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# Study of palm press fibre and sheanut cake based complete diets on environmental effect on lactating Murrah buffaloes

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**Abstract**
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 and compared with conventional ration (RI) (consisting of chopped jowar straw, chopped jowar fodder and concentrate mixture, fed separately) to study their effect of the fluctuations in relative humidity (R.H) and ambient temperature on rectal temperature, pulse rate, respiration rate and daily feed intake of a total of twelve lactating graded Murrah buffaloes fed with conventional (RI) and complete feed (RII,RIII) were studied for 120 days. Thermal humidity Index (THI) was 35.56 observed during experimental period. A positive and significant correlation between ambient temperature and rectal temperature (r=0.60, 0. 61 and 0.49) was observed in rations I and II ($p$<0.01) and III ($p$<0.05). A significant negative correlation between R.H and rectal temperature (r=-0.45 and -0.51) was observed in rations RI and RII ($p$<0.05). A significant ($p$<0.01) positive correlation between ambient temperature and pulse rate (r=0.63,0.69 and 0.73) was observed in rations I,II and III respectively and significant ($p$<0.05)negative correlation was observed between R.H. and pulse rate (r=-0.40 and -0.43) in rations II and III.A significant ($p$<0.01) positive correlation between ambient temperature and respiration rate (r= 0.72 and 0.74) was observed in ration I and II, whereas negative correlation was observed in ration III (r= -0.09). A significant ($p$<0.05) negative correlation was observed between R.H and respiration rate (r=-0.50, and -0.51) in ration I and II and positive correlation in ration III ($p$<0.01). A significant ($p$<0.01) and positive correlation between ambient temperature and daily feed intake and DMI (r=0.41, 0.67 and0.65) and a significant ($p$<0.05) negative correlation between R.H and daily feed intake (r=0.35, 0.69 and-0.56) were observed respectively in rations I, II and III. The data on environmental effect indicated that non-significant differences in rectal temperature, pulse rate, respiration rate and daily feed and DM intake in lactating buffaloes fed rations RI, RII and RIII reflecting lower THI values due to low variation in micro-environmental conditions during the respective experimental periods.

**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*., 2004) [9]. The Sheanut cake (SNC) and palm press fibre (PPF), the by-products of sheanut 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). 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 lactating Murrah buffaloes 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 lactating buffaloes.

## 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 |

Twelve lactating graded Murrah buffaloes were distributed randomly into three experimental groups of four 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 120 days of experimental period. A 7 day digestion trial was conducted at the end of the experiment 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 lactating buffaloes. The complete diets were offered twice daily *ad libitum*, while in conventional group, the roughages and concentrates were offered separately to meet the maintenance and production requirements of lactating buffaloes (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, milk yield and body temperature of animals.

Thermal humidity index (THI) was calculated using the following formula as per Somparn *et al*. (2004) [13].

$$THI = Tdbf - (0.55 - (0.55 \times (RH / 100))) \times (Tdbf - 58)$$

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

Pulse rate, respiration rate and rectal temperature of all the lactating buffaloes 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) [12] 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 lactating buffaloes

| 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 35.56 in lactating buffaloes (Table 3).

**Table 3:** Temperature relative humidity & THI Index values at different weeks during experimental period in lactating graded Murrah buffaloes

| Experimental period (Week) | Temperature (°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 | 41.60 |
| 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 |
| Mean | 32.71 | 78.63 | 35.56 |
| SE± | 0.88 | 1.88 | 0.99 |

* Values are mean of 18 weeks average value

The mean values of rectal temperature were 100.05±0.05, 100.10±0.05 and 100.08±0.04 ºC for lactating buffaloes fed with rations I, II and III, respectively (Table 4). Statistical analysis revealed no significant difference in rectal temperature among three treatment groups

**Table 4:** The mean rectal temperature, pulse and respiration rate of lactating graded Murrah buffaloes fed experimental diets.

| | Animal No. | Temperature (°F) | pulse rate/Min. | Respiration rate/Min. |
|---|---|---|---|---|
| **I (Conventional ration)** | | | | |
| Control | 457 | 100.10 | 44.74 | 13.99 |
| Control | 430 | 100.10 | 44.55 | 13.77 |
| Control | 408 | 99.90 | 44.57 | 13.85 |
| Control | 409 | 100.10 | 44.54 | 13.93 |
| Mean | | 100.05 | 44.60 | 13.89 |
| ±SE | | 0.05 | 0.05 | 0.05 |
| **II (Complete diet-mash I)** | | | | |
| Mash | 357 | 100.26 | 44.71 | 14.00 |
| Mash | 458 | 100.04 | 44.56 | 13.95 |
| Mash | 473 | 100.04 | 44.55 | 13.74 |
| Mash | 432 | 100.06 | 44.76 | 13.89 |
| Mean | | 100.10 | 44.65 | 13.90 |
| ±SE | | 0.05 | 0.05 | 0.06 |
| **III (Complete diet-mash II)** | | | | |
| Mash | 381 | 100.04 | 44.61 | 13.95 |
| Mash | 464 | 100.20 | 44.70 | 13.93 |
| Mash | 462 | 99.99 | 44.44 | 13.93 |
| Mash | 397 | 100.08 | 44.60 | 13.89 |
| Mean | | 100.08 | 44.59 | 13.93 |
| ±SE | | 0.04 | 0.05 | 0.01 |

A significant positive correlation between ambient temperature and rectal temperature (r = 0.60, 0.61 and 0.49) was observed in lactating buffaloes fed with rations I and II ($p$<0.01) and III ($p$<0.05). A non-significant negative correlation between R.H. and rectal temperature (r = -0.45 and -0.51) was observed in lactating buffaloes fed with rations R I and RII ($p$<0.05) (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 lactating graded Murrah buffaloes

| Ration | Ambient temperature (ºC) | Relative humidity (%) |
|---|---|---|
| **Rectal/body temperature** | | |
| Conventional ration (R I) | 0.60** | -0.45* |
| Complete diet- Mash-I(R II) | 0.61** | -0.51* |
| Complete diet- Mash –II (R III) | 0.49* | -0.34 |
| **Pulse Rate** | | |
| Conventional ration (R I) | 0.63** | -0.33 |
| Complete diet- Mash-I(R II) | 0.69** | -0.40* |
| Complete diet- Mash –II (R III) | 0.73** | -0.43* |
| **Respiration Rate** | | |
| Conventional ration (R I) | 0.72** | -0.50* |
| Complete diet- Mash-I(R II) | 0.74** | -0.51* |
| Complete diet- Mash –II (R III) | -0.09 | 0.63** |
| **Daily feed intake** | | |
| Conventional ration (R I) | 0.41* | -0.35* |
| Complete diet- Mash-I(R II) | 0.67** | -0.69* |
| Complete diet- Mash –II (R III) | 0.65** | -0.56* |
| **DMI** | | |
| Conventional ration (R I) | 0.41* | -0.35 |
| Complete diet- Mash-I(R II) | 0.71** | -0.69** |
| Complete diet- Mash –II (R III) | 0.64** | -0.55* |

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

Pulse rate (per minute) of lactating buffaloes fed with rations I, II and III were 44.60±0.05, 44.65±0.05 and 44.59±0.05, respectively (Table 4). However, the differences in these values between experimental groups were insignificant.

A significant ($p$<0.01) positive correlation between ambient temperature and pulse rate (r = 0.63, 0.69 and 0.73) was observed in lactating buffaloes fed with rations I, II and III respectively and significant ($p$<0.05) negative correlation was observed between R.H. and pulse rate (r = -0.40 and -0.43) in rations II and III. (Table 5).

The mean values of respiration rate (per minute) were 13.89±0.05, 13.90±0.06 and 13.93±0.01, respectively for lactating buffaloes fed with rations I, II and III (Table 4). Statistical analysis revealed no significant difference among the experimental groups.

A significant ($p$<0.01) positive correlation between ambient temperature and respiration rate (r = 0.72 and 0.74) was observed in lactating buffaloes fed with ration I and II whereas negative correlation was observed in ration III (r = -0.09). A significant ($p$<0.05) negative correlation was observed between R.H. and respiration rate (r = -0.50 and -0.51) in lactating buffaloes fed ration I and II and positive correlation in ration III ($p$<0.01) (Table 5).

A highly significant ($p$<0.01) positive correlation between ambient temperature and daily feed intake and DMI (r = 0.41

and 0.67 and 0.65) and a significant ($p$<0.05) negative correlation between R.H and daily feed intake (r = 0.35, 0.69 and -0.56) were observed in buffaloes fed with rations I, II and III.

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 lactating buffaloes (Table 4). This could be due to lower mean thermal humidity index (THI) values (35.56 ± 0.99) during experiment on lactating buffaloes recorded during the respective experiments indicating no stress on experimental animals due to environmental fluctuations (Table 3). Somparn *et al*. (2004) [13] observed stress on cattle and buffaloes due to environmental fluctuations with a THI value of ≥84. Significant ($p$<0.01/$p$<0.05) positive correlation (Table 4) between ambient temperature and rectal temperature and non-significant negative correlation between R.H. and rectal temperature were recorded for lactating buffaloes fed with ration I, II and III. 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. 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.

There was a non-significant difference in the pulse rate per minute among the lactating buffaloes (Table 4) fed experimental rations R I, R II and R III. Lower thermal humidity index recorded during the respective experimental periods could be the reason for non-significant differences in lactating buffaloes. The results were in agreement with Somparn *et al*. (2004) [13] who reported stress on cattle and buffaloes with a THI value of ≥84. In the present study a significant ($p$<0.01) positive correlation between ambient temperature and pulse rate was observed in lactating buffaloes fed with ration I, II and III respectively and a significant negative ($p$<0.05) correlation was observed between R.H. and pulse rate in buffaloes fed with ration III where as it was negatively non-significant with ration I and II (Table 5). 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 lactating buffaloes (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) [13] observed stress on cattle and buffaloes due to environmental fluctuations with a THI value of ≥84. A significant ($p$<0.01) positive correlation was observed between ambient temperature and respiration rate in lactating buffaloes fed with ration I and II and negative correlation with ration III (Table 5). Further significant ($p$<0.05) negative correlation was observed between R.H. and respiration rate in buffaloes fed with ration I and II and significant ($p$<0.05) positive correlation with ration III (Table 5)

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) in buffaloes fed with R II and R III. The correlation between R.H. and daily feed intake and DMI it was negative highly significant ($p$<0.01) with R II and RIII whereas with ration I also negatively significant ($p$<0.05) (Table 5) indicating lower feed intake/DMI with the rise of ambient temperature. Correlations between ambient temperature and daily feed intake and DMI were positive and highly significant ($p$<0.01). 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 lactating buffaloes 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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