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# Effect of Microclimate Alteration Devices and Feed Additive on Productive Performance and Feed Intake of Murrah Buffaloes

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**A B S T R A C T**

The present study was undertaken to evaluate the effect of microclimate alteration devices and feed additives on productive performance and feed intake of lactating Murrah buffaloes during summer for a period of 90 days. Twenty four early lactating Murrah buffaloes of similar body weight, parity and milk yield were selected and distributed randomly into 4 equal groups by using randomized block design (RBD). The first group $T_1$ was provided with foggers operated daily during hot hours from 12.00 Noon to 15.00 PM, $T_2$ with fans, $T_3$ with fans and feed additive containing Chromisac (Chromium plus yeast) @ 500 g/ton of feed and control group without any cooling device and feed additive. The average daily dry matter intake (DMI) in $T_1$ (15.37 ± 0.08 kg) was found to be significantly higher than$T_2$ (14.25 ± 0.15), $T_3$ (14.65 ± 0.06) and control group (13.99 ± 0.11 kg).The average daily milk yield was significantly higher in $T_1$ (10.94 ± 0.33) compared to $T_2$, $T_3$ and control groups, 9.55 ± 0.63, 9.78 ± 0.30 and 9.16 ± 0.36 kg, respectively. The milk constituents fat, SNF and Total solids did not differ significantly among the groups. The average daily 6% FCM yield of various experimental was found to be 12.58 ± 0.34, 10.89 ± 0.73, 11.33 ± 0.29 and 10.44 ± 0.40 percent for $T_{1,}$ $T_2$, $T_3$ and control, respectively. The use of foggers as microclimate alteration device was more advantageous over the other air circulating devices and with feed additive supplementation.

## Introduction

The livestock sector is an important component of India's economy in terms of income, employment and foreign exchange earnings. As per the 19th Livestock Census-2012, the total bovine population (Cattle and Buffalo) is 299.9 million. The Buffalo population in India is 108.7 million. Milk production in India during 2014-15 was 146.3 million tons and ranks first in the world. The per capita availability of milk in the country was 322 gram per day in 2014-15 (DAHD, GOI). India is a tropical country with hot and humid summer and relatively less stressful winter season. During summer (May-June), the atmospheric temperature goes as high as 45° C during day time and 30°C during night and photoperiod extends up to 12-14 hours. Global warming has a great impact on the reproductive activity of cattle and buffaloes. Global warming has risen the surface temperature by about 0.7°C since the early $20^{th}$century. It is anticipated that the temperature rise will be 1.8-4°C by 2100(IPCC, 2014).

One of the great challenges faced by the farmers is the increasing temperature in summer. These deleterious effects of heat stress are the results of either the hyperthermia associated with heat stress or the physiological adjustments made by the heat-stressed animal to regulate body temperature (Savsani *et al.*, 2015). Some of the adverse effects of heat stress are reduced milk yield (15-40%), lower milk fat, and greater susceptibility to diseases and environmental stress in bovines.

Stress factors stimulate the production and release of corticosterone (Siegel, 1995).

Chromium is known to influence the secretion of corticosteroids and decrease sensitivity to stress in animals fed chromium supplements as a result of reduced concentrations of cortisol in the blood (Pechova *et al.*, 2002).

Yeast supplementation increases nutrient digestibility, alteration of the proportion of volatile fatty acids produced in the rumen, reduction in ruminal ammonia and increase of ruminal microorganism population (Chaucheyras *et al.*, 2007).

The sprinklers combined with forced air movement help increase the loss of body heat up to three- or four-folds. Foggers disperse very fine droplets of water which quickly evaporate and cool the surrounding air.

If air flows over the animal with a velocity between 2 and 3 m/s, it increases convective heat loss during stressful conditions which can be achieved with air circulators (shearer *et al.*, 1991). A study on the effect of microclimate alteration devices and feed additive was carried out on productive performance of Murrah buffaloes at Livestock Research Station, Mamnoor, Warangal District, Telangana State.

## Materials and Methods

The experiment was carried out for 90 days during the month of March to May, 2016 when average temperature and THI ranged between 32–36 °C and 73–90, respectively at the Livestock Research Station (LRS), Mamnoor, Warangal district under P.V. Narasimha Rao Telangana Veterinary University, Telangana State, India which is located in Central Telangana Zone (longitude 78° 49’’to 80° 43’’E and latitude 17° 19’’to 80° 36’’N). The average annual maximum and minimum ambient temperature ranges from 12 to 45°C. The mean annual relative humidity ranges from 25 to 85%. The annual rainfall in this area is 1050 mm.

### Selection of experimental animals

Twenty - four healthy and second stage of lactating Murrah buffaloes were selected having similar body weight, parity and milk yield in current lactation. They were randomly distributed into four groups ($T_1$, $T_2$, $T_3$ and control) with six animals in each group in a randomized block design (RBD), in such a way that the order of lactation and average milk yield were more or less similar.

## Experimental design

They were divided into four equal groups of six animals in each and given four different treatments. The first group ($T_1$) was housed with foggers operated daily during hot hour's from12:00 Noon to 15:00 PM, the second group ($T_2$) was provided with ceiling fans (air circulating device) and third group ($T_3$) was housed with ceiling fans (air circulating device + feed additive), while the control group was not provided with cooling device or feed additive. The feed additive used is Chromium supplement blended with probiotics (yeast) @ 500 g per ton of feed. The particulars of the animals used for the experiment are furnished in Table 1.

## Management -feeding and watering

All the experimental buffaloes were offered weighed quantities of chopped hybrid Napier (CO-4), kutti (chopped Jowar straw) and concentrate mixture to meet their dry matter requirements. Experimental buffaloes were offered with daily average 25 kg and 5 kg of hybrid Napier (CO-4) and kutti (chopped Jowar straw), respectively and the concentrate mixture was fed @1.5 kg/day/animal for body maintenance in general. Concentrate mixture was formed with Maize grain, Ground Nut Cake, Wheat Bran, Red Gram Chunny, Salt, Mineral Mixture and feed additive (chromisac). Milking cows were given additional concentrate @1.0 kg for every 2 kg milk production, above 5.0 kg milk yield. The animals were provided balanced ration as per the recommendations as per nutrient requirements of cattle and buffalo (ICAR, 2013). The details of ingredient composition of concentrate mixture are presented in Table 2.

Representative samples of green fodder, chopped jowar straw (kutti) and concentrate mixture were collected daily during the collection period before offering to animal and kept for dry matter estimation. Similarly, representative samples of feeds and fodders and refusals were collected every day during the trial for dry matter estimation.

AOAC (2012) methods of analysis were followed for the determination of proximate principles of fodder and concentrate mixture.

The experimental buffaloes were housed in different sheds under loose housing system in head to head position and sheds were fitted with fogger systems and ceiling fans. Prophylactic measures against diseases were carried out as prescribed by the health calendar of the LRS farm. Standard managemental practices like cleaning, watering and feeding were adopted in all the experimental groups.

## Foggers

Foggers (BLUESTAL agri equipment) with four way anti-leak technology with nozzle size 0.5mm and droplet size 80-100µ were used in the experimental Murrah buffalo houses. The fogger system consisted of nozzles in a line placed 8 to 9 feet above the floor. This system disperses very fine water droplets and cools the air while raising the relative humidity.

## Recording daily milk yield

Buffaloes were completely milked with full hand milking method twice at 5.00 AM and 4.00 to 4.30 PM throughout the experimental period and milk yield were recorded.

## Sampling of milk

About 10 ml of milk samples were collected in clean milk sample bottles from buffaloes of the four groups during the experiment period fortnightly for milk qualitative analysis. The aliquots of milk of A.M and P.M milking were pooled. The milk samples were also collected at the commencement of the experiment and analyzed for Fat, SNF and Total solids and milk samples were analyzed for milk fat, SNF, total solids and 6 % FCM yield at fortnightly intervals with automatic milk analyzer i.e., LACTOSCAN.

A 6 per cent fat corrected milk yield (6% FCM) was calculated using method of Rice *et al.,* (1970) with the following formula.

6% FCM = 0.308 X Total Milk Yield +11.54 X Total Fat Yield (kg)

The total solids content of the milk was arrived by the addition of fat and SNF percentage.

Total solids % = Fat % + SNF %

## Sampling of feeds and fodders

Representative samples of green fodder, chopped jowar straw (kutti) and concentrate mixture were collected daily during the collection period before offering to animal and kept for dry matter estimation. Similarly, representative samples of feeds and fodders and refusals were collected every day during the trial for dry matter estimation to know the dry matter intake.

## Statistical analysis

The data were analyzed using General Linear Model procedure of Statistical Package for Social Sciences (SPSS) $15^{th}$ version and significance was considered at $P<0.05$.

## Results and Discussion

Results showing the chemical composition of feed are presented in Table 3. The per cent of crude protein in concentrate mixture is 16.87 on dry matter basis.

## Milk yield

The average daily milk yields of the lactating Murrah buffaloes of various groups were presented in Table 3. 10.94± 0.33, 9.55± 0.63, 9.78 ± 0.3 and 9.16±0.36 in $T_1$, $T_2$, $T_3$ and control, respectively. $T_1$ showed significantly higher milk yield (Fig. 1).

## Milk fat percent

The average fat percent of the experimental Murrah buffaloes was 7.31 ± 0.28, 7.22 ± 0.1, 7.38 ± 0.18kg, 7.20 ± 0.08 in Foggers, Fan, Fan and Feed additive, and control, respectively. No significant ($P>0.05$) difference between the groups was observed. Kamiya *et al.,* (2006) reported fat concentration in milk of HF cows did not differ significantly ($P>0.01$) between treatments which supported our results. Aggarwal (2004), reported similar trend in milk fat 6.92 and 7.42 in buffaloes housed without misters and misters, respectively supported the present study. Whereas significant ($p<0.001$) differences were found by Sandeep Reddy *et al.,* (2015a) and Jegoda *et al.,* (2015) in Mehasana buffaloes which differed with present study.

## Fat yield

The average daily fat yields for $T_1$, $T_2$, $T_3$ and control were 0.80± 0.02, 0.69 ± 0.05 0.72 ± 0.02 and 0.66 ± 0.03 kg, respectively (Table 3). $T_1$ showed significantly ($P<0.05$) higher fat yield than $T_2$ and control. In general, the treated groups showed higher yield as compared to the control

## Solid Non Fat (SNF%)

The average solids non-fat (SNF) per cent of the experimental Murrah buffaloes were 10.01 ± 0.11, 9.91 ± 0.14 and 9.95 ± 0.06 kg, 9.80 ± 0.09 in Foggers ($T_1$), Fan ($T_2$), Fan and Feed additive ($T_3$) and control, respectively (Table 3). No significant (P>0.05) difference was observed among the experimental groups.

### Total Solids (TS %)

The daily average total solids percent of experimental Murrah buffaloes was 17.32 ± 0.36, 17.12± 0.25, 17.33 ± 0.23 and 17.00 ±0.11 per cent in $T_1$, $T_2$, $T_3$ and control, respectively (Table 3). Statistical analysis revealed no significant (P>0.05) difference among the experimental groups.

### Feed intake

The average daily dry matter intake of various treatment groups were given in Table 3. $T_1$, $T_2$, $T_3$ and control was observed to be 15.37 ±0.08, 14.25 ±0.14, 14.65 ±0.06 and 13.99±0.11 kg, respectively (Table 3).

Gradual decrease in milk production was observed during the experimental period in all groups. Average daily milk yield of treatments $T_1$, $T_2$, $T_3$, was superior to control. Among treatments, $T_1$ was significantly (P<0.05) higher followed by $T_3$ and $T_2$, but there was no significant (P<0.05) difference with $T_2$ and control group but higher average daily milk yield was observed in $T_2$ group. The present research findings were in corroboration with research findings of Sandeep Reddy *et al.,* (2015a) where the mean milk production (kg) in experimental buffaloes with microclimate alteration was 6.05± 0.02, 7.30±0.01, 6.75± 0.01 and 7.31± 0.01 kg/day in control (I), fogger (II), fans (III) and fogger and fans (IV) respectively, Significantly (P<0.001) higher milk production was observed in fogger, fan plus fogger and fan groups of buffaloes compared to control group. Similarly, Ambulkar *et al.,* (2011) found significantly (P<0.05) higher milk yield observed in Murrah buffaloes maintained under the high-pressure fogger system.

In $T_1$, significantly higher daily average milk yield was obtained which might be due to decreased heat stress on buffaloes where foggers decreased heat stress due to evaporative cooling through free circulation of natural air over the body and provided more body comfort and increased dry matter intake. Whereas $T_2$ and $T_3$ gave more body comfort than control group. The mean daily milk yield was 6.9 kg and 8.1 kg/day in Nili Ravi buffaloes which were significantly (P<0.05) higher in houses with ceiling fans and foggers/misting fans compare to control group reported by Das *et al.,* (2014) which corroborate with the present findings.

Control group showed decreased milk yield compared to other treatment groups which might be due to high ambient temperatures because heat stress resulting in decreasing dry matter intake and milk yield. Suadsong *et al.,* (2008), Kamiya *et al.,* (2006) reported similar findings in HF cows and Brijeshyadav *et al.,* (2016) in lactating Murrah buffaloes which supported our results.

**Table.1** Details of experimental Murrah buffaloes

| Treatment | Body Wt. | Parity | Stage of lactation (days) |
|---|---|---|---|
| **$T_1$** | 520.17±4.59 | 2.17±0.17 | 41.2±5.64 |
| **$T_2$** | 515±5.34 | 2.17±0.17 | 38.33±10.83 |
| **$T_3$** | 516.33±2.23 | 2.50±0.5 | 38.00±9.05 |
| **Control** | 518.67±5.64 | 2.67±0.49 | 33.83±5.82 |

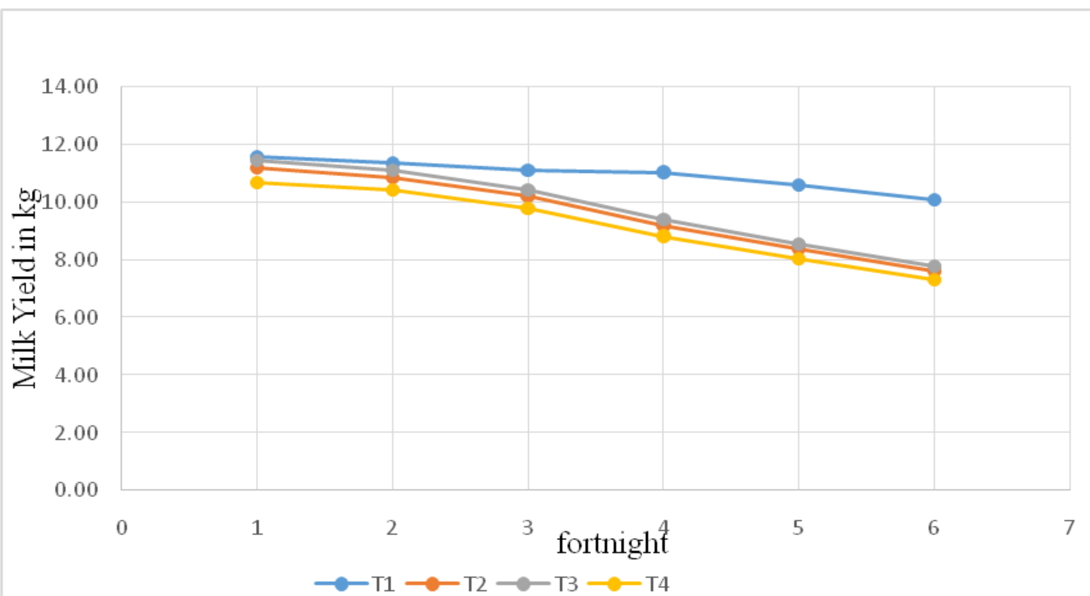
**Table.2** Composition of concentrate mixture

| Concentrate Mixture | Percent |
|---|---|
| **Maize grain** | 35 |
| **Ground Nut Cake** | 13 |
| **Coconut Cake** | 12 |
| **Wheat Bran** | 25 |
| **Red Gram Chunny** | 12 |
| **Salt** | 2 |
| **Mineral Mixture** | 1 |
| **feed additive** | 50g per 100 kg |

**Table.3** Effect of microclimate alteration and feed additive on quantity and quality of milk of experimental Murrah buffaloes (fortnight intervals)

| Treatment | Body Wt. | Milk yield (Kg) | Fat (%) | Fat yield (Kg) | 6% FCM | SNF% | TS% | DMI (kg) |
|---|---|---|---|---|---|---|---|---|
| **T1** | 520.17± 4.59 | 10.94± 0.33[a] | 7.31± 0.28 | 0.8± 0.02[a] | 12.58± 0.34[a] | 10.01± 0.11 | 17.32± 0.36 | 15.37 ±0.08[a] |
| **T2** | 515± 5.34 | 9.55± 0.63[b] | 7.22± 0.1 | 0.69± 0.05[b] | 10.89± 0.73[b] | 9.91± 0.14 | 17.12± 0.21 | 14.25± 0.15 [c] |
| **T3** | 516.33± 2.23 | 9.78± 0.30[ab] | 7.38± 0.18 | 0.72± 0.02[ab] | 11.33± 0.29[ab] | 9.95± 0.06 | 17.33± 0.23 | 14.65± 0.06 [b] |
| **Control** | 518.67± 5.64 | 9.16± 0.36[b] | 7.2± 0.08 | 0.66± 0.03[b] | 10.44± 0.40[b] | 9.8± 0.09 | 17± 0.11 | 13.99± 0.11[c] |

**Fig.1** Effect of microclimate alteration devices and feed additive on milk yield of Murrah buffaloes



Significantly ($p<0.05$) higher average daily milk yield was observed in $T_3$ when compared to $T_2$ and control group. Even though both $T_2$ and $T_3$groups were having ceiling fans, higher milk yield was observed in $T_3$ due to additionally $T_3$ were supplemented with anti-stress agent i.e., feed additive containing chromium and yeast. These results corroborate the research findings of Popovic *et al.,* (2000) who reported that higher milk yield than control group with chromium supplementation.

Increased milk production in $T_3$ might be due to an indirect effect of chromium which is responsible for increased glucose production and glucose is the main driver of lactose synthesis, and lactose production is linked to fluid milk yield. Chromium supplemented during early lactation has increased milk production as reported by Hayirli *et al.,* (2001) and Smith *et al.,* (2013) in dairy cows supported our present results.

It might be attributed to the positive effect of yeast culture in relieving stress thereby maintaining the DM intake, which might have led to increased milk production. Sirinivas *et al.,* (2009), Hossain *et al.,* (2014) and Yasuda *et al.,* (2007) observed significant ($P<0.05$) improvement in milk yield in dairy cows by supplementing the diet with probiotics which supported our findings.

No significant ($P>0.05$) difference was observed among the experimental groups.

The effect of fogger was not found significant on milk solids-not-fat percent. The present findings are in accordance with report of Fulsounder (1982) in Mehsana buffaloes that observed the daily average percent SNF was higher in cooling group than control and the difference was not significant ($p>0.05$). On the contrary, Radadia *et al.,* (1980) and Sandeep Reddy *et al.,* (2015a) observed significant ($p>0.001$) effect in solid-not-fat percentage of milk in Murrah buffaloes.

Agarwal (2004) reported that the milk fat and milk total solids were and 17.41 and 18.23 percent in buffaloes housed without misters and misters, respectively which is consistent with the present findings. Present results differed with Sandeepreddy *et al.,* (2015a) who reported that total solids differ significantly ($p<0.001$) in Murrah buffaloes with microclimate modification in summer.

It might be due to microclimate modification by foggers and ceiling fans reducing heat stress on buffaloes giving more body comfort and increased ruminal motility and better enhancement of rumen fermentation with microbial population in rumen.

Present results were agreement with the findings of Jegoda *et al.,* (2015) who reported that significantly ($P<0.01$) increased weekly mean feed intake (kg/animal/day) was observed in foggers(12.66 kg/buffalo/day) compared to control group (11.95 kg/buffalo/day) in Mehsana buffaloes. Singh *et al.,* (2014) observed increased DMI in Murrah buffalo heifers housed with fan cum mist system. Also, Fulsoundar and Radadia (1993) reported that the daily DM intake was 13.86 and 14.76 kg/day ($P<0.01$) for buffaloes managed under shelter alone (control) or shelter and also splashed with water (test group) at 10-min intervals between 12.30 and 14.20 h, daily in summer.

Higher average Dry matter intake (DMI) was observed in $T_3$ group than $T_2$. This could be due to heat stress was reduced by air circulation in sheds and higher DMI in $T_3$ was observed compared to $T_2$. It might be due to Yeasts which stimulate cellulolytic populations in the rumen and increase their enzymatic activity. This improves fiber degradation in the rumen and it results increased dry matter intake (Desnoyers, 2009). Moallem *et al.*, (2009) found daily Dry Matter Intake (DMI) in the live yeast group was 2.5% greater than control in dairy cows are corroborate the present findings. McNamara and Valdez (2003) reported that Chromium supplementation tends to increase dry matter intake.

The micro-climate alteration devices foggers, fans and fans with feed additive of chromium supplementation provision to experimental animals helped in improving Dry Matter Intake resulting in increase in milk yield, butterfat and SNF. The effective usage of foggers in houses of buffaloes can cause evaporative heat loss by wetting of buffalo skin resulting in reducing heat stress significantly. Therefore based on results obtained during the present study concluded that foggers and ceiling fans, very useful as a microclimate alteration in buffalo sheds for reducing heat stress thereby improving the dry matter intake and favours to increase milk yield in Murrah buffaloes during summer season

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