The performance of growing goats fed urea treated rice straw supplemented with Incum (*Klienhovia hospita*) foliage

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Abstract

The usage of locally available forages such as agricultural by-products and native trees is the crucial thing for goat farmers to obtain good quality feed and to reduce cost of feeding. A study was conducted to investigate the performance of crossbred goats fed urea treated rice straw supplemented with different levels of *Klienhovia hospita* foliage, in particular to determine the nutrient feeding value of experimental feed diets, evaluate the growth performance, feed intake and digestibility of the diets by goats. The feeding trial conducted was divided into two sections: digestibility and animal performance. The digestibility test was performed using total faecal collection method. The treatment diets were based on urea treated rice straw (RS) supplemented with commercial concentrate (C) and *Klienhovia hospita* (KH) herbage: T1 with 85% RS and 15% C, T2 with 85% RS and 5% KH and 10% C, T3 with 85% RS, 10% KH and 5% C, and T4 with 85% RS and 15% KH. The feeding trial used 12 6-mo old crossbred male goats divided into 4 groups with the diets offered *ad libitum* and had access to clean drinking water. The left over feed was removed and weighed daily to determine voluntary DM intake. The initial average body weight of goats used ranged between 20.14±1.03 kg and 20.29±0.18 kg. The animals were placed in individual metabolic crates on slatted floor of 0.8 m above ground for 100 consecutive d. The results showed that there was no significant difference observed on body weight of goats among the treatments. ADG of goats was significantly higher in goats on diets T3 and T4 than those on control diet. Significant higher feed intake was observed in goats fed diet containing KH foliage than those fed with diet T1. Results for ASH, CP and ADF digestibility among different treatments were not significantly different whereas NDF digestibility was significantly higher in T2 treatment in comparison with T1, T3 and T4. The dry matter digestibility values of T1 and T2 diets were significantly higher than that of diet T4. Thus the study indicated that feeding goats with urea treated rice straw supplemented with KH foliage gave a positive effect on growing goats replacing concentrate fed with rice straw basal diet. It is concluded that the inclusion of KH foliage in the diet of goats has improved their growth performance and feed intake.

Keywords: *Klienhovia hospita*, urea treated rice straw, digestibility, goats

Introduction

Ruminant production in many developing countries is limited by unavailability and high cost of feeds as the major constraints hampering its productivity, in addition to feeding with low quality feeds and limited availability of feed in the dry season when natural pastures are mature, highly fibrous and inadequate (Oni *et al*.,

2010) with low nutritive value due to low crude protein content (Moyo *et al*., 2012). Most farmers fed their animals with crop residues and low-quality hay that are low in nitrogen, high in lignocellulose and poor in vitamin and mineral contents, which leads to low digestibility and reduced voluntary intake. These feeds cannot support the required level of protein and energy leading to poor growth rate, delayed animal sexual maturity, poor reproductive performance, inferior meat quality and low milk yield (Whittemore, 2004).

Supplementing concentrate in the diet could improve voluntary intake and digestibility of poor quality roughages (Nurfeta, 2010). However, many smallholder farmers are facing problem to feed their animal due to unavailability and high cost of cereal grain or byproduct ingredients. In order to solve this problem, there is a necessity to look for alternative energy and protein sources that farmers can obtain within their surroundings such as rice straw and tree forage foliage without incurring additional costs.

The quality and digestibility of rice straw can be improved via urea treatment, which was reported in many reports, and the abundance of tree species in Malaysia could be good feed resources for goats. The trees provide good and cheaper sources of protein and micronutrients (Aganga and Tshwenyane, 2003; Moyo *et al.*, 2012). In recent years, there has been increased research on alternative protein sources from forage trees and shrubs that can be fed to goats.

Incum (*Klienhovia hospita*) is a plant native to Southeast Asia, which has been traditionally used in Indonesia as phytotherapic medicine to cure liver disease.

Therefore, this study was conducted to investigate the performance of crossbred goats fed urea treated rice straw supplemented with different levels of *Klienhovia hospita* foliage, in particular to determine the nutrient feeding value of experimental feed diets, evaluate the growth performance, feed intake and digestibility of the diets by goats.

Materials and Methods

Experimental site, design and treatments

The field study was conducted at Ruminant Unit and the laboratory analysis was done at Nutrition Laboratory, Department of Animal Science, Faculty of Agriculture, Universiti Putra Malaysia, Serdang, Selangor. This study was conducted from June until August 2016, and urea treated rice straw, dried *Klienhovia hospita* leaves and 12 6-mo old crossbred male goats were used as experimental materials.

The feeding trial was divided into two sections: digestibility and animal performance. The digestibility test was performed using total faecal samples in nutritive quality test. The experimental design used was completely randomized design (CRD) with three replicates. The treatment diets were based on urea treated rice straw (RS) supplemented with commercial concentrate (C) and *Klienhovia hospita* (KH) herbage with the treatments, T1 with 85% RS and 15% C, T2 with 85% RS and 5% KH and 10% C, T3 with 85% RS, 10% KH and 5% C, and T4 with 85% RS and 15% KH.

The feeding trial on animal performance used 12 6-mo old crossbred male goats and the animals were randomly and equally allotted to the 4 dietary groups with the diets offered *ad libitum* as two separate meals at regular intervals between 0700 and 1830. At 0730, the KH herbage was mixed with the concentrate and fed to the animals, and at 1200, roughages were provided in the form of urea treated rice straw. The same procedure was repeated between 1600 and

1630, daily. The feed was offered daily based on 3% of body weight dry matter intake (DMI) throughout the experimental period, with *ad libitum* access to clean and cool drinking water. The left over feed was removed and weighed daily to determine voluntary DM intake. The initial average body weight of goats used in this experiment ranged between 20.14±1.03 kg and 20.29±0.18 kg. The animals were placed in individual metabolic crates placed slatted floor of 0.8 m above ground. Each pen was provided with watering and feeding facilities. The feeding trial was conducted following the guidelines of the research policy of UPM on animal ethics. The entire feeding trial lasted for 100 consecutive d.

During the trial, feed intake was recorded daily, while growth performance was monitored by weighing the animals at the beginning of the experiment and subsequently on a weekly basis. The average daily gain of the animal was determined in order to determine feed efficiency. Efficiency of feed utilization and live weight gains were monitored weekly and calculated as Feed intake/Weight gain live = New live weight - Initial live weight. Each goat was subjected to 7 d of adaptation period conducted before the actual data collection was taken.

Feed sample analysis

Ground samples were analyzed for dry matter (DM) by drying at 105.1°C for 24 h in a forced air oven. The crude protein (CP) was determined by the Kjeldahl method (AOAC, 2000). Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined by the method of Goering and Van Soest (1970).

Statistical analysis

One-way analysis of variance (ANOVA) was carried out for the experimental data and the significant differences among treatment means were detected using Duncan Multiple Range Test at probability $p<0.05$ using Statistical Analysis Software (SAS, 2013).

Results and Discussion

Chemical composition

The chemical composition of different experimental diets in each treatment is shown in Table 1. The dry matter (DM) of experimental diets decreased with decreasing concentrate level in the diet. The crude protein (CP) content of four experimental diets was similar and did not differ much among them. The neutral detergent fibre (NDF) and acid detergent fibre (ADF) content increased with increasing KH foliage in the diet. The acid detergent lignin (ADL) content in T4 was higher compared to the other treatments. The DM content of diet T1 was higher, then gradually decreased with increasing KH foliage inclusion in the diet.

Table 1 : Chemical composition of experimental diets (%)

Diets	% DM	% ASH	% CP	% CF	% NDF	% ADF	%ADL
T1 (TRS85:0KH:15C)	56.93	86.89	8.49	39.15	48.78	25.82	9.04
T2 (TRS85:5KH:10C)	54.11	85.70	8.15	36.82	50.92	27.26	10.66
T3 (TRS85:10KH:5C)	51.28	84.50	8.22	34.49	53.05	28.71	10.71
T4 (TRS85:15KH:0C)	48.46	83.31	8.35	32.16	55.19	30.15	10.80

TRS = Treated Rice Straw; KH= *Klienhovia hospita*; C= Concentrate; DM= Dry Matter; CP= Crude Protein; CF= Crude Fiber; NDF= Neutral Detergent Fiber; ADF= Acid Detergent Fiber; ADL= Acid Detergent Lignin

The crude protein (CP) content was not significantly different among diets which ranged between 8.15% - 8.49%. There was significant difference in dry matter (DM) content between diets T1, T2 and T3 which were higher than T4. The digestibility among the diets in the rumen is related to the proportion and lignification of plant cell wall (NDF). Tree forages with low NDF content (20-35%) are usually highly digestible and species with high lignin content are often of low digestibility. The NDF and ADF content increased with increasing KH foliage in the diet. The ADL content in T4 was higher compared to the other treatments. The DM content of diet T1 was higher, then gradually decreased with increasing KH foliage.

Body weight

The effect of the dietary treatments on growth performance based on body weight is shown in Figure 1. No significant difference ($P<0.05$) in the live weight gain among the four experimental groups was observed. Goats on experimental diets T3 and T4 showed increase in body weight which was almost comparable of goats on T1 and T2 diets which meant that body weight had increased due to a positive effect of KH foliage on intake and digestibility.

Goats fed diet T3 had the highest growth rate based on body weight and average daily gain which was almost comparable to growth rate of goats on diets T1, T2 and T4. Increased growth rate obtained from goats in T2, T3 and T4 was due to positive effect of KH foliage on intake and digestibility. Recommended level for ADF content for growing goats is about 23% (Lu and Mosier, 2008). T1 contained low ADF content while T2, T3 and T4 diet had higher ADF than recommended level.

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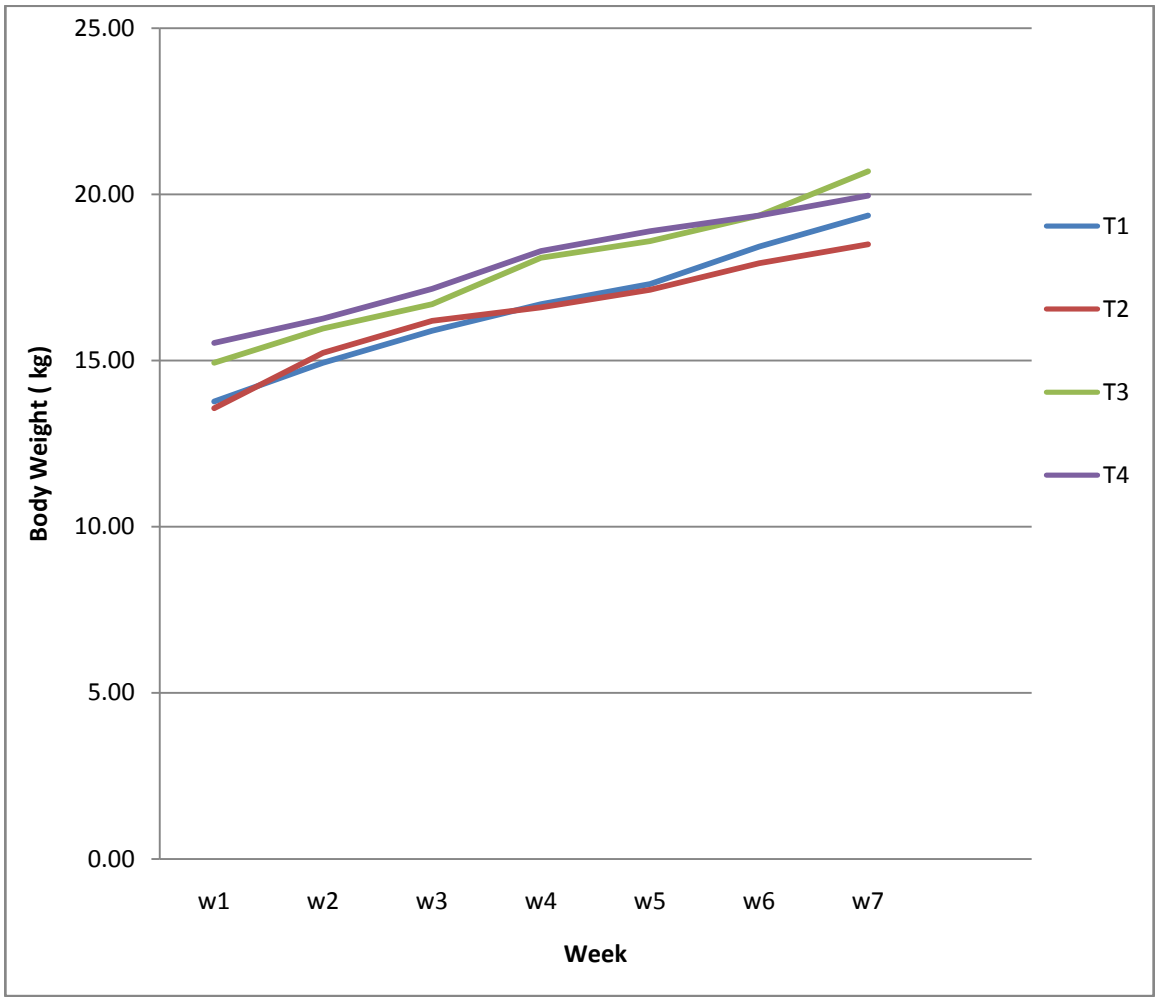
Figure 1 : Effects of supplementation of Incum (*Klienhovia hospita)* on live weight gain of goats



T1 : 85% urea treated rice straw + 15% concentrate
T2 : 85% urea treated rice straw + 5% Klienhovia hospita + 10% concentrate
T3 : 85% urea treated rice straw + 10% Klienhovia hospita + 5% concentrate
T4 : 85% urea treated rice straw + 15% Klienhovia hospita

Average daily gain (ADG)

ADG of goats was significantly higher ($P<0.05$) in goats on diets T3 and T4 than those on diets T1 and T2. The compensatory weight gain was observed in wk 1. The goats had lost their weight during adaptation period, and ADG increased in the following wk due to the period of treatment (Figure 2)

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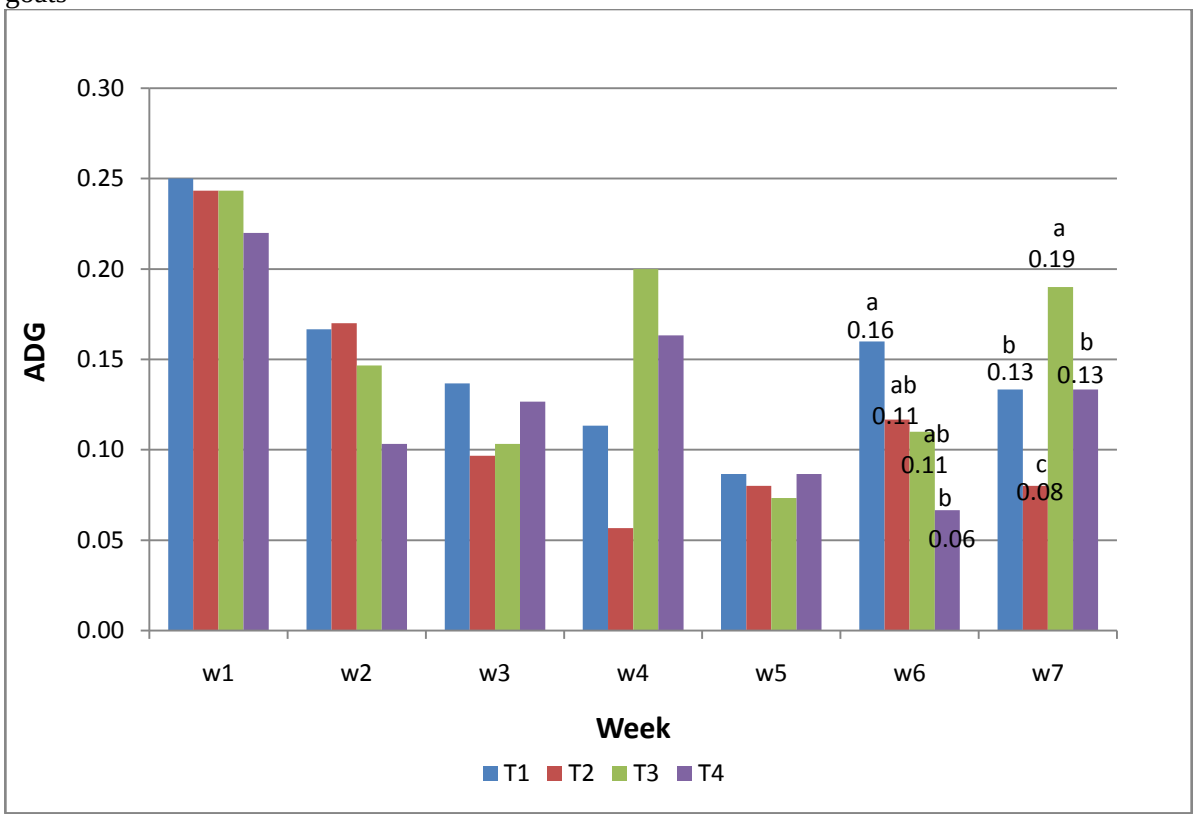
Table 2 : Effects of supplementation Incum (*Klienhovia hospita*) on digestibility of goats.

Diets	% DM	% ASH	% CP	% CF	% NDF	% ADF
T1(TRS85:0KH:15C)	35.42 ± 0.87	90.53 ± 0.15	65.17 ± 0.25	75.87 ± 0.35	49.10 ± 0.20	26.60 ± 0.46
T2(TRS85:5KH:10C)	33.10 ± 0.90	90.80 ± 0.26	63.60 ± 0.26	59.70 ± 0.46	50.13 ± 0.21	26.63 ± 0.31
T3(TRS85:10KH:5C)	22.46 ± 0.92	89.47 ± 0.55	60.83 ± 0.35	73.63 ± 0.45	46.60 ± 0.44	23.33 ± 0.47
T4(TRS85:15KH:0C)	17.40 ± 0.72	89.30 ± 0.36	59.40 ± 0.72	70.37 ± 0.42	48.80 ± 0.26	25.40 ± 0.50

TRS = Treated Rice Straw; KH= Klienhovia hospita; C= Concentrate; DM= Dry Matter; CP= Crude Protein; CF= Crude Fiber; NDF= Neutral Detergent Fiber; ADF= Acid Detergent Fiber

Figure 2 : Effects of supplementation of Incum (*Klienhovia hospita)* on average daily gain of goats



T1 : 85% urea treated rice straw + 15% concentrate
T2 : 85% urea treated rice straw + 5% Klienhovia hospita + 10% concentrate
T3 : 85% urea treated rice straw + 10% Klienhovia hospita + 5% concentrate
T4 : 85% urea treated rice straw + 15% Klienhovia hospita

Dietary fibre gave significantly positive effect in goat production through its influence and interaction with intake and digestion of nutrients (Lu and Mosier, 2008) who also reported that optimum dietary fibre in the diet increased the cellulolytic activity in the rumen and the salivation also increased through eating and ruminating. Salivation will enhance the growth of cellulolytic bacteria which leads to increase in rumen pH. The ruminal pH increased linearly as ADF intake increased from 14 to 26% as reported by Lu and Mosier (2008) and the growth rate of goats on diets T3 and T4 were almost doubled that of the sole concentrate diet T1. The lowest growth rate of goats in diet T1 might be due to the low fibre intake in the diet. Safari *et al.* (2009) and Mahgoub *et al.* (2005) reported that increase in concentrate in the diets increased the growth rate of goats while there was low quality grass hay as basal diet which is contradictory to the present result. The sole concentrate diet showed the lowest growth rate which might be due to low fibre and high non-structural carbohydrate in the diet.

Naidu *et al.* (1999) reported that feeding large amount of grain enhanced the growth of lactic acid bacteria, which reduced the rumen pH causing acidosis. When rumen pH is below 6.0, it will inhibit the growth of cellulolytic bacteria and protozoa, thus decreases the fibre digestibility in the rumen that leads to reduce of feed intake resulting in decrease in body weight (Russell and Wilson, 1996). Thus increasing KH foliage with concentrate increased live weight gain of goats. There were no detrimental health effects when dry KH foliage replaced the concentrate over the experimental period.

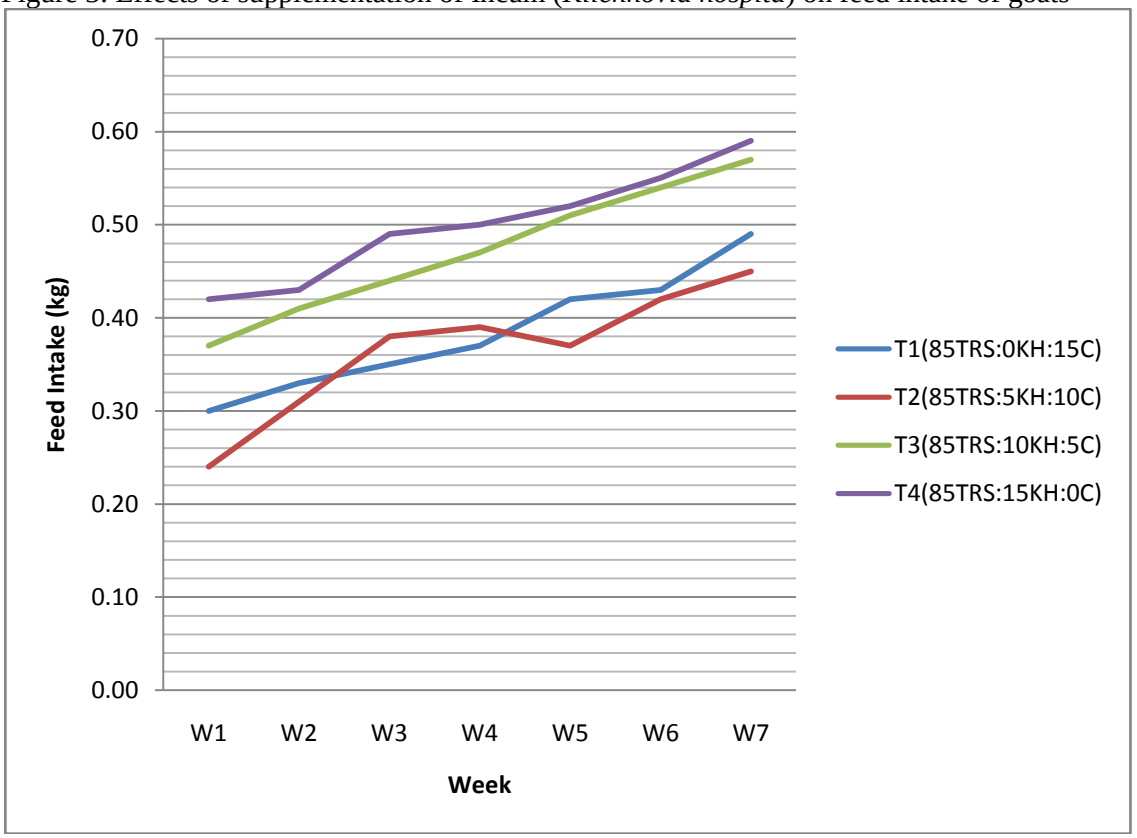
Feed intake

The effect of supplementation of KH foliage on feed intake of goats is presented in Figure 2. Significant higher feed intake was detected ($P<0.05$) in goats fed diet containing KH foliage than those in the control diet (T1). Increasing level of KH foliage showed higher ADF intake. This was expected as KH foliage had a higher ADF content compared to concentrate. The relative palatability and acceptability of supplemented feed to the animals could be reflected based on intake pattern. Feed intake is an appraisement of diet appreciation, selection and consumption by an animal (Majuva-Masafu and Linington, 2006). It is a key process which determines the quantity of feed stuff which is ingested over a period of time, usually per day (McDonald *et al.*, 2011).

Nutrient digestibility

Apparent DM, Ash, CP, CF, NDF and ADF digestibility of the 4 experimental diets were not significantly ($P>0.05$) different whereas NDF digestibility was significantly higher in T2 treatment in comparison with T1, T3 and T4 diets. The dry matter digestibility values of T1 and T2 diets were significantly ($P<0.05$) higher than that of T4 diet (Figure 3). The difference in digestibility of DM and nutrients of the feed observed in the present study could be attributed to the low CP content of the experimental diets of T2, T3 and T4, because digestibility is very much reduced when a ration contains little protein in proportion to the amount of readily digestible carbohydrate (McDonald *et al.*,2011). Despite the digestibility of goats decreased in T2, T3 and T4 diets, there was no difference in the feed intake and live weight gain among the treatments.

Figure 3: Effects of supplementation of Incum (*Klienhovia hospita*) on feed intake of goats



T1 : 85% urea treated rice straw + 15% concentrate
T2 : 85% urea treated rice straw + 5% Klienhovia hospita + 10% concentrate
T3 : 85% urea treated rice straw + 10% Klienhovia hospita + 5% concentrate
T4 : 85% urea treated rice straw + 15% Klienhovia hospita

Conclusion

The result obtained from this study indicated that feeding goats with urea treated rice straw supplemented with KH foliage had positive effects on growing goats when 5%, 10%, and 15% KH foliage replaced concentrate basal diet (RS) and concentrate. The inclusion of KH foliage in the diet of goats had improved their growth performance and feed intake. Therefore, it can be used as natural growth promoter in the diet of growing goats for better growth performance at small holder farmers' level where *Klienhovia hospita* can be grown in their surroundings. It is recommended that *Klienhovia hospita* foliage can also be used as cheap protein supplement for goats thus can reduce cost for farmers to provide a continuous concentrate supply. In addition, the inclusion of *Klienhovia hospita* foliage may increase the protein content significantly.

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