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Effect of housing systems and levels of feeding on feed conversion efficiency in murrah buffalo calves in hot-humid weather

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Abstract
A study was conducted on 24 Murrah buffalo calves of either sex between 6 to 9 months of age at animal Farm, LUVAS, Hisar during the summer season from July 15, 2015 to October 15, 2015 (90Days). Experimental calves were divided into four treatments having six animals in each treatment viz. Loose housing system + 100% feeding level (T1), Loose housing system + 120% feeding level (T2), Conventional barn housing system + 100% feeding level (T3) and Conventional barn housing system + 120% feeding level (T4). There was significantly higher (p<0.05) temprature and temprature humidity index in conventional house than loose house. The analysis of variance revealed that there were significant (P<0.05) difference in dry matter intake per kg body weight gain between loose house and conventional barn housing system. It is higher in conventional barn housing system that mean animals in conventional barn required more dry matter to gain 1 kg body weight as compared to loose house. Corresponding to that same as dry matter (DM), crude protein (CP) and total digestible nutrient (TDN) requirement per kg body weight gain is also higher in conventional barn housing system. There were no significant effect of feeding level on feed conversion efficiency. Higher feed conversion efficiency in loose house may be due to a comfortable environment to the animals in reference with the low temperature and low temperature humidity index in a loose house as compared to conventional barn housing system.

Keywords: Murrah buffalo calves, feed conversion efficiency, temperature humidity index, loose housing system, conventional barn housing system and feeding level

Introduction
Buffaloes have immense agricultural importance by virtue of their high production potential through meat and milk for mankind besides being a source of sustenance to the poor and marginal farmers as well as landless labourers in the developing world. Buffalo is a triple purpose animal, being suitable for milk, meat and draught. Buffalo can efficiently utilize the roughages and crop by-products into high quality milk suitable for a wide range of dairy products. Buffaloes are better converter of poor quality fibrous feeds into milk and meat. Terramoccia *et al.* (2000) reported better degradation of both crude protein (CP) and protein free dry matter (DM) in buffaloes than in cattle [1]. Other workers have also demonstrated a better digestive ability of buffaloes than cattle to utilize poor quality roughage (Agarwal *et al*., 2009) [2]. The heat stress affect the physiological systems governing thermal regulation and the maintenance energy of buffalo during extreme summer. In tropical and subtropical areas, high ambient temperature is the major constraint on animal and the effect of heat stress is aggravated when heat stress is accompanied with high humidity (Marai *et al.*, 2008) [3]. Exposure of buffaloes to the hot conditions evokes a series of drastic changes in the biological functions that include depression in feed intake, efficiency and utilization, disturbances in metabolism of water, protein, energy and mineral balances, enzymatic reactions, hormonal secretions and blood metabolites. Such changes result in impairment of reproduction and productive performances. In India, not much of attention has been paid so far on this aspect. So, the present work was under taken to study the effect of housing systems and levels of feeding on feed conversion efficiency in murrah buffalo calves in hot-humid weather.

Materials & Methods
The experiment was conducted from 15th July 2015 to 15th October, 2015 at the Buffalo farm of the Livestock Production Management Department, College of Veterinary Sciences, Lala

Lajpat Rai University of Veterinary and Animal Sciences, Hisar. Hisar city is situated in semi-arid region and climatic condition is sub-tropical in nature. Geographically, Hisar is situated at 29° 10' N latitude, 75° 40' E longitude and 215.2 meters altitude.

Animals and Experimental Design

Twenty four Murrah buffalo calves of either sex between 6 to 9 months of age were selected from the Old Buffalo Farm, Livestock Production Management Department, LUVAS, Hisar. These calves were divided into four groups of six calves each on the basis of nearness of their weight. Prior to start of experiment an adjustment period of 10 days will be given to all the calves. The experiment groups were randomly allocated to one of the four treatments viz. Loose housing system + 100% feeding level (T1), Loose housing system + 120% feeding level (T2), Conventional barn housing system + 100% feeding level (T3) and Conventional barn housing system + 120% feeding level (T4). Feeding level were according to the ICAR recommendation.

Feeding and Watering

All the experimental calves were fed jowar during the experimental period. Wheat straw ad libitum and a concentrate mixture containing Barley, Ground Nut cake (GNC), Deoiled Rice Polish (DORP), Mineral mixture (MM) and Salt was prepared. The allowance of concentrate mixture was fixed in such a way that calves of T_2 and T_4 got 20 per cent higher and calves of T_1 and T_3 at the normal ICAR recommendation level of concentrate per head per day. A weighted amount of Jowar was fed to all calves daily according to the dry matter requirement of calves other than the dry matter present in the concentrate mixture. The Quantity of different feeds fed to each calf was adjusted at fortnightly intervals in order to meet the requirement of the calves with the change in their body weight. Animals were given ad lib fresh water throughout the experimental period. Before formulation of rations, the feed ingredients were analyzed (AOAC, 2005) for proximate composition (Table 1) [4]. Based upon the proximate composition of feed ingredients, the ration for the different experimental groups of animals was formulated. The composition of the experimental diet of different treatment groups and proximate chemical composition is presented in Table 2.

Observations

Chemical Analysis Of Feed Ingredients For Proximate Principles

Analysis of chemical constituents of feed ingreedients was done in the laboratory. All parameters like Total moisture, Crude proteins, Crude fibers, Total Ash and Ether extract were analyzed accurately by laboratory methods.

Feed Intake

Amount of feed and water intake was measured in 3 consecutive days in a fortnight. In every fortnight to determine feed intake the buffalo calves were given weighted quantity of feed and fodder as per their requirements. The feed intake during the experimental period was determined on the basis of feed and fodder offered and left over for three consecutive days in a fortnight.

Body Weight

The calves were weighted in Kilograms (kg) at the beginning of the experiment and thereafter at fortnightly intervals till the end of the experiment. The weights were recorded in the morning before providing feed and water. These weight were used for computation of ration as well as to study the body weight changes of buffalo calves.

Calculation of body weight gain

$$\text{Average daily weight gain} = \frac{\text{Final weight} - \text{Initial body weight}}{\text{Time interval}}$$

Weight gain (Table 3.) = Final weight – Initial body weight

Digestion Trial

A digestion trial of the 5 days collection period was conducted at the end of the experiment to know the effect of treatment on digestibility of feed and fodder. During the collection period of the trial, all the dung voided by the individual calf was collected manually in separate labelled plastic buckets provided with lids. The dried dung of the individual calf was pooled for 5 days, milled and stored in a plastic bag for proximate analysis except for crude protein, which was analyzed by wet dung sample preserved in 40 per cent sulphuric acid in plastic bottles. Representative sample of concentrate mixture, Jowar, Wheat straw and left over feed were also taken daily during the trial and dried in hot air oven for determining dry matter content. The five days dried samples for feed and fodder were pooled, milled and stored for proximate analysis. The feed, fodder and dung samples were analyzed for proximate analysis according to AOAC (2005).

Feed Conversion Ratio

Dry matter intake per kilogram body weight gain is calculated.

Microclimates

Changes during the period in the microclimatic variables like temprature and Temperature Humidity Index were noted. The mean values of monthly recorded maximum and minimum temperature (^{0}C), maximum and minimum relative humidity (%) and their corresponding THI values pertaining to micro climatic conditions has been tabulated in Table 4.and Table 5.

Statistical Analysis

The experiment data was planned and analyzed as per Snedecor and Cochran, 1999 [5].

Results and Discussion

Feed conversion efficiency

The efficiency of an animal species can be expressed in several ways, the foremost being the biological efficiency, which is a measure of the ability of the species to reproduce and survive in a given environment. It became important that the animal be economically efficient, so it has also been physiologically efficient. Physiologically efficiency in the simplest way, can be measured as feed efficiency. Feed efficiency is determined by finding out the unit of feed required to produce a unit of animal product. The mean value of nutrient intake per kg body weight gain of buffalo calves under different treatments have been presented in Table 6 and effect of housing system and level of feeding on average daily nutrient intake per kg body weight gain by buffalo calves have been presented in Table 7.

The analysis of variance revealed that there were significant (P<0.05) difference in dry matter intake per kg body weight gain between loose house and conventional barn housing system. It is higher in conventional barn housing system that mean animals in conventional barn required more dry matter to gain 1 kg body weight as compared to loose house. So a loose house is more efficient than conventional house in hot-humid weather. Corresponding to that same as dry matter (DM), crude protein (CP) requirement per kg body weight gain is also higher in conventional barn housing system. There were no significant effect of feeding level on Feed conversion efficiency of animals in any house. Higher feed conversion efficiency in loose house may be due to a comfortable environment to the animals in reference with the low temperature and low temperature humidity index in a loose house as compared to conventional barn housing system.

Table 1: Chemical analysis of feed ingredient (on DM basis)

Ingredients	DM%	OM%	CP%	CF%	EE%	ASH%	NDF%	ADF%	NFE%
Barley	92.06	89.71	10.5	7.02	3.5	2.3	24.23	8.71	76.7
GNC	92.72	85.74	39.16	8.12	8.31	7.1	23.07	10.12	37.54
DORP	90.07	83.61	14.5	13.09	2.1	6.41	49.23	16.13	64.1
Sorghum	25	14.32	7.45	27.01	3.4	10.73	64.87	37.84	51.45
Wheat Straw	90	78	2.81	35	1.05	12.16	74.83	51.9	49.14

Table 2: Ingredients of concentrate mixture (kg) and its chemical composition (on DM basis)

Ingredients	Qunatity in kg	DM%	OM%	CP%	CF%	EE%	ASH%	NDF%	ADF%	NFE%
Barley	40	36.8	35.88	4.2	2.8	1.4	0.92	9.692	3.484	30.68
GNC	30	27.81	25.71	11.748	2.4	2.49	2.1	6.921	3.036	11.262
DORP	27	24.3	22.572	3.915	3.51	0.54	1.728	13.2921	4.3551	17.307
Whole conc.	100	88.91	84.162	19.863	8.71	4.43	4.748	29.9051	10.8751	59.249

Whole concentrate mixture also contain 2 kg Mineral mixture (MM) and 1kg Salt.

Table 3: Average body weight (in KG) gain of buffalo calves under different treatments

Variables	T_1	T_2	T_3	T_4
Initial body weight	113.67±10.385	110.67±8.305	109.17±6.949	111.00±7.497
Final body weight	186.50±11.552	186.67±9.376	170.83±6.755	181.00±8.161
Total weight gain	72.83±4.037	76±4.531	61.66±1.764	70±2.530
Daily weight gain	0.80±0.045	0.84±.050	0.68±0.020	0.77±0.028

Table 4: Average fortnightly Temperature (ºC) of loose house and conventional barn during experiment period.

Fortnights	Temperature (ºC)			
	Loose house		Conventional Barn	
	Max.	Min.	Max	Min.
1	36.215 ^{c} ±0.542	33.252 ^{d} ±0.433	39.785 ^{a} ±0.728	29.322 ^{b} ±0.965
2	35.141 ^{c} ±0.684	32.793 ^{d} ±0.273	36.993 ^{a} ±0.916	27.070 ^{b} ±0.470
3	36.522 ^{c} ±0.628	32.770 ^{d} ±0.203	38.744 ^{a} ±0.725	29.822 ^{b} ±0.728
4	38.304 ^{c} ±0.163	28.822 ^{d} ±0.322	40.667 ^{a} ±0.695	26.304 ^{b} ±0.634
5	35.044 ^{c} ±0.894	27.844 ^{d} ±0.365	38.059 ^{a} ±0.892	25.419 ^{b} ±0.652
6	36.426 ^{c} ±0.325	25.385 ^{d} ±0.408	39.363 ^{a} ±0.353	21.326 ^{b} ±1.571

Means in Rows with different superscripts differ significantly (P<0.05)

Table 5: Average fortnightly Temperature humidity index (THI) of loose house and conventional barn during experiment period

Fortnights	Temperature Humidity Index (THI)			
	Loose house		Conventional Barn	
	Max.	Min.	Max	Min.
1	87.286^{c}±1.750	78.251^{a}±1.257	93.400^{b}±0.976	75.165^{a}±0.505
2	88.712^{c} ±1.626	76.486^{a} ±0.865	93.065^{b} ±1.046	75.548^{a} ±0.304
3	84.698^{c}±1.205	79.368^{d}±0.891	93.131^{a}±0.889	74.286^{b}±0.309
4	87.776^{c} ±0.742	73.396^{d} ±0.943	93.039^{a} ±0.467	71.213^{b} ±0.598
5	84.952^{c} ±0.878	72.522^{a} ±0.877	90.832^{b} ±1.039	71.856^{a} ±0.674
6	86.020^{c} ±0.512	67.039^{a} ±1.812	90.713^{b} ±0.490	67.097^{a} ±0.556

Means in Rows with different superscripts differ significantly (P<0.05)

Table 6: Average daily nutrient intake per kg body weight gain by buffalo calves under different treatments

Treatments	Daily dry matter intake (kg)	Crude protein intake (gm)	Total digestible nutrients intake(kg)
T_1	5.910±0.345	665.970±39.142	4.140±0.244
T_2	6.100±0.321	691.350±36.955	4.450±0.238
T_3	7.030±0.201	777.000±22.207	4.830±0.139
T_4	6.510±0.212	743.120±24.348	4.640±0.151

Table 7: Effect of Housing System and level of feeding on Average daily nutrient intake per kg body weight gain by buffalo calves

Variables	Housing System		Feeding Level	
	Loose house	**Conventional barn**	**ICAR 100%**	**ICAR 120%**
Daily dry matter intake (kg)	6.010^{a}±0.280	6.770^{b}±0.164	6.470^{ab}±0.215	6.310^{ab}±0.113
Crude protein intake (gm)	678.660^{a}±32.064	760.060^{b}±18.579	721.480^{ab}±24.006	717.240^{ab}±13.162
Total digestible nutrients intake(kg)	4.290±0.203	4.730±0.116	4.480±0.150	4.540±0.085

Means in Rows with different superscripts differ significantly (P<0.05)

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