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Efficacy of tree leaf based complete feed blocks on performance of growing yaks

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Yak *(Poephagus grunniens)* found between altitude of 3,000 and 6,000 m above msl, plays a major role in the economy of the tribal population living in difficult terrains of the foot hills of Himalayas. Yak herdsmen usually do not fed any supplementary feed except some salts at regular interval, and generally milch and pregnant animals are fed small amounts of concentrates in the form of wheat flour or maize flour. Most of the yak rearing areas of the country are facing an acute shortage of both feeds and fodders especially during winter when entire grassland remains covered with snows. In India, the yak keepers practice two-pasture utilization strategies. The summer pasture extends for 190 days (May–October) and winter pasture for about 138 to 150 days (November–April). The rest period is spent on transit from winter pasture to summer pasture. Traditionally, they maintain yaks to allow heavy weight gain through feeding *ad lib.* summer forages and utilize the reserved fat for survival in winter when there is scarcity of feed (Ramesha *et al*. 2009). Yaks are taxed heavily in winter due to inadequate fodder resulting 25 to 30% loss of body weight and the milk yields (Baruah *et al*. 2012). Yak herdsmen usually feed these animals with salt at regular interval. The periodic feed shortage results in the weight loss of grazing ruminants and is particularly evident in young animals (Ryan 1990). In such situation, nutritional intervention may be an effective weapon to improve the productive performance of yak that is already undernourished. Supplementing concentrate mixture may not solve the problem of acute scarcity of green and dry forages, particularly during winter under field condition at higher altitude. Therefore, Complete Feed Block (CFB)s, may be useful to overcome this problem which also involve cheaper cost of transportation. Further, majority of livestock in hilly region are generally fed on forest grasses and tree leaves though all of them are not palatable to these animals. Animals even refuse to eat certain tree leaves in a particular season, mainly because of high concentration of some anti-nutritional factors like tannin. Therefore, selection of suitable tree leaves for preparation of complete feed blocks by observing their proximate compositions, anti-nutritional factor contents and effects on rumen fermentation and palatability for supplementing nutrients to the yaks during scarcity particularly during winter for improving its productivity is important. Hence, the present study was undertaken to observe the quality of different tree leaves relished by yaks and their conservation as complete feed blocks for scarcity feeding, their effect on growth performance and blood biochemical profiles in growing yaks.

The samples of the tree leaves were oven dried/ processed, pooled and analyzed for proximate composition as per AOAC (1984). The cell wall constituents were estimated as per the method given by Van Soest (1967). The experiment was carried out at ICAR-NRC on Yak farm, situated at 7,500 ft. above msl using 20 male yak calves of uniform age (12–13 months) and body weight (130.7 kg). The animals were randomly divided into four groups, viz. G_1, G_2, G_3 and G_4 each having five calves. Group G_1 was fed CFBs comprising 50% concentrate and 50% paddy straws [as per NRC (1989) requirements of dairy cattle] and 50% paddy straw of this ration was replaced with maar, blemkar and salix tree leaves and was fed to groups G_2, G_3 and G_4, respectively. All the animals were allowed to feed individually for 120 days and at the last part of the feeding, a digestibility trial of 6 days was carried out. Standard managemental practices were applied for each animal and were treated for both ecto and endo parasitic infestation before the start of the experiment. The samples of feed, faeces and residue left were analyzed for proximate composition (AOAC 1990). The data were subjected to statistical analysis (2×2 factorial designs) as per the methods (CRD design) described by Snedecor and Cochran (1986).

Fourteen tree fodders relished by the yaks growing in various yak pockets of the West Kameng district of Arunachal Pradesh were collected and based on their availability pattern and biomass yields, nine tree leaves were selected for their proximate analysis and fibre fractionization. Phrengpa and Syluli were better for feeding growing animal because of their higher protein contents with comparatively low fibre levels (Table 1). Estimation of anti-nutritional factors like total phenolics, condensed tannin, total tannins, etc were completed (Table 2) and based on their availability, growth pattern, biomass yield, chemical

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Table 1. Per cent composition of tree fodders (on DM basis) commonly fed to yaks in West Kameng district of Arunachal Pradesh

Particular	Tree fodders								
	Blemkar (*Buddija asitica*)	Domkar (*Symplocus racemosa*)	Salix (*Salix humboltiana*)	Xyululi (*Acer campbellii*)	Maar (*Costanpsis* spp.)	Zimbu (*Lingustrum myrsinites*)	Marsing (*Acer hookeri*)	Bagar (*Berberis* spp.)	Phrengpa (*Quercus walliasehiana*)
Crude protein	13.67± 0.43	11.32± 0.24	13.97± 0.76	15.97± 0.36	12.54± 0.42	10.42± 0.40	6.73± 0.35	7.21± 0.30	20.12± 0.57
Ether extract	1.02± 0.11	2.26± 0.31	3.01± 0.11	1.72± 0.31	0.97± 0.13	1.51± 0.17	1.83± 0.11	2.73± 0.13	4.23± 0.28
Total ash	6.26± 0.21	7.82± 0.18	10.35± 0.45	5.36± 0.14	5.01± 0.18	5.62± 0.12	6.02± 0.23	5.78± 0.09	6.34± 0.18
T-CHO	78.8± 2.1	79.0± 1.5	72.3± 1.8	77.9± 1.9	82.5± 1.7	84.1± 1.9	85.5± 2.0	83.9± 1.7	70.7± 1.4
CF	22.54± 1.43	23.23± 1.05	21.65± 2.22	19.67± 1.35	22.32± 2.18	20.12± 1.23	21.45± 1.27	20.45± 1.41	18.98± 1.78
Organic matter	93.74± 2.23	92.18± 1.75	89.65± 1.54	94.64± 2.08	94.99± 1.89	94.38± 1.23	93.98± 3.12	94.22± 0.21	93.64± 1.37
NDF	58.9± 1.3	46.5± 1.1	56.6± 1.4	45.6± 0.9	65.6± 0.8	47.8± 1.1	36.4± 0.7	56.4± 0.9	75.5± 1.2
ADF	41.1± 0.9	38.4± 0.8	29.8± 0.5	28.5± 0.4	51.9± 0.9	36.6± 0.7	23.1± 1.0	50.0± 1.4	54.8± 1.7
Cellulose	16.9± 0.06	23.6± 0.2	13.0± 0.08	16.7± 0.09	21.0± 1.0	5.0± 0.02	11.4± 0.09	27.7± 1.1	22.3± 1.0

Table 2. Total phenolic, non-tannin phenolic, total tannin and condensed tannin content of different tree fodders of Arunachal Pradesh and their CFBs produced

Sample	Total phenolic (g %)	Non-tannin phenolics (g %)	Total tannin (g %)	Condensed tannins (mg/100 g)
Marsing (*Acer hookeri*)	2.52±0.18	1.23±0.18	1.86±0.94	8.07±0.23
Phrengma (*Quercus walliasehiana*)	6.24±0.12	2.32±0.13	4.15±0.23	9.23±0.51
Blemkar (*Buddlija asitica*)	5.12±0.04	2.22±0.32	2.92±0.23	2.49±0.20
Maar (*Costanpis* sp)	5.21±0.23	1.63±0.52	4.02±0.14	2.21±0.11
Khakusuma (*Araliaceae family*)	2.62±0.18	l. 12±0.25	1.46±0.21	1.02±0.23
Baggar (*Berberis* sp)	2.09±0.21	1.02±0.21	1.62±0.72	7.02±0.35
Zimbu (*Lingustrum myrsinites*)	4.98±0.42	2.05±0.02	3.63±0.42	3.05±0.23
Domkar (*Symplocus racemosa*)	1.84±0.20	0.85±0.11	1.35±0.05	3.01±0.18
Xyululi (*Acer campbelli*)	5.24±0.12	1.52±0.03	3.47±0.12	8.20±0.42
Matekpa (*Quercus fenestrate*)	5.11±0.07	1.48±0.19	3.63±0.12	28.02±0.51
Salix (*Salix humboldtana*)	4.62±0.05	1.23±0.28	3.02±0.32	22.02±0.56

composition, and the tannin content, Salix, Maar and Blemkar were selected for preparation of Complete Feed Block (CFB)s. Composition of different experimental rations and that of tree leaves based CFBs is presented in Table 3. It was observed that the proximate compositions of the CFBs varied according to the proximate composition of the tree leaves incorporated in the ration.

The feeding trial and digestibility studies revealed that, the average daily gain in body weight and feed efficiency of the animals ranged from 392.44±19.04 to 402.99±4.88 g and 6.84±0.21 to 7.18±0.38, respectively with highest gain and feed efficiency observed in group G_4 fed salix tree leaves based CFBs. The daily dry matter intake per unit body weight in yak calves were almost similar and the values are in the same range as reported by Liu *et al*. (1997) and Medhi *et al.* (2016). The dry matter intake varied from 1.38 to 2.34 kg/100 kg body weight in 2 to 3 year old castrated yaks under stall-fed condition when the animals are maintained on green forages, dry roughages, or on diets based on dry roughages and concentrates (Han *et al*. 1990a). The increased gain in body weight of the yaks might be due to increased protein content of the tree leaves incorporated in the diets. The possibility of utilizing tree leaves in complete feed blocks as roughage source in sheep ration with lowering of the feed cost was indicated by earlier workers (Afzal *et al*. 2009).

The dry matter as well as the organic matter digestibility was similar among all the four experimental groups except the crude protein and crude fibre digestibility which was significantly higher (P>0.01) in salix leaf based complete feed block fed group (G_4). The digestibility of dry matter and the organic nutrients was also similar irrespective of

Table 3. Composition of the experimental diets

Particular	Experimental diet				Concentrate mixture	Paddy straw
	G_1	G_2	G_3	G_4		
Physical composition (*parts per 100 kg*)						
Paddy straw	50	25	25	25		
Maar leaves	–	25	–	–		
Blemar leaves	–	–	25	–		
Salix leaves	–	–	–	25		
Maize crushed	20	20	20	20		
Wheat bran	06	06	06	06		
DOGNC	10	10	10	10		
DOMOC	08	08	08	08		
Molasses	03	03	03	03		
Mineral mixture	02	02	02	02		
Common salt	01	01	01	01		
Chemical composition (%)						
Dry matter	87.49	86.56	87.28	88.95	87.86	87.12
Organic matter	88.57	90.24	89.34	87.65	90.30	8.84
Crude protein	10.63	11.15	12.08	12.31	17.61	3.65
Crude fibre	19.56	17.45	17.18	17.01	7.12	32.00
Nitrogen free extracts	56.04	59.79	58.46	56.22	61.10	48.60
Ether extracts	2.34	1.85	1.62	2.11	4.38	1.00
Total ash	11.43	9.76	10.66	12.35	9.7	15.20
Cost per kg CFBs (₹)	24.69	22.31	22.31	22.31	42.00	17.25

different tree leaf based CFBs fed to the experimental animals. Mishra *et al*. (2013) recorded linear increase in the organic matter digestibility with no significant variation of the dry matter digestibility in sheep fed with complete feed blocks comprising 0 to 30% levels of fallen tree leaves. Their study also revealed no change in the average daily body weight gain and body condition score in sheep fed with complete feed blocks with incorporation of fallen tree leaves up to 20% levels without any adverse effect on general health status of the animals. In the present study, at the end of 120 days of feeding trial, the average daily gain (ADG) in body weight and feed conversion efficiency (FCE) of the yak calves were significantly better in group fed CFB with salix leaves followed by the group fed with CFB comprising of maar leaves. Comparatively lower digestibility and growth performance was indicated by Afzal *et al*. (2009) in sheep fed with complete feed blocks based on paddy straw than that of maize and oats straws which showed the similarity of the results as indicated herewith the lower values of paddy straw based complete feed blocks.

Different blood biochemical profiles (Table 5) also indicated no significant difference amongst different treatment groups. The study revealed that there is possibility of incorporation of tree leaves available in Arunachal Pradesh in diets of growing yaks without any adverse effect on their growth and health status.

SUMMARY

An experiment was carried out at ICAR-NRC on Yak farm using 20 male yak calves of uniform age (12–13 months) and body weight (130.7 kg). The animals were randomly divided into four groups, viz. G_1, G_2, G_3 and G_4 each having five calves. Group G_1 was fed CFBs comprising 50% concentrate and 50% paddy straws [as per NRC (1989) requirements of dairy cattle] and 50% paddy straw of this ration was replaced with maar, blemkar and salix tree leaves and was fed to groups G_2, G_3 and G_4, respectively. All the

Table 4. Performance of the experimental animals fed complete feed block based diets

Attribute	G_1 (Paddy straw based CFBs)	G_2 (CFB with maar leaves)	G_3 (CFB with blemkar leaves)	G_4 (CFB with salix leaves)
Growth performance				
Initial body weight (kg)	131.00±15.11	130.80±10.85	130.60±12.06	130.40±13.28
Final body weight (kg)	178.09±17.31	177.13±12.43	176.97±13.32	178.76±13.75
Experimental period	120 days			
Average daily gain	392.44^{b}±19.04	386.04^{b}±14.40	386.41^{b}±12.07	402.99^{a}±4.88
Dry matter intake				
kg /100 kg BW/day	1.90^{a}±0.22	1.79^{b}±0.14	1.83^{ab}±0.12	1.82^{ab}±0.12
g /kg $W^{0.75}$/day	66.97±5.13	63.05±3.88	65.17±2.81	64.91±2.47
kg/day	2.82^{a}±0.27	2.71^{b}±0.45	2.77^{ab}±0.23	2.76^{ab}±0.14
Feed efficiency				
Dry matter intake (kg/kg BW gain)	7.18^{a}±0.38	7.02^{b}±0.31	7.17^{a}±0.19	6.84^{b}±0.21
Digestibility co-efficient (%)				
Dry matter	58.41^{a}±1.25	59.22^{b}±1.42	59.24^{a}±2.01	60.12^{a}±1.22
Organic matter	61.42±0.24	60.42±0.23	58.96±0.18	62.34±0.41
Crude protein	62.17^{a}±0.30	58.98^{b}±0.23	60.77^{ab}±0.36	62.98^{a}±0.43
Ether extract	59.47±0.44	59.11±0.52	59.04±0.45	60.78±0.96
Crude fibre	61.24^{a}±0.35	59.04^{b}±0.34	60.54^{ab}±0.42	62.34^{a}±0.47
Nitrogen free extract	60.21±0.22	57.78±1.10	59.47±0.45	60.68±0.47

Means bearing same superscripts in the same row are non-significant.

Table 5. Mean±SE Blood biochemical constituents of the animals in different experimental groups

Attribute	G_1 (Paddy straw based CFBs)	G_2 (CFB with maar leaves)	G_3 (CFB with blemkar leaves)	G_4 (CFB with salix leaves)
Hb (g/dl)				
Initial^{NS}	11.72±0.12	11.62±0.24	11.74±0.42	12.03±0.23
Post feeding^{NS}	11.81±0.45	11.37±0.35	11.31±0.52	12.22±0.62
Blood glucose (g/dl)				
Initial^{NS}	61.42±1.41	63.24±1.15	60.45±2.11	63.23±1.33
Post feeding^{NS}	64.41±1.24	66.20±1.09	63.27±1.12	67.67±1.39
Total serum protein (g/dl)				
Initial^{NS}	7.41±0.16	7.15±0.16	7.28±0.16	7.36±0.24
Post feeding^{NS}	7.22±0.31	7.34±0.34	7.35±0.42	7.38±0.45
Blood urea nitrogen (g/dl)				
Initial^{NS}	20.48±0.21	20.15±0.22	20.95±0.35	20.95±0.39
Post feeding ^{NS}	22.04±0.11	21.27±0.24	22.67±0.12	23.56±0.45
Alkaline phosphatase (IU/L)				
Initial^{NS}	184.27±0.17	180.07±1.12	180.47±0.27	183.45±0.18
Post feeding^{NS}	186.29±1.47	183.41±1.32	183.57±1.46	187.27±1.42
SGOT (U/L)				
Initial^{NS}	34.19±0.62	34.28±0325	34.23±1.08	34.98±0.75
Post feeding^{NS}	36.23±1.25	38.42±1.02	38.38±1.45	39.20±1.07
SGPT (U/L)				
Initial^{NS}	23.42± 2.11	23.27± 1.07	24.24±1.23	25.45±1.08
Post feeding ^{NS}	27.17±0.48	25.12±0.24	27.72±0.43	28.67±0.52

NS, Non-significant.

animals were allowed to feed individually for 120 days and at the last part of the feeding, a digestibility trial of 6 days was carried out.Standard managemental practices were applied for each animal and were treated for both ecto and endo parasitic infestation before the start of the experiment. At the end of 120 days, the average DMI/100 kg body weight and per kg metabolic body weights ($W^{0.75}$) ranged from 1.90±0.22 to 1.79±0.14 kg, and 63.05±3.88 to 66.97±5.13 g indicating comparatively higher dry matter intake in G_1 group; however, the values were statistically non-significant amongst the groups. Further, average daily gain in body weight and feed efficiency of the animals ranged from 392.44±19.04 to 402.99±4.88 g and 6.84±0.21 to 7.18±0.38, respectively with highest gain and feed efficiency observed in Group G_4.

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