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Effect of sheanut cake based complete diets on environmental effect on growing graded murrah buffaloe calves

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Abstract
Three experimental diets, RI conventional ration (RI) (consisting of chopped jowar straw, jowar green fodder and concentrate mixture fed separately) compared with two complete diets (roughage, concentrate ratio, 40:60) in mash form (RII and RIII) were formulated using palm press fibre (20% & 15%) and chopped jowar straw (20% & 25%) as roughage source and sheanut cake (18.5% & 28%) along with locally available concentrate ingredients to study their effect on environmental fluctuations in relative humidity (R.H) and ambient temperature on rectal temperature, pulse rate, respiration rate and daily feed intake of a total of Eighteen growing graded Murrah buffaloe calves fed with conventional (RI) and complete feed (RII, RIII) were studied for 180 days. The data on environmental effect indicated that non-significant differences in rectal temperature, pulse rate, respiration rate and daily feed and DM intake in growing buffalo calves fed experimental diets RI, RII and RIII reflecting lower THI values due to low variation in micro-environmental conditions during experimental period.

Keywords: Sheanut cake, palm press fibre, buffaloes, complete diets

Introduction
The India being a developing country has potential to utilize agro-industrial by-products and crop residues to reduce the gap between availability and requirement of livestock's' feed stuffs. According to the reports of ICAR (2013) [4] at present the country is in the net deficit of 28% green fodder, 23.5% dry crop residues and 65% compounded feeds. Such deficit can be minimized by using crop residues and agro-industrial by-products in preparation of complete diets of livestock (Nagalakshmi *et al.*, 2010) [9]. The Sheanut cake (SNC) and palm press fibre (PPF), the by-products of shea fat industry and palm oil industry could be utilized as concentrate ingredients as protein and roughage source, respectively. Shea nut cake a solid residue of sheanuts, could be a potential ingredient available in West Africa (Dei *et al.*, 2007) [2]. The production of sheanut cake is approximately 18,000 tons per year from M/S Foods, Fats and Fertilizers Pvt. Ltd. Located in West Godavari District A.P. It is the only industry that is importing Sheanut cake in Andhra Pradesh. The present study made an attempt to utilize palm press fibre and sheanut cake at different levels along with other locally available concentrate ingredients in complete diets for growing buffaloe calves to assess the effect of these complete diets on environmental effect fluctuations in relative humidity (R.H) and ambient temperature on rectal temperature, pulse rate, respiration rate and daily feed intake of growing buffaloe calves.

Material and Methods
Two complete diets (roughage concentration ratio, 40:60) were formulated with Sheanut cake as concentrate ingredient and palm press fibre as roughage component being incorporated at 18.5% and 20.0% (RII) and 28.0% and 15.0% (R III) level. The other roughage used was chopped jowar straw. The complete diets (R II and RIII) were compared with conventional ration (RI) consisting of chopped jowar straw, Jowar green and concentrate mixture. The ingredient composition of concentrate mixture and complete diets has been shown in Table 1.

Table 1: Ingredients composition of experimental diets

Ingredient	Concentrate mixture	Complete diets	
Chopped jowar straw (kutti)	RI -	RII 20.00	RIII 25.00
Palm press fibre	-	20.00	15.00
Maize	30.0	10.00	10.00
Deoiled rice bran	17.0	10.50	4.00
Wheat bran	20.0	9.00	5.00
Groundnut cake	15.0	9.00	10.00
Cottonseed cake	15.0	-	-
Sheanut cake	-	18.50	28.00
Salt	1.00	1.00	1.00
Mineral mixture	2.00	2.00	2.00
Vitamin AD_3 (g/q)	20.0	10.0	10.0

Eighteen growing graded Murrah buffaloe calves were distributed randomly into three experimental groups of six animals each in a complete randomized design. The animals were housed in a well ventilated conventional stall barn maintained in hygienic conditions and stall fed with the respective diets throughout 180 days of experimental period. The experiment conducted to assess the effect of these complete diets on environmental effect fluctuations in relative humidity (R.H) and ambient temperature on rectal temperature, pulse rate, respiration rate and daily feed intake of growing graded Murrah buffaloe calves. The complete diets were offered twice daily *ad libitum*, while in conventional group, the roughages and concentrates were offered separately to meet the maintenance requirements of growing buffaloe calves (ICAR, 1998) [3].

Daily data on minimum and maximum temperature, relative humidity (RH) and rain fall for the study period was collected from Meteorological Department, Agriculture Research Institute (ARI), Rajendranagar and used to study the environmental effect on daily feed intake, pulse rate, respiration rate per minute and body temperature of animals.

Thermal humidity index (THI) was calculated using the following formula as per Somparn *et al*. (2004) [14].

THI = Tdbf - (0.55 - (0.55 x (RH / 100))) x (Tdbf - 58)

Where,
Tdbf = Ambient Temperature (oF),
RH = Relative Humidity (%)

Pulse rate, respiration rate and rectal temperature of all the calves were noted every day in the morning when the animals were in a state of rest and free from excitement. Number of pulsations of coccygeal artery per minute was taken as pulse rate. Respiration rate was noted visually by observing the inhalation and exhalations per minute by placing reverse of the palm at the nostrils. Rectal temperature was recorded with digital clinical thermometer, as it is a fair index of animal's body temperature (Jagadish Prasad, 1989) [5].

Statistical analysis of the data was carried out according to the procedures suggested by Snedecor and Cochran (1989) [13] and the means were compared by Least Significant Difference (LSD) test.

Results and Discussion

The chemical composition of complete diets, concentrate mixture, Sheanut cake and Palm press fibre on DM basis is given in Table 2. Average CP and CF of complete diets was 12.2% and 24% respectively.

Table 2: Chemical composition of experimental rations (% DM) fed to buffaloe calves

Nutrient	Complete diet		Ration I (Control)			Sheanut cake	Palm press fiber
	Ration II (Mash I)	Ration III (Mash II)	Concentrate mixture	Chopped jowar straw	Jowar green fodder		
Proximate principle							
Dry matter	89.27	89.44	93.69	91.88	24.92	93.26	89.22
Organic matter	92.78	93.48	91.32	88.24	91.74	92.19	90.76
Crude protein	12.12	12.30	17.94	3.46	7.18	13.21	8.28
Crude fibre	23.84	24.22	9.56	30.12	28.02	9.82	38.74
Ether extract	1.50	1.79	5.34	1.11	1.24	2.12	9.16
NFE	55.32	55.17	58.48	53.55	55.30	67.04	34.58
Total ash	7.22	6.52	8.68	11.76	8.26	7.81	9.24
Cell wall constituent							
NDF	59.92	56.20	33.26	70.20	66.48	60.27	72.14
ADF	46.62	46.92	17.22	50.70	46.31	41.13	53.12
Hemi cellulose	13.30	9.28	16.04	19.50	20.17	19.14	19.02
Cellulose	18.41	15.93	13.28	42.12	33.52	7.22	33.28
Mineral							
Ca	0.96	1.12	1.08	0.64	0.74	1.16	0.62
P	0.68	0.72	0.82	0.38	0.18	0.22	0.21

The average Thermal humidity index (THI) was 35.03 in buffalo calves (Table 3)

Table 3: Temperature relative humidity & THI Index values at different weeks during experimental period in graded Murrah buffalo calves

Experimental period (Week)	Temperature (^{0}C)	RH (%)	THI
1	26.86	86.71	29.14
2	28.87	87.00	30.95
3	27.99	84.57	30.54
4	27.93	88.57	29.82
5	31.31	85.57	33.43
6	30.14	84.14	32.57
7	32.00	84.14	34.27
8	31.57	84.14	33.88
9	30.36	83.14	32.92
10	31.43	77.29	34.75
11	33.86	68.86	37.99
12	34.80	80.29	37.31
13	35.09	62.14	39.86
14	37.93	66.71	41.6
15	37.64	72.43	40.73
16	38.71	75.00	41.36
17	36.71	71.14	40.09
18	35.64	73.57	38.89
19	39.59	63.52	33.15
20	39.16	69.29	35.98
21	40.51	43.86	35.11
22	40.06	46.71	34.80
23	38.21	75.86	33.21
24	37.21	71.29	33.93
25	34.50	82.43	32.23
26	34.60	82.43	32.34
Mean	34.33	75.03	35.03
SE ±	0.81	2.28	0.71

* Values are mean of 26 weeks average value

Rectal temperature of growing buffalo calves fed with the rations I, II and III were 100.28±0.02, 100.48±0.15 and 100.27±0.02 ^{0}F, respectively (Table 4). However, the differences in these values between experimental groups were insignificant.

Table 4: The mean rectal temperature, pulse and respiration rate of graded Murrah buffaloe calves fed experimental diets

	Animal No.	Temperature (^{0}F)	Pulse rate/Min	Respiration rate/Min
I (Conventional ration)				
Control	1114	100.19	45.73	14.40
Control	519	100.3	45.82	14.47
Control	1113	100.26	45.86	14.32
Control	1121	100.28	45.79	14.41
Control	521	100.36	45.86	14.25
control	515	100.27	45.84	14.44
Mean		100.28	45.82^a	14.38
±SE		0.02	0.02	0.03
II (Complete diet-mash I)				
Mash	1111	100.30	45.77	14.56
Mash	509	100.30	45.92	14.49
Mash	1119	100.32	45.89	14.37
Mash	1120	101.22	45.85	14.42
Mash	518	100.41	45.86	14.26
Mash	510	100.35	45.74	14.27
Mean		100.48	45.84^a	14.40
±SE		0.15	0.03	0.05
III (Complete diet-mash II)				
Mash	516	100.31	46.12	14.51
Mash	1117	100.30	45.96	14.39
Mash	1112	100.23	45.92	14.31
Mash	1118	100.20	45.87	14.27
Mash	514	100.32	46.05	14.32
Mash	513	100.28	45.77	14.30
Mean		100.27	45.95^b	14.35
±SE		0.02	0.05	0.04

Means with different superscripts in a row and column differ significantly (p<0.05)

The correlations between ambient temperature and rectal temperature were (r = 0.12, 0.20) non significant and positive with ration I and II and significant (p<0.05) with ration III (r = 0.32) in growing buffalo calves. The correlation between R.H and rectal temperature (r =0.09 and -0.17) were non significant in buffalo calves fed with ration II and III and negatively non significant with ration I (r = -0.07) (Table 5)

Table 5: Correlations between environment (ambient temperature and relative humidity) and rectal temperature, pulse rate, respiration rate, daily feed intake and DMI in graded Murrah buffalo calves

Ration	Ambient temperature (ºC)	Relative humidity (%)
	Rectal/body temperature	
Conventional ration (R I)	0.12	-0.07
Complete diet- Mash I (RII)	0.20	0.09
Complete diet- Mash II (R III)	0.32	-0.17
Pulse rate		
Conventional ration (R I)	0.27	-0.27
Complete diet- Mash I (RII)	0.39	-0.26
Complete diet- Mash II (R III)	0.43*	-0.27
Respiration rate		
Conventional ration (R I)	0.43*	-0.31
Complete diet- Mash I (RII)	0.34	-0.31
Complete diet- Mash II (R III)	0.45*	-0.22
Daily feed intake		
Conventional ration (R I)	0.85**	- 0.63**
Complete diet- Mash I (RII)	0.86**	- 0.61**
Complete diet- Mash II (R III)	0.85**	- 0.59*
DMI		
Conventional ration (R I)	0.85**	-0.62**
Complete diet- Mash I (RII)	0.87**	-0.61**
Complete diet- Mash II (R III)	0.85**	-0.59*

** Significant (p<0.01) * Significant (p<0.05)

The mean values of pulse rate were 45.82±0.02, 45.84±0.03 and 45.95±0.05 respectively for the growing buffalo calves fed with rations I, II and III (Table 4). Statistical analysis revealed significant difference (p<0.05) between conventional ration (R I) and complete diets (R II and R III) fed groups.

The correlations were positive and non significant between ambient temperature and pulse rate (r = 0.27) for the growing buffalo calves fed with ration I where as it was significant (p<0.05) with ration II and III (r = 0.39 and 0.43). The correlations were negative and insignificant between R.H and pulse rate (r = -0.27) in growing buffalo calves fed with ration I, where as it was positive with ration II and III (r = -0.26 and -0.27) (Table 5).

Respiration rate (per minute) of growing buffalo calves fed with the rations I, II and III were 14.38±0.03, 14.40±0.05, and 14.35±0.04, respectively (Table 4). However, the differences in these values between experimental groups were insignificant.

The correlations were positive and significant (p<0.05) between ambient temperature and respiration rate (r = 0.43, 0.34 and 0.45) for the growing buffalo calves fed with rations I, II and III. A non significant negative correlation was observed between R.H and respiration rate r = -0.31 in buffalo calves fed with ration I where as it was positive with rations II and III (r =-0.31 and -0.22) (Table 5).

Correlations between ambient temperature and daily feed intake were (r =85, 0.86 and 0.85) positive and significant (p<0.01), where as negative and non significant between R.H. and daily feed intake (r = -0.63, -0.61 and -0.59) respectively for the growing buffalo calves fed with diet I, II and III (Table 5).

Effect of ambient temperature and relative humidity (R.H.) on rectal temperature, pulse rate, respiration rate and daily feed and DM intake of animals was studied during the experimental period and computed thermal humidity index (THI) to know the environmental stress on animals.

A non-significant difference was observed in the rectal temperature values among the experimental groups fed R I, R II and R III rations to buffalo calves (Table 4). This could be due to lower mean thermal humidity index (THI) values (35.03 ± 0.71) during experiment on buffalo calves recorded during the experiments indicating no stress on experimental animals due to environmental fluctuations (Table 3). Somparn *et al*. (2004) [14] observed stress on cattle and buffaloes due to environmental fluctuations with a THI value of ≥84. The correlation between ambient temperature and rectal temperature were non significant and positive with ration I and II where as it was significant (p<0.05) with ration III. The correlation between R.H and rectal temperature in respect of buffalo calves fed with ration II and III was positive where as it was negative with ration I (Table 4). Chaudhry *et al*. (1988) [1] and Sanjay and Sahota (2003) [12] reported significant correlation between ambient temperature and rectal temperature, which is in agreement with the data of the present study. Nagpal *et al.* (2005) [10] reported increase in skin and rectal temperature in buffaloes as the intensity of solar radiation increases.

Significant (p<0.05) difference in the pulse rate per minute was observed in buffalo calves (Table 4) between conventional ration (RI) and complete diets (R II and R III). Even though significant (p<0.05) the difference in pulse rate per minute between three treatment groups (45.82, 45.84 and 45.95) respectively was negligible (Table 4). Somparn *et al*. (2004) [14] who reported stress on cattle and buffaloes with a THI value of ≥84. In buffalo calves a positive and significant (p<0.05) correlation between ambient temperature and pulse rate was observed in calves fed RII and RIII. A negative and non significant correlation was observed between RH and pulse rate (Table 4) with ration I where as it was positive with ration II and III. Koubkova *et al.* (2002) [7] studied the influence of higher environmental temperature and reported that cooling by sprinklers improved pulse rate in high yielding dairy cows. However, a highly significant correlation between ambient temperature and pulse rate was recorded by Sanjay and Sahota (2003) [12] in dairy animals.

A non-significant difference in the respiration rate per minute was observed in buffalo calves (Table 4) fed experimental rations R I, R II and R III. It could be due to lower THI values recorded (Table 3) during the respective experiments indicating no environmental stress on animals. Somparn *et al*. (2004) [14] observed stress on cattle and buffaloes due to environmental fluctuations with a THI value of ≥84. The correlation was positive and significant (p<0.05) between ambient temperature and respiration rate for the growing buffalo calves fed with ration I,II and III. A negative non significant correlation was observed between RH and respiration rate in calves fed with ration I where as it was positive with ration II and III.

Kanda *et al.* (1985) [6] and Vazhapilly *et al.* (1990) [16] found that high temperature/heat stress caused increase in respiration rate in cows. A highly significant (p<0.01) correlation between ambient temperature and pulse rate was reported by Sanjay and Sahota (2003) [12].

Correlations between ambient temperature and daily feed intake and DMI were positive and highly significant (p<0.01) where as it was negatively non significant between RH and daily feed intake in buffalo calves fed with rations I, II and III. These results were in agreement with NRC (1981) [11]. Strickland *et al.* (1989) [15] recorded an increase in feed consumption when cows were cooled in the barn (p<0.01) or holding area (p<0.05). Further, Lee *et al.* (1999) [8] reported that daily feed intake increased by 2.79 kg in cooled cows compared to control. Nagpal *et al.* (2005) [10] concluded that microclimate of the house has significant (p<0.01) effect on the DMI in dairy animals.

The data on environmental effect indicated that non-significant differences in rectal temperature, pulse rate, respiration rate and daily feed/DM intake in growing buffalo calves fed experimental rations R I, R II and R III reflecting lower THI values due to low variation in micro-environmental conditions during the respective experimental periods

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