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RESEARCH ARTICLE

EFFECT OF MICROCLIMATE ALTERATION DEVICES AND FEED ADDITIVE ON ADAPTABILITY INDICES IN MURRAH BUFFALOES.

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Abstract

The present study was carried out on twenty four lactating Murrah buffaloes housed in four different groups (six in each group) viz. foggers (T1), fans (T2), fans and feed additive (T3) and control group (C). The adaptability indices studied were Temperature Humidity Index (THI), Iberia Heat Tolerance Coefficient (IHTC), Benezara Coefficient of Adaptability (BCA) and Dairy Search Index (DSI). THI was significantly (P<0.01) higher in C group of buffaloes followed by T2, T3 which were same and least in T1 group. IHTC was significantly (P<0.01) higher in T1 group of buffaloes followed by T3 and T2 which did not differ much and least in C group. BCA was significantly (P<0.01) higher in C group followed by T3, T2 and T1 group of buffaloes but BCA did not differ between T2, T3 and C group. DSI was significantly (P<0.01) higher in C group of buffaloes followed by T2, T3 and least in T1 group but T2 did not differ with T3 and C. IHTC was negatively (P<0.01) correlated with THI, BCA, DSI, RT, RR and PR, while THI, BCA and DSI were positively (P<0.01) correlated with each other and also with RT, RR and PR.

Introduction:-

Environmental stress has a measurable effect on the comfort levels of buffaloes and can be assessed by using the following adaptability indices viz., Temperature Humidity index (THI)

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(Bianca, 1962), Iberia Heat Tolerance Coefficient (IHTC) (Rhoad, 1944), Benezara Coefficient of Adaptability (BCA) (Benezara, 1954) and Dairy Search Index (DSI) (Thomas *et al.*, 1973). Buffaloes have poor heat tolerance capacity compared to other domestic ruminants and are more prone to heat stress due to scarcely distributed sweat glands, dark body colour and sparse hair on body surface (Das *et al.*, 1999; Khongdee *et al.*, 2013) which reduce the capacity of cutaneous evaporation (Gudev *et al.*, 2007). The combined effect of temperature and humidity has adverse effect on livestock (Key and Sneeringer, 2014). Altering the microclimate by providing foggers, fans, sprinklers, anti-stress agents can improve the animal welfare (Ambulkar *et al.*, 2011; Anjali and Mahendra, 2010).

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The present study of adaptability indices and their correlation with the physiological responses evaluate the adaptability of buffaloes in response to changing climatic conditions under the influence of microclimate alteration devices viz. foggers, fans and feed additive.

Materials and Methods:-

A study was conducted on the adaptability indices of 24 lactating Murrah buffaloes available at Livestock Research Station, Mamnoor, Warangal district, Telangana. All the buffaloes were maintained under standard feeding and managemental conditions. The buffaloes were housed in four different groups (six in each group) viz. foggers (T1) operated from 12.00 noon to 3.00 pm, fans (T2), fans and feed additive in the form of Chromium supplement and yeast culture as an anti-stress agent @ 500g/tonne of feed (T3) and control group of buffaloes were housed under loose housing system (C). The physiological responses and adaptability indices of the above animals were studied twice daily i.e, in the morning between 7.30 and 8.00 am and at noon between 3.00 and 3.30 pm during the entire length of study period of 90 days and the data was analyzed by using Completely Randomized Design (CRD).

The climatic variables recorded during the study period were dry bulb temperature and wet bulb temperature using N.S Dimple dry & wet bulb thermometer.

The rectal temperature was measured by inserting clinical thermometer per rectum and observation was recorded after one min. Due care was taken to ensure that the thermometer was placed obliquely and touching the lumen of the rectum and expressed in ^{0}F as well as ^{0}C. The respiration rate was recorded by observing the flank movements for one minute expressed as breaths per minute (bpm) in which each inward and outward movement of the flank was counted as one complete respiration. Pulse rate of the animals was recorded by observing the pulsation of middle coccygeal artery at the base of tail. The pulse rate was expressed as beats per minute.

Heat tolerance indices / adaptability indices

The following adaptability indices were calculated from the recorded shed temperatures and physiological responses (Rectal temperature, Respiration rate and Pulse rate) for assessing the thermal adaptability of buffaloes during 90 days of study period. These were estimated twice a day and the average of two readings was taken for the day.

Temperature Humidity Index (THI) was calculated as per Bianca (1962).

$$\mathbf{THI = (0.35xT_{db} + 0.65xT_{wb}) x1.8+32}$$

Where, T_{db} : Dry bulb temperature and T_{wb} : Wet bulb temperature (^{0}C)

Iberia Heat Tolerance Coefficient (IHTC) was estimated as suggested by Rhoad (1944).

$$\mathbf{IHTC = 100 – 10 (BT-101)}$$

Where, BT : Observed body temperature (^{0}F) of the animal

An IHTC value of '100' indicates the perfect adaptability.

Benezara Coefficient of Adaptability (BCA) was estimated as suggested by Benezara (1954).

$$\mathbf{BCA= BT/38.33 + NR/23}$$

Where, BT: Rectal temperature (^{0}C) and NR: Respiration rate per minute

An increase in BCA from '2.0' indicates reduction in thermal adaptability.

Dairy Search Index (DSI) was estimated as suggested by Thomas *et al.* (1973).

$$\mathbf{DSI = 0.5(X_1/X) + 0.2 (Y_1/Y) + 0.3(Z_1/Z)}$$

Where, X_1, Y_1, and Z_1 are observed rectal temperature (^{0}C), respiration rate/minute and pulse rate/minute, respectively. X, Y and Z are normal temperature, respiration rate and pulse rate, respectively. The normal temperature, respiration and pulse rates in the present study for calculation of DSI were 38.67^{0}C, 30 bpm and 70/min, respectively. An increase in DSI value from '1.0' indicates decrease in thermal adaptability.

Results and Discussion:-

The effect of microclimate alteration devices and feed additive on the physiological responses of Murrah buffaloes viz., rectal temperature (RT), respiratory rate (RR) and pulse rate (PR) during morning (7.30 to 8.00 am) and noon (3.00 to 3.30 pm) has been presented in Table1.

Table – I:-Effect of microclimate alteration devices and feed additive on physiological responses in Murrah buffaloes

Experimental Groups		RT (°F)		RR (bpm)		PR (beats/min)	
		Morning	Noon	Morning	Noon	Morning	Noon
C	Mean	99.42	102.06^{b}	31.69	37.59^{b}	47.58	57.70^{c}
	±SE	0.01	0.06	0.12	0.19	0.22	0.34
T1	Mean	99.38	101.85^{a}	31.30	34.80^{a}	47.42	55.08^{a}
	±SE	0.01	0.05	0.14	0.28	0.20	0.19
T2	Mean	99.39	101.97^{ab}	31.63	37.27^{b}	47.47	56.33^{b}
	±SE	0.01	0.04	0.10	0.20	0.19	0.24
T3	Mean	99.38	101.95^{ab}	31.41	37.15^{b}	47.19	56.27^{b}
	±SE	0.01	0.04	0.08	0.19	0.18	0.24

A, B, C means with different superscripts within column differ significantly (P<0.05)

The present study revealed that the physiological responses (RT, RR and PR) increased from morning to noon in response to sun radiation. The mean values of physiological responses obtained in the noon were significantly (P<0.05) higher in group C, followed by T2, T3 and least in T1 group of buffaloes. Similar results were observed under foggers by Ambulkar *et al.,* 2011 and Sandeep, 2014. Results of mean RT and RR were in consistent with the findings of Chaiyabutr *et al.,* 2008; Chaiyabutr *et al.,* 2011 and Singh *et al.,* 2014 under mist-fan system. While Brijesh *et al.* (2016) observed that RT and RR were significantly (P<0.05) lower in misting group of Murrah buffaloes. Supplementation of buffaloes in T3 group with chromium and yeast cultures exhibited significantly (P<0.05) decreased RT, RR, PR and the results were in agreement with the observations of Kumar *et al.* (2013) and Das *et al.* (2014).

The effect of microclimate alteration devices and feed additive on adaptability indices of Murrah buffaloes was put forth in Table 2.

Table – II:-Effect of microclimate alteration devices and feed additive on adaptability indices of Murrah buffaloes

Experimental groups		THI	IHTC	BCA	DSI
C	Mean	88.32^{c}	102.63^{a}	2.50^{b}	0.95^{c}
	±SE	0.32	0.34	0.01	0.00
T1	Mean	86.00^{a}	103.83^{b}	2.43^{a}	0.93^{a}
	±SE	0.25	0.26	0.01	0.00
T2	Mean	87.34^{b}	103.19^{ab}	2.49^{b}	0.95^{c}
	±SE	0.23	0.25	0.01	0.00
T3	Mean	87.34^{b}	103.34^{ab}	2.49^{b}	0.94^{b}
	±SE	0.23	0.24	0.01	0.00

A, B, C means with different superscripts within column differ significantly (P<0.05)

The present study revealed that the mean THI for the groups C, T1, T2 and T3 were 88.32±0.32, 86.00±0.25, 87.34±0.23 and 87.34±0.23, respectively. The statistical analysis of data indicated that the mean THI were significantly (P<0.01) different from each other, while T2 and T3 groups had the same mean THI (Table 2). Mean THI was least in T1 followed by T2 and T3 group of buffaloes which were the same since both include fans, while it was significantly (P<0.01) higher in C group without foggers nor fans and suggested the need for microclimate alteration devices as heat ameliorative measures in buffalo sheds. These results were consistent with Chaiyabutr *et al.* (2008); Chanpongsang *et al.* (2010); Sandeep (2014) and Singh *et al.* (2014).

Mean IHTC during the study was 102.63±0.34, 103.83±0.26, 103.19±0.25 and 103.34±0.24 for C, T1, T2 and T3 groups of buffaloes, respectively and differed significantly (P<0.05) from each other. Mean IHTC was higher in T1 group followed by T3 and T2 groups which did not differ much and least in C group.

The data obtained during the study for mean BCA was 2.50±0.01, 2.43±0.01, 2.49±0.01 and 2.49±0.01 in C, T1, T2 and T3 group of buffaloes, respectively which were significantly (P<0.01) different from each other. Mean BCA was higher in C group followed by T3, T2 and T1 groups but mean BCA did not differ between T2, T3 and C groups.

Mean DSI during the study was 0.95±0.00, 0.93±0.00, 0.95±0.00 and 0.94±0.00 for C, T1, T2 and T3 groups, respectively. The statistical analysis of data indicated that the mean DSI differed significantly (P<0.01) from each other. Mean DSI was higher in C group followed by T2, T3 and least in T1 group of buffaloes.

In the present study, the effect of microclimate alteration devices and feed additive as the heat ameliorative measures revealed that the degree of comfort was significantly (P<0.01) more in T1 group of buffaloes followed by T3, T2 and C as stated by THI, BCA and DSI. Whereas, IHTC revealed the degree of comfort was more in T1 group of buffaloes followed by T3, T2 and C at the level of significance (P<0.05). These results suggested that foggers as a management tool in animal sheds were more efficient in relieving heat stress and thus provided comfort to animals from the scorching sun during summer.

Correlation between adaptability indices and physiological responses

The correlation coefficients of adaptability indices and physiological responses were presented in Table 3.

Table – III:-Correlation Coefficients (r) of adaptability indices and physiological responses of Murrah buffaloes

	IHTC	**BCA**	**DSI**	**THI**	**RT**	**RR**	**PR**
IHTC	1.00	-0.89**	-0.95**	-0.73**	-1.00**	-0.88**	-0.96**
BCA	-0.89**	1.00	0.98**	0.77**	0.89**	1.00**	0.90**
DSI	-0.95**	0.98**	1.00	0.78**	0.95**	0.97**	0.97**
THI	-0.73**	0.77**	0.78**	1.00	0.73**	0.77**	0.76**
RT	-1.00**	0.89**	0.95**	0.73**	1.00	0.88**	0.96**
RR	-0.88**	1.00**	0.97**	0.77**	0.88**	1.00	0.89**
PR	-0.96**	0.90**	0.97**	0.76**	0.96**	0.89**	1.00

**Significant (P<0.01)

The present study revealed that IHTC was negatively correlated with BCA (r = -0.89**), DSI (r = -0.95**), THI (r = -0.73**), RT (r = -1.00**), RR (r = -0.88**) and PR (r = -0.96**) and has shown that as the rectal temperature increased, IHTC decreased stating discomfort to buffaloes.

BCA was positively correlated with DSI (r = 0.98**), THI (r = 0.77**), RT (r = 0.89**), RR (r = 1.00**) and PR (r = 0.90**). DSI was positively correlated with THI (r = 0.78**), RT (r = 0.95**), RR (r = 0.97**) and PR (r = 0.97**) indicating that increased physiological responses in response to heat stress increased THI, BCA and DSI accordingly.

THI was positively correlated with the physiological responses viz., RT (r = 0.73**), RR (r = 0.77**) and PR (r = 0.76**) showing that as the THI increased, the physiological responses also increased accordingly and similar results were observed by Sivakumar *et al.* (2010), Saikia *et al.* (2013) and Popoola *et al.* (2014).

Conclusion:-

The inclusion of microclimate alteration devices and feed additive were beneficial for Murrah buffaloes in adapting to the changing climate by altering physiological responses, thus providing comfort to animals.

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