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Effect of Feeding *Dolichousnea longissima* (Ach.) Articus as Supplement during Winter on Milk Yield and its Composition in Yaks

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Abstract

The study was conducted to determine nutrient contents of *Dolichousnea longissima* (Ach.) Articus – Methuselah Beard and to assess the effect of feeding it on production of milk and its composition in milking yak cows. The study was undertaken in Haa Dzongkhag during the winter months of December, 2016 to February, 2017. A total of 14 milking cows were selected for this study. *D. longissima* was collected in and around yak rearing area of Chelela place. All the cows are reared under existing rearing system and feeding practices in the day out and night in system. The experimental animals were divided into two groups and assigned to two treatments, namely feeding and control groups in a Completely Randomized Design (CRD). The treatment group was fed with 3 kg of *D. longissima* over 42 days including an adjustment period of 14 days in addition to grazing while the control group did not receive the supplement. The milk yield for all the cows was measured daily for 7 days prior to the start of actual feeding trial and for 28 days post the adjustment period. Composite milk samples with 3 replicates were taken on alternative days, stored and transported in cool box and analyzed after 2 hours of sample collection for milk composition. There was no significant difference ($p \geq 1.00$) in milk yield between the control group (0.45 ± 0.12 l) and feeding group (0.45 ± 0.08 l) respectively. The fat content of milk also did not differ significantly ($p \geq 0.05$) between the groups. While statistically insignificant, the SNF and protein content were slightly higher in the control. Significantly higher ($p \leq 0.05$) lactose content was recorded in the control group (5.57 ± 0.06%) than the treated group (5.40 ± 0.17%). There was no significant change in body condition score over the experimental period. This study found that feeding of *D. longissima* had no effect on milk yield and composition. However, feeding *D. longissima* could have supplied additional energy and protein to maintain the body condition of animals during harsh climate.

Keywords: Composition, *D. longissima*, nomadic, yak

Introduction

Bhutan is an agrarian country with around 60% of the population dependent on farming for their livelihood. Livestock rearing is an integral component of the smallholder mixed farming system. Livestock contributes 10% of the GDP and around 22% of the household income (DAMC, 2013). Livestock also contributes to the nutrition and income of the rural communities through meat, milk and eggs; manure and draught power for agricultural activities.

In Bhutan, there are three main livestock production systems; nomadic, migratory and sedentary. Yak production is practiced by no-

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mad and supports the livelihood of about 10% of the population of Bhutan. The Yak herders live a transhumant and nomadic life with their yak, between altitudes of 3000-5000 msl. Yaks have multiple functions; providing food in terms of milk, milk products and meat; and transportation and fibre. Herders' garments and tents for shelter are made from yak fibre. Pack yak is an important means of transport in the alpine region. In recent years, yaks are increasingly being used by tourism in the high altitude for tours and trekking. Yak dung is used as fuel wood for cooking by the nomads. Yaks also play special roles in the religious and cultural life of the herders. In fact, yak symbolizes these nomadic societies and has shaped the culture and tradition of these societies.

According to the Livestock Census 2013, Bhutan has around 39,543 yaks. The yaks are found in high elevation mountains in the northern belt of 10 districts including Haa, Paro (Soe -Naro) Thimphu (Lingshi, Dagala), Wangdue (Sephu), Gasa (Laya, Lunana) in the west, Bumthang (Dhur) and Trongsa in the central region and Tashigang (MerakSakten), Tashi-Yangtsi (Bumdeling) and Lhuentse in the east. The western region has the highest density, with more than 50% of the total yak population in Bhutan. Yak is reared on the alpine rangelands in an extensive grazing system, in demarcated grazing areas – *Tsamdrok*. Tsamdroks are either owned by the herder or leased with payment in yak products. However, most of the Tsamdroks are community owned, the grazing right of which is allocated to the herders on a rotational basis. Herders migrate to the lower elevation pastures in the winter months in search of greener pasture as well as to avoid the extreme cold and snow fall. Yaks are not provided any shelter throughout the year except for the calves in the winter season. The milking cows are brought to the homestead in the morning for milking after which the calves are allowed to suckle the remaining milk. The calf is removed in the evening and sheltered in a makeshift enclosure.

Nutrition is one of the most important factors in any livestock production system. The nutrition of the yak depends on grazing in the alpine meadows during summer months with little or no feed supplement. In the winter months milking cows are fed with hay, dried turnip, oilcake and salt. While nutrition of yaks in the summer is considered adequate, they are underfed during the winter as they have to depend on what they can scrap from grazing in the forest, especially dried grasses, bamboo leaves, dried under growths and *Dolichousnea longissima* (Ach.) Articus, Methuselah Beard. Generally, yaks are known to be in very poor physical condition and thus produce relatively less milk in winter due to feed scarcity when the ground is covered with snow. According to Dorji (2000) the herdsmen cited the lack of winter feed as one of their major constraints in improving yak productivity.

The *Dolichousnea longissimi,* locally known as '*haym*" or "*ham-pey*," is usually fed to the calves and milking cows in winter as a supplementary feed. However, the nutritive value and effect on milk yield are not known. While there are numerous studies and literature on its medicinal property and use, there is very little or no literature on the use of *Dolichousnea longissima* as a feed. Therefore, it is important to know its feeding value. Accordingly, this study was conducted to evaluate the nutrient content of *D. longissima* and the effect of its feeding on milking yield and composition. Thus, the main objective of this study was to determine nutrient contents of *D. longissimi* Methuselah Beard and to assess the effect of feeding it on milk production and composition in yak milking cows.

Materials and Methods

The study area

Haa District is situated in the western region of the country at an altitude ranging from 1000 to 5600 m above sea level. It has cold and dry winter and wet and warm summer. In winter, the temperature drops down to minus 10 ^{o}C at the extreme minimum. The District receives

snow fall several times in a year from late October till April. The current total geographical area of the District is 1,899.02 km^2 with a human population of little over 13,401. Livestock farming is an integral part of farming system and constitutes an important economic activity in the District, with a majority of the northern blocks depending on livestock products such as butter, cheese and yak meat for their livelihood. The Dzongkhag has 9,702 heads of yaks (DoL, 2013).

Selection of animals

This study was conducted from December, 2014 to February 2015. A total of 14 milking yak cows were selected for this study irrespective of stage of lactation. The cows were reared under the existing system of grazing in the forest during the day and night-in-shed system.

Collection of Dolichousnea longissima

The *Dolichousnea longissima* plants were collected from Chelela a week ahead of feeding. In total 882 kg *D. longissima* was collected.

Experimental design and treatment

The selected animals were randomly assigned to two groups in a Completely Randomized Design (CRD). Animals in the treatment group (Group I) was marked with white colour stripe of linen tied to the horn while the control group (Group II) was marked with yellow colour. The Group I animals were fed with 3 kg of *D. longissima* daily for 42 days. Half the quantity of *D. longissima* was fed in the morning after milking and half in the evening after the animals returned from the day-out grazing. All the experimental animals were sent for day -out grazing from 9.00 AM to 4.00 PM on the natural pasture, and animals have free access to drinking water during the free range grazing hours.

Body condition score

The body condition score of all 14 animals were assessed visually and recorded before start and at the end of experimental period. In this study, the American system of scoring on a scale of 1 to 5 was used.

Milk sample and measurement

Milk yield of all the yak cows were measured daily for 7 days prior to the start of the feeding trial and for 28 days after the start of feeding with an adjustment period of 14 days. Composite milk samples were taken on alternative days with 3 replications. The milk samples were stored and transported in cool box for analysis. The analysis was done within 2 hours of collection to prevent milk curdling and quality change. The collected milk samples were analyzed for fat, solid non-fat, protein and lactose content using Ultrasonic Milk Analyzer (UMA) at an average temperature of 22 °C.

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Data analysis

The data was compiled in the Microsoft Excel and analyzed using SPSS software version 16.0. Descriptive statistics are presented as necessary. Independent *t*-test was conducted to compare the means between treatments on milk yield and composition. The Kendall's tau correlation was used to determine the relation between milk yield and components for treatment and control groups. All the statistical differences were tested at 95% confidence interval.

Results and Discussion

Chemical composition of Dolichousnea longisimma

The nutrient content of *D. longissima* for the summer and winter months are presented in Table 1. The nutrients content in winter months were found to be lower than in the summer months. The higher nutrient contents in summer may be because of higher nutrient contents during the initial growth in summer which declined as growth advanced corresponding with the fall and winter seasons. The result obtained here is consistent with the finding of Kilcher (1981) who reported that forage quality such as protein, energy, vitamins and minerals decline and fiber and lignin increase as growth progress and plant become mature. The crude protein is found to be high which is above the protein requirement of cattle. However, the utilization of the crude protein in the rumen is not known and is a subject for further research. The crude fibre such as acid detergent fibre (ADF) and neutral detergent fibre (NDF) could not be determined due to unavailability of equipment and chemical reagents.

Table 1: Chemical Composition of *Dolichousnea longisimma*

	DM %	CP %	Moisture %	Ash %	N %
Summer (n = 3)	88.57	21.27	11.43	2.49	3.4
Winter (n = 3)	87.31	19.54	12.69	1.74	3.13
Average	87.94	20.41	12.06	2.12	3.27

Milk yield and composition of yak cows before treatment

The milk yield and composition of yak cows before the start of feeding trial for the two groups are shown in Table 2. There was no significant difference ($p > 0.05$) in milk yield between the treatment and the control group. Similarly, the fat, SNF, protein and lactose also did not differ significantly ($p > 0.05$) between the groups. The mean milk yield was much lower than that reported by Wangdi (2015) in Bhutan (1.09 ± 0.05). The difference could be attributed to the season of study. According to Magash (1991), daily milk yield in July is higher because of the good grazing available which declines from September to November and the yak cows become dry around December-January when there is scarce feed available with very low quality.

In terms of composition, solid non-fat (SNF), protein and lactose content in this study falls within the range of 10.62 ± 0.08, 4.86 ± 0.03 and 5.82 ± 0.04 respectively) as reported by Wangdi (2015). However, fat content was much higher (7.08 ± 0.20). This could be due to the lower milk yield in this study as there is an inverse relationship between milk yield and fat content.

Effect of feeding Dolichousnea longissima on milk yield

The mean milk yield of yaks after feeding *Dolichousnea longisismma* is presented in Table 3. The results showed that there is no significance difference ($p > .05$) in milk yield between the group fed with *D. longissima* (0.45 ± 0. 08 l) and the control group (0.45 ± 0.12 l). The milk yield over the experimental period in

Table 2: Milk yield and its composition before *Dolichousnea longisimma* feeding

Group	Milk yield (L)	Fat (%)	SNF (%)	Protein (%)	Lactose (%)
Treatment (n=7)	0.60 ± 0.29^{a}	8.87 ± 1.23^{b}	10.31 ± 0.32^{c}	4.09 ± 0.26^{d}	5.31 ± 0.34^{e}
Control (n=7)	0.51 ± 0.09^{a}	8.91 ± 1.08^{b}	$10.46 \pm .32^{c}$	4.19 ± 0.10^{d}	5.55 ± 0.21^{e}

Means within the column with different superscripts differ significantly ($p > 0.05$)

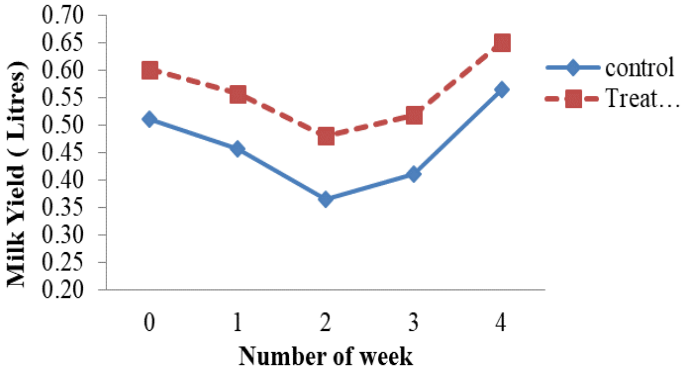

Figure 2: Milk yield before and after feeding *D. longissima*

both the groups decreased in the second and third week but picked up from fourth week as shown in Figure 2. This could be due to the inclement weather stress to the animals during the second and third weeks. Usually, as the season advances towards winter, the temperature as well as the fodder availability and quality decline resulting in decline in milk yield in yaks. While there is no information on the effect of cold stress on milk yield in yaks, cows kept outdoors year round and exposed to extreme weather conditions can impact the production and welfare of animals (Bryant, 2010) and exposure to temperature below the lower critical level is shown to cause stress (Webster *et al*., 2008) and consequently increases metabolic activity to produce heat to maintain body temperature (Ames, 1987). This results in increase in basal energy requirement, thereby reducing the energy available for other processes such as milk production and reproduction (Broucek, 1991). MacDonald and Bell (1958) showed that milk yield starts to decline in cows fed ad libitum at -4 °C which markedly decline when cows were exposed to ambient temperature below -23 °C. In yaks, it is estimated that for every 1 °C drop below the lower critical temperature, there is an approximately 2.5% increase in metabolic demand (Zhang, 2000).

Effect of feeding Dolichousnea longissima on milk composition

The mean milk composition of yaks after feeding *D. longissima* is presented in Table 3. The fat content of milk did not differ significantly ($p > 0.05$) between the two groups, although the mean fat content was slightly higher in control group (9.54 ± 0.69%) when compared to yak cows fed with *D. longissima* (8.80 ± 1.30%). The fat content of control groups in this study is consistent with the findings of Gyeltshen and Dorji (2014) who reported a fat content of 9.52 ± 0.73% but rest of the composition was higher than those previously reported. Similarly, there was no significant difference ($p > 0.05$) in SNF and protein content between the two groups.

Table 3: Milk composition after feeding *Dolichousnea longissima*

	Milk composition				
Group	**Yield (L)**	**Fat (%)**	**SNF (%)**	**Protein (%)**	**Lactose (%)**
Treatment (n = 7)	0.45 ± 0.08[a]	8.80 ± 1.30[a]	10.60 ± 0.88[a]	4.23 ± 0.34[a]	5.40 ± 0.17[b]
Control (n = 7)	0.45 ± 0.12[a]	9.54 ± 0.69[a]	10.80 ± 0.31[a]	4.27 ± 0.10[a]	5.57 ± 0.06[a]

Relation between milk components

Kendall's tau correlation analysis was conducted to examine the relationship between the milk yield and its components. It was observed that there was negative correlation between the milk yield and fat (r = -0.49), between milk yield and protein (r = -0.59) and milk yield and SNF (r = -0.40). However, there was positive relationship between fat and protein content in milk (r = 0.71).

Effect of Dolichousnea longissima feeding on body condition score (BCS)

The BCS is recorded to assess the effect of feeding *Dolichousnea longissima* as shown in Figure 4. There was no significant change in body condition score in the experimental animals before the start of feeding trial and after feeding *D. longissima.* The mean BCS recorded was 2.5 and thin and emaciated animals were recorded in both the groups. During the experimental period, the animals were exposed to inclement weather and subzero temperature and had not much to eat since the ground was snow covered. There is an increased metabolic activity to generate body heat during cold stress and when the additional energy requirement is not met from the feed, they use body reserves, thereby loosing body weight and condition (Zhang, 2000). The fact that the animals did not lose body condition under such adverse climatic and nutritional conditions indicates that feeding of *D. longissima* was able to supply the required energy for BCS maintenance. Although there is no perceptible effect of feeding *D. longissima* within the experimental period but the effect may manifest at a later stage. Supplementary feeding is reported to improve reproductive rate and milk yield in the following season (Dong *et al*., 2007).

Conclusion

Dolichousnea longissima is the main source of supplementary feed for yaks during winter. The nutrients content of *D. longissima* for the summer months were higher than the winter months. *D. longissima* has nutrient content comparable to many fodder resources and could be used for supplementary feeding. Its protein content is higher than most concentrate feeds.

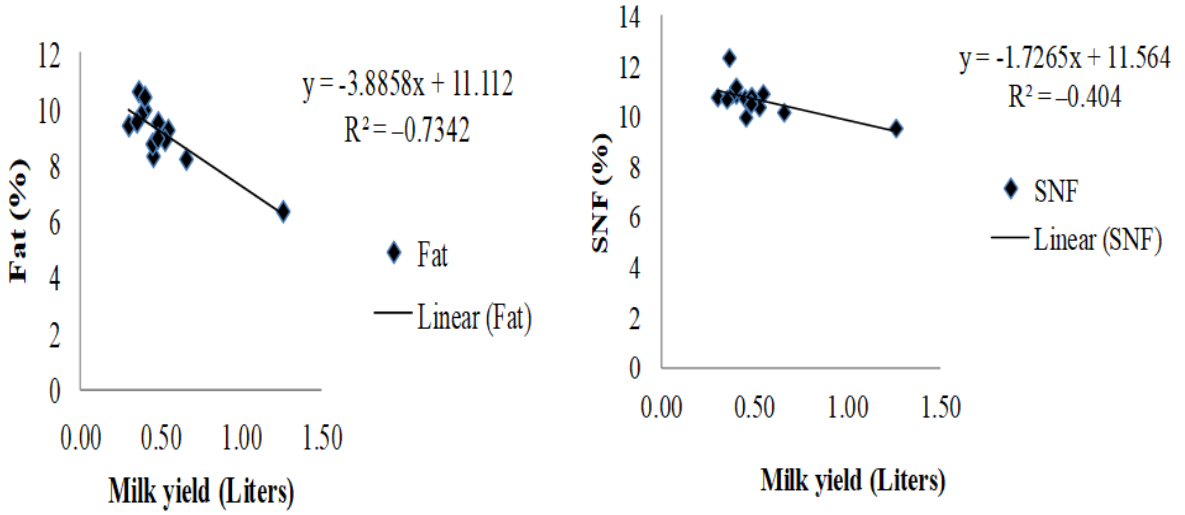

Figure 3: Correlation between milk yield, fat and SNF

Feeding of *Dolichousnea longissima* at the rate of 3 kg/day had no significant effect on milk yield and its composition. However, maintenance of body condition and milk yield even through the adverse climatic conditions indicates that feeding *D. longissima* supplied additional energy to maintain the body condition of animals during harsh climatic and nutritional stress conditions. Based on the results of this study it could be concluded that supplemented feeding of *D. longissima* can supply additional energy requirement when they are much needed in winter. This study was conducted for the first time in Bhutan in peak winter season in a very harsh climatic condition. The cows might have not responded to treatment due to cold stress and shortage of forage due to snow fall. Future studies on *D. longissi-*

ma as a feed resource should look at the energy content which could not be carried out in this study. Studies also need to be carried out with different experimental design to determine the optimal intake of *D. longissima* with large sample size.

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