mg of residual N (0.4 g sample) into a 50 mL sterile centrifugation tube. Affix 10 mL of a pH 1.9, 0.1 N HCl solution containing 1 g/L of pepsin (Sigma P-7012, Sigma), vortex and incubate for 1 hour in a 30°C shaker water bath. After incubation, add 0.5 mL of a 1 N NaOH solution and 13.5 mL of a pancreatin solution (0.5 M KH_2PO_4) buffer standardized at pH 7.8 containing 50 ppm of thymol and 3 g/L of pancreatin (Sigma P-7545, Sigma). Vortex and incubate samples at 38°C for 24 h in a shaker water bath. Vortex samples test approximately extremely 8 hours. After incubation, immediately add 3 mL of a 100% (wt/vol) solution of TrichloroaCetic Acid (TCA) to the tubes fetch toward stop enzymatic action and impetuous undigested proteins. Vortex all tubes and permission to them to set intended for 15 min. Centrifuge samples at 10,000 x g for 15 min and analyze the supernatant designed for soluble N by the Kjeldahl method (AOAC, 1980). Pepsin-pancreatin digestion of protein is estimated as TCA-soluble N partitioned by amount of sample N (Dacron bag residue) used in the assay. The experimental samples were chemical analyses for Dry Matter (DM), ash and Kjeldahl-N according to AOAC (1985). Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) were determined by the method of Goering and Van Soest (1970).

Feed intake, body weight change and data analysis: Feed offered and refused were weighed daily prior to the morning feeding to determine the daily Dry Matter Intake (DMI). The body weight of each dairy cows were measured weekly immediately before the morning feeding. Average Dairy Gain (ADG) was calculated as slop of linear regression of BW with time.

The calculated was done in this study by using NEWAY program (Chen, 1996). The calculation was subject mattered to psychoanalysis of variance using SAS software (SAS, 1996). The difference between treatment means was statistically compared by Duncan's New Multiple Range Test (Steel and Torries, 1980).

RESULTS AND DISCUSSION

Chemical compositions of the Guava (*Psidium guajava* l.) and Jack fruit (*Artocarpus heterophyllus* Lamk) are shown in Table 1. All the two Thai leaves had similar concentration of DM, OM, Moisture, Ash, Fat, Crude Fiber (CF), Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF). However, the Guava leaves contained Crude Protein (CP) is lower than jack fruit.

The results have shown that degradability in the rumen of jack fruit were lower ($p<0.05$) than guava respectively (Fig. 1).

Table 1: Chemical compositions of the Guava (*Psidium guajava* l.) and Jack fruit (*Artocarpus heterophyllus* Lamk) leaves (%based on DM basis)

Item	Guava (*Psidium guajava* l.)	Jack fruit (*Artocarpus heterophyllus* Lamk)
Dry matter	68.1	72.8
Organic matter	64.3	67.6
Ash	7.9	9.5
Fat	1.4	1.3
Crude protein	8.2	8.5
Crude fiber	48.0	50.4

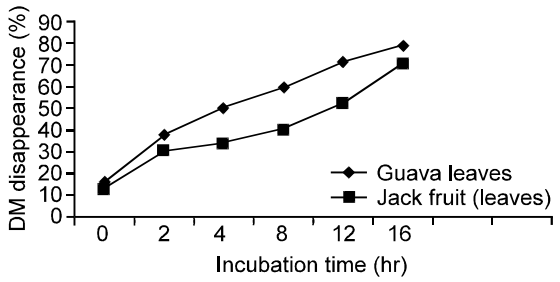

Fig. 1: Ruminal dry matter degradability of Guava leaves and Jack fruit at the various incubation times

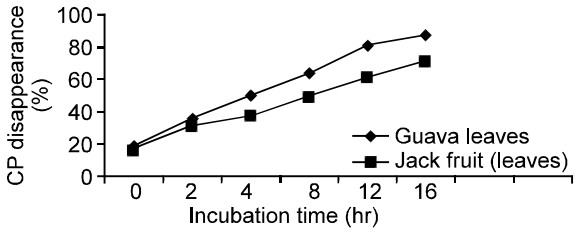

Fig. 2: Crude protein disappearance in the rumen of Guava leaves and Jack fruit at the various incubation times

Ruminal DM and CP degradation rate (P) of the two leaves sources are shown in Fig. 1 and 2. Rumen DM and CP of P increased with the rumen incubation times for all leaves. Dry matter degradation rates of guava leaves were significantly higher ($p<0.05$) than jack fruit especially, at 2, 4, 8, 12, 16 hr of incubation times (Fig. 2).

The loss of DM by washing (A) of guava leaves was higher than jack fruit. The potential degradation (A+B) of guava leaves was higher than jack fruit Similarly, the effective degradability at outflow rate of 0.05/h of guava leaves was higher than jack fruit.

The loss of CP by washing of jack fruit was higher than guava leaves and degradability of water insoluble fraction of guava leaves was higher than jack fruit foliage. The potential degradation and the degradability of guava leaves were higher than the jack fruit.

Crude protein digestion in the intestinal (from ruminal residues) of jack fruit was higher ($p<0.05$) than guava

Table 2: Ruminal and intestinal of crude protein degradability of the Jack fruit (*Artocarpus heterophyllus* Lamk) and Guava *(Psidium guajava* l.) in dairy cattle

	Local leaves		
Items	Jack fruit (*Artocarpus heterophyllus* Lamk)	Guava (*Psidium guajava* l.)	SEM
Chemical compositions (%)			
Dry matter	68.1	72.8	
Crude protein	8.2	8.6	
Ruminal degradability (%)			
Dry matter	52.1^{b}	71.4^{a}	0.27
Crude protein	60.4^{b}	70.7^{a}	0.40
Intestinal digestion (%)			
Crude protein	38.1^{c}	34.2^{bc}	0.29
Proportion of CP digestion (%)			
Rumen	52.1^{b}	71.4^{a}	0.35
Intestine	14.3^{c}	16.1^{b}	0.38
Undigested	33.6^{a}	12.5^{b}	0.37
Total tract digestion	66.4^{b}	87.5^{a}	0.25

^{a,b,c}Means within row with different superscripts differ significantly ($p<0.05$)

leaves, nevertheless, potential degradation of DM and CP of guava leaves was higher ($p<0.05$) than with the purpose of jack fruit, correspondingly, While the proportion of CP digestion in the intestinal of the guava leaves were significantly higher ($p<0.05$) than the jack fruit.

The undigested CP in total tract of jack fruit was higher ($p<0.05$) than guava leaves. However, CP digestion in total tract of guava leaves was higher ($p<0.05$) than with the intention of jack fruit but no significant differences, respectively.

It is concluded that dry matter degradability of jack fruit were lower than guava leaves While proportion of CP digestion in the intestinal of and guava leaves were higher jack fruit. The locally feed resources have high potential to utilize for protein supplements to ruminant animals in tropical.

An animal responds differently to dietary tannins in part because of the variation in the biological activity of the tannins themselves (Wanapat, 1993; Reed, 1995; Makkar *et al*., 1997). It has been believed for various considerable periods that tannin above 5% is able to become a serious anti-nutritional factor in plant materials used for feed to ruminants (Mcleod and Minson, 1978). Qualification the protein-tannin complex dissociated under acid conditions subsequently the protein can be digested in the lower gut. At the high levels (5-9%) tannins become highly detrimental (Barry, 1983) as they reduce digestibility the fibre in the rumen (Reed, 1995) by inhibiting the activity of bacteria and anaerobic fungi (Chesson *et al*., 1982) high levels also lead to reduced intake (Akin and Rigsby, 1985), above 9% tannins might be turn into lethal to an animal that has no other feed (Kumar, 1983). Barry (1983) and his colleagues have demonstrated with *Lotus pendunculatus* that the ideal concentration of condensed tannins inside this forage legume is between 2-4% of the diet dry matter, at which level they bind with the dietary proteins during mastication and appear to protect the protein from microbial attack in the rumen. Many tropical foliages e.g.

Madras thorn and Leucaena foliages can substitute 45-50% of CP from SBM without affecting productive performance, ruminal fermentation and microbial protein yield and can be used for goats in the tropics as high protein source (Paengkoum and Paengkoum, 2010). Thus a little tannin has been usually accepted as being able to protect protein of foliage, another local plants and tropical leaves allow a higher efficiency of feed utilization by the animals.

Conclusion: Locally available leaves sources will continue to be important in the feeding systems of livestock. Leaves from trees are very valuable in upland farming systems, particularly during the dry season and in the pasture farming system. Better animal performances are observed with increasing levels of tree fodder in animal rations (Leng, 1991). Provision of year round and efficient uses of roughage based on foliage and another leaves to ruminants will leads to enhanced production and maintained environmentally friendly atmosphere. The tropical protein foliage to be an importance sources of the protein for the ruminants.

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