Indian J. Anim. Nutr. 2024. 41 (1): 112-117
doi:10.5958/2231-6744.2024.00010.0

Indian Journal of Animal Nutrition

Effect of Melatonin Supplementation on Feed, Water Intake and Body Weight in Buffalo Calves under Summer Stress

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ABSTRACT

A study was undertaken to investigate the effect of melatonin supplementation on feed, water intake and body weight in buffalo calves under summer stress. Twelve healthy Murrah buffalo male calves of 6 month to 1 year age group were taken for the study. Buffalo calves were divided into control (CG) and treatment (TG) group. In TG, Melatonin (18mg/50 kg BW) was injected subcutaneously, two times at 1st and 20th day. Within and between the control and melatonin treated group the dry matter intake of buffalo calves did not differ significantly ($P<0.05$) during the experimental period. Within and between the control and melatonin treated group water intake of buffalo calves did not differ significantly ($P>0.05$) during the experiment. Within and between the control and melatonin treated group, the body weight of buffalo calves did not differ significantly ($P>0.05$) before start of experiment, 21 days after start of experiment and at the end of the experiment. In conclusion, the water intake and dry matter intake was at higher side in treated animals as compared to control group. It shows that during summer, buffalo calves treated with melatonin were at comfortable conditions so they were able to consume more feed and water as well.

KEY WORDS: Body weight, Buffalo calves, Feed, Melatonin, Summer stress, Water

Article received: 18 August 2023; Article accepted: 30 November 2023

INTRODUCTION

Buffaloes have great 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 laborers in the developing world. Melatonin plays so many important physiological functions in mammals, such as reproductive activities regulation, immune enhancement and regulation of dark-light signal transduction. Heat stress is a major constraint on animal productivity in tropical conditions. Supplementation of melatonin in feed and drinking water had positive effect on health, immune status and growth performance (Renata et. al., 2022). The variation in climatic variables like temperature, humidity and radiations are recognized as the potential hazards in the growth and production of all domestic livestock species. High ambient temperature accompanied by high air humidity causes an additional discomfort and enhances the stress level which in turn results in depression of the physiological and metabolic activities of animal. Reactions of homeotherms to moderate climatic changes are compensatory and are directed at restoring thermal balance (Kumar et al., 2015) However, when environmental temperature reaches near the animal's body temperature along with high relative humidity which causes reduction in evaporative capabilities of animals, it directly affects the cooling capacity of animals and resulted in the drastic increase in the body temperature of livestock's.

MATERIALS AND METHODS

Animals

Twelve healthy buffalo bull calves of uniform age (6 month to 1 year) were selected for the experiment and used in the present study. The animals were kept under dry, clean and well ventilated shed. Good quality drinking water was offered daily at 08:00 am and 02:30 pm. Water intake was measured with the graduated container. The buffalo calves were feed a ration consisting of concentrate: roughages ratio approximately 50:50 *ad libitum* as per predicated requirement (Kearl, 1982). The proximate analysis of feed sample was presented in table 1.

Table 1. Proximate analysis of feed sample

Feed	Dry matter (%)	Crude protein (%)	Ether Extract (%)	Ash (%)	Crude fiber (%)
Wheat straw	90.9	3.97	0.78	8.15	37.4
Green	28.1	6.95	1.73	9.97	29.9
Concentrate mixture	91.8	18.5	5.26	7.63	8.27

Experimental Design

Buffalo calves were divided randomly in two groups control and treatment (n=6 in each group). Crystalline melatonin powder was dissolved in corn oil (Coronola containing refined corn oil, Sangrur Agro Ltd., Sangrur, Punjab, India) in quantities sufficient to make a final concentration of 18 mg/ mL at room temperature. Once dissolved, the suspension was used on the same day. Melatonin was injected 18 mg/50 kg Body weight subcutaneous injection to treatment group two times at 1st and 20th day. The experiment trial was 42 days in which both control and treatment group were reared under strict management and proper hygienic conditions.

Data analysis

Data obtained was analysed statistically by one way ANOVA followed by Tukey's b test (SPSS, Inc., 1997) within group between the days and independent t test for between groups with the help of SPSS 17.0 software.

RESULTS AND DISCUSSION

Dry Matter Intake

The result of dry matter intake of control and treated animals has been presented in table 2. Within and between the control and melatonin treated group the dry matter intake of buffalo calves did not differ significantly (P<0.05) during the experimental period. The dry matter intake in treated group was higher but did not reach up to the level of significance (P<0.05) in comparison to control group of animals.

Table 2. Dry matter intake (DMI) of control and melatonin supplemented animals during summer stress

Parameter	Group	0 day	7 day	14 day	21 day	28 day	35 day	42 day
Dry matter intake (DMI)	Control	6.54±0.33^{aA}	6.48±0.36^{aA}	6.07±0.35^{aA}	6.01±0.36^{aA}	6.15±0.31^{aA}	6.16±0.32^{aA}	6.16±0.33^{aA}
	Treatment	6.57±0.20^{aA}	6.63±0.21^{aA}	6.57±0.20^{aA}	6.61±0.22^{aA}	6.57±0.20^{aA}	6.72±0.20^{aA}	6.72±0.23^{aA}

Column bearing superscript 'a' differ significantly (P<0.05) in the same group between days and superscript 'A' denotes significant (P<0.05) difference between the groups during study period.

Water intake

The result of water intake of control and treated animals has been depicted in table 3. Within and between the control and melatonin treated group water intake of buffalo calves did not differ significantly (P>0.05) during the experiment. In general the water intake was at higher side in treated animals as compared to control group.

Body Weight

The results of body weight of control and treated animals have been depicted in table 4. Within and between the control and melatonin treated group, the body weight of buffalo calves did not differ significantly (P>0.05) before start of experiment, 21 days after start of experiment and at the end of the experiment.

Table 3. Water intake (liter) of control and melatonin supplemented animals during summer stress

Parameter	Group	0 day	7 day	14 day	21 day	28 day	35 day	42 day
Water Intake (Liter)	Control	12.3 ± 0.38^{aA}	13.0 ± 0.60^{aA}	13.6 ± 0.74^{aA}	13.9 ± 0.56^{aA}	15.8 ± 0.68^{aA}	15.5 ± 0.90^{aA}	15.1 ± 0.81^{aA}
	Treatment	12.5 ± 0.76^{aA}	13.2 ± 0.87^{aA}	14.0 ± 1.44^{aA}	13.9 ± 1.22^{aA}	16.1 ± 0.93^{aA}	15.5 ± 1.15^{aA}	15.2 ± 1.08^{aA}

Column bearing superscript 'a' differ significantly (P<0.05) in the same group between days and superscript 'A' denotes significant (P<0.05) difference between the groups during study period.

Table 4. Body weight of control and melatonin supplemented animals during summer

Parameter	Group	Before start of experiment	21 days after start of experiment	At the end of the experiment
Body weight (Kg)	Control	229 ± 20.19^{aA}	215 ± 19.98^{aA}	201 ± 20.93^{aA}
	Treatment	220 ± 30.09^{aA}	205 ± 31.32^{aA}	192 ± 31.32^{aA}

Column bearing superscript 'a' differ significantly (P<0.05) in the same group between days and superscript 'A' denotes significant (P<0.05) difference between the groups during study period.

Drinking water is not only the most important essential nutrient for dairy cattle (NRC, 2001), but it also has high specific heat which promotes heat dissipation. There is a direct association between water intake and environmental temperature (Coimbra, 2007; Arias et al., 2008). The immediate response to heat load decrease feed intake and increase water intake (Maurya et al., 2007; Bernabucci et al., 2010) further, hot conditions evokes a series of drastic changes including depression in feed efficiency and utilization, disturbances in metabolism of water, protein, energy and mineral balances, enzymatic reactions, hormonal secretions and blood metabolites (Habeeb et al., 1992; Marai et al., 2006, Maurya et al., 2016). Pregnant rabbits under heat stress had high RT, RR, water intake and with low feed intake (Sabah et al., 2016). Water intake, respiratory rate and rectal temperature increased progressively at 35°C and 40°C as compared to 25°C and 30°C temperature exposure in cattle (Yadav et al., 2015). Higher water intake/ day at 35°C and 40°C of temperature exposure was mainly due to evaporatory heat loss water (respiration, sweating or panting), resulting in increased osmolarity of the extracellular fluid in the body, ultimately leading to activation of thirst center in the hypothalamus and increase in water intake (Pereira et al., 2008; Banerjee and Ashutosh, 2011). Melatonin plays an important role in thermoregulation in pigeon (John et al., 1978). Oxenkrug and McIntyre (1985) reported an increase in plasma melatonin in rats exposed to stress and suggested melatonin involvement in physiological adaptation.

In present study water intake and dry matter intake was at higher side in treated animals as compared to control group. It shows that during summer calves treated with melatonin were at comfortable conditions so they were able to consume more feed and water as well. In agreement to our study Sahin et al. (2003) also reported that melatonin supplementation reversed the impairment of live weight, feed efficiency, carcass traits and restored mineralstatus. Marai et al. (1997) reported that in control and melatonin treated groups, the bodyweight of buffalo calves decreased from start through mid to the end of the experiment during summer season and it may be due to that exposure to elevated temperatures impairs the bodyweight, growth rate, total body solids and body solids daily gain. The effects of elevated ambient temperature on growth performance are the product of a decrease in anabolic activityand the increase in tissue catabolism. This decrease in anabolism is essentially caused by a decrease in voluntary feed intake of essential nutrients. The decrease, especially metabolizable energy for both body maintenance and weight gain, causes a loss in the production per unit of feed (Habeeb et al., 1992; Marai and Habeeb, 1998). Exposure of sheep to elevated temperatures results in a decrease of body weight, average daily gain (ADG), growth rate andbody total solids (Abdel, 2002) and to solar radiation increased the loss in weight gain in the Comisana and Sardinian breeds of sheep (Nardon et. al., 1991).

CONCLUSION

It may be concluded from present study that the water intake and dry matter intake was at higher side in melatonin treated animals as compared to control group. It shows that during summer, buffalo calves treated with melatonin were at comfortable conditions and they were able to consume more feed and water as well.

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