Indian Journal of Animal Sciences **81** (9): 961–964, September 2011

Effect of yeast supplementation on feed intake and thermal stress mitigation in buffaloes

S P SINGH[1], O K HOODA[2] and PARVEEN KUMAR[3]

National Dairy Research Institute, Karnal, Haryana 132 001 India

Received: 26 August 2010; Accepted: 6 May 2011

Key words: Dry matter intake, Heat stress, Physiological responses, Yeast

ABSTRACT

Murrah buffaloes (18) divided into 3 groups of 6 animals each. Group 1 served as control, group 2 exposed to heat stress, group 3 exposed to heat stress and supplemented with yeast powder. The animals of heat exposed groups (group 2 and group 3) were kept at 40 °C for 4 h daily for 16 days. During the period of heat exposure animal's physiological responses were recorded at every fourth day. Dry matter intake recording and supplementation of yeast started 21 days before heat exposure. Feed intake recording was done daily. Supplementation of yeast resulted into significant increase in DMI of group 3 before thermal exposure and thereafter dropped marginally during heat exposure. DMI decreased significantly in group 2 due to heat stress. Physiological responses (RR, PR and RT) did not differ significantly in all the 3 groups before exposure to thermal stress. On exposing the animals at 40°C, RR, PR and RT increased significantly in all the 3 groups compared to beginning of the exposure. RR, PR and RT were significantly higher in groups 2 and 3 compared to group 1. In group 3, RR and PR dropped significantly and RT nonsignificantly compared to group 2, however, the values of all these parameters remained significantly higher compared to group 1. The results indicated that supplementation of yeast prevented decrease in DMI but RR and PR decreased significantly and RT nonsignificantly.

Key words: Dry matter intake, Heat stress, Physiological responses, Yeast

Heat stress is a major concern, which compromise productivity in tropics due to harsh environmental conditions (Silanikove *et al.* 1997). Heat stress results in increased respiratory frequency, pulse rate and rectal temperature, which in turn impose higher energy demand upon the animal body. Supplementation of yeast culture in the diet of dairy cows results in improvement of feed efficiency, this improvement may occur due to alteration in rumen fermentation pattern, improvement in digestibility and minimization of heat stress (Schingoethe *et al.* 2004, Shwartz *et al.* 2009, Meena *et al.* 2011). Fungal cultures marketed as feed additives for livestock have affected tolerance of dairy cows to hot environment (Huber *et al.* 1994). Higginbotham *et al.* (1993) fed Aspergillus oryzae to heat stressed cows and reported lower rectal temperature and respiration rate compared to control. In the present study effects of yeast supplementation on feed intake and physiological responses in buffaloes are reported.

Present address: [1]Scientist CIRG, Makhdoom, Mathura, Uttar Pradesh 243 189.

[2,3]Principal Scientists (e mail: hoodaomkanwar1 @gmail.com; drpk1959@gmail.com), Division of Dairy Cattle Physiology.

MATERIALS AND METHODS

Healthy buffalo heifers (18), weighing 270–280 kg, were divided into 3 groups of 6 animals each. Group 1, served as control throughout the experiment. Group 2, animals were exposed in a psychrometric chamber at 40°C for 4 h daily for 16 days. Group 3 animals were supplemented with dried yeast powder @ 10 g/ animal/ day (5×10^9 C F U) and were exposed at 40°C for 4 h daily for 16 days. The feed offered to animals was recorded daily. The recording of feed and yeast supplementation started 21 days before thermal exposure. The ration consists of wheat straw *ad lib*. and concentrates @ 2.5 kg/ animal/ day. Physiological responses were recorded at every fourth day during the exposure period in all the animals. In group1, recording was done at 8.00 am and 2.30 pm. In group 2 and group 3, the recording was done before exposure of the animals in psychrometric chamber and after 4 h of exposure. Respiration rate (RR) was recorded by flank movements per minute, pulse rate per minute recorded by palpation of coccygeal artery and rectal temperature was recorded by digital thermometer. The data obtained subjected to test of significance between different groups as per the methods described by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Average dry matter intake (DMI) of 21 days before exposure to thermal stress was significantly higher in group 3 compared to group 1 and group 2. After exposure at 40°C in a psychrometric chamber, the DMI of group 2 decreased significantly but no significant drop of DMI occurred in group 3. High feed intake is associated with high metabolic rate so a reduction of feed intake is a immediate response to heat stress (Blackshaw and Blackshaw 1994). The decreased DMI of thermal exposed animals may be due to the direct effect of elevated temperature on appetite center of hypothalamus. Homeostatic mechanisms attempt to maintain the body temperature during heat stress by reducing feed consumption. The reduction in feed intake with the corresponding decline in heat generated by rumen fermentation and body metabolism helps in maintenance of homeothermy (Sanchez *et al.* 1994).

The increase in DMI of group 3 (supplemented with yeast) in the present study are corroborated by other workers also. Huber (1998) reported improvement in appetite during heat stress in cattle supplemented with yeast. Yeast culture added to ruminant diets resulted in increased number of various types of rumen microbes which improved the nutrient digestibility and feed efficiency (Jouany and Morgavi 2007, Raeth-Knight *et al.* 2007) resulting in increased DMI and productivity (Shwartz *et al.* 2009). Williams *et al.* (1991) reported that yeast culture beneficially alters condition detrimental to cellulolysis, thereby increasing the DMI. The *in vivo* findings of experiments showed that the supplementation of yeast culture in the diet increased the palatability of feed, rate of fiber digestion, rate of digesta flow and nutrient digestibility (Kamra and Pathak 2005). Stabilization of rumen pH by increasing the number of lactic acid utilizing bacteria (Koul *et al.* 1998) and improvement in the appetite of heat stressed cows (Schingoethe *et al.* 2004) may be contributing factor for the prevention in drop of DMI during the periods of heat stress in yeast supplemented animals.

Rectal temperature increased significantly after 4 h of exposure compared to at the beginning of the exposure in all the groups throughout the exposure period starting from day first to day 16 of the exposure. The overall averages were also significantly higher (P<0.05) after 4 h of the exposure compared to beginning of exposure in all the 3 groups. The significant increase in rectal temperature of buffaloes was reported by Verma *et al.* (2000) and attributed it to the inability of the buffaloes to eliminate excess heat load due to low sweat glands per unit area. Higginbotham *et al.* (1993) and Huber *et al.* (1994) noticed lower RT in dairy cows during heat stress supplemented with yeast. In the present study RT of group 3 was lower than group 2 but the difference was nonsignificant. The exact mechanism of action of yeast to lower the RT is unknown. The previous authors suggested that the increase in feed efficiency due to yeast supplementation may aid into lowering the RT. A specific influence of fungal metabolites on temperature control centers of brain was reported (Huber *et al.*1994).

The respiration rate (RR) was comparable in 3 groups before exposure in psychrometric chamber. The values increased significantly in groups 2 and 3 after 4 h of exposure at 40°C on day Ist, 4th, 8th 12th and 16th of exposure (Table 2). The RR was significantly lower in group 3 compared to group 2 at the end of 4 h of exposure. The increase in RR after thermal exposure in the present study was corroborated by other workers (Das *et al.*1999, Verma *et al.* 2000, Vijay Kumar 2005) who also reported increase in RR of buffaloes due to exposure in hot environment. These authors suggested that increase in RR during heat stress is the means to dissipate heat for keeping the body temperature within the normal range. An increase in RR when animals are exposed to environmental temperature above the thermo-neutral zone is due to direct stimulation of peripheral temperature receptors that transmit nerve impulse to the heat center in the hypothalamus. The decrease in RR of group 3 supplemented with yeast cultures may be due to minimization of thermal stress as also suggested by Schingoethe *et al.* (2004).

After 4 h of exposure of animals to heat stress at 40°C, the pulse rate (PR) increased significantly compared to the beginning of the exposure in all the treatment groups throughout the exposure period starting from day first to day 16th of exposure. The overall mean averages of PR were significantly (P<0.05) higher in groups 2 and 3 compared to group 1 and the values of group 3 were significantly lower compared to group 2. These findings are in agreement with the findings of Joshi *et al.* (1982) and Gangwar (1988). Under

Table 1. Average dry matter intake (kg) before and during exposure to heat stress in buffaloes

Groups	Before exposure (days)				During exposure (days)					
	–21	–14	–7	Overall average	1	4	8	12	16	Overall average
Group 1	5.46^{a}±0.28	5.31^{a}±0.21	5.36^{a}±0.17	5.34^{a}±0.23	5.48^{a}±0.05	5.54^{a}±0.14	5.50^{a}±0.17	5.58^{a}±0.28	5.61^{a}±0.21	5.54^{a}±0.13
Group 2	5.35^{a}±0.28	5.41^{a}±0.24	5.48^{a}±0.23	5.42^{a}±0.25	5.95^{b}±0.14	4.60^{b}±0.09	4.80^{b}±0.11	4.95^{b}±0.16	5.01^{b}±016	5.06^{b}±0.10
Group 3	5.67^{a}±0.32	6.09^{b}±0.26	6.60^{b}±0.21	6.12^{b}±0.16	6.63^{c}±0.21	5.65^{a}±0.25	5.56^{a}±0.22	5.60^{a}±0.16	5.68^{a}±0.16	5.82^{a}±0.19

Means bearing different superscripts (a, b, c) differs significantly (P<0.05) in a column.

Table 2. Average physiological responses during exposure to heat stress in buffaloes

Groups	Ist day		4th day		8th day		12th day		16th day		Overall average	
	BE	AE	BE	AE	BE	AE	BE	AE	BE	AE	BE	AE
Rectal temperature (°F)												
Group 1	99.65^{A}	100.63^{Ba}	99.43^{A}	100.17^{Ba}	99.18^{A}	100.88^{Ba}	99.83^{A}	100.27^{Ba}	98.85^{A}	100.07^{Ba}	99.19^{A}	100.40^{Ba}
	±0.12	±0.16	±0.25	±0.13	±0.39	±0.23	±0.27	±0.24	±0.29	±0.27	±0.18	±0.14
Group 2	99.83^{A}	101.65^{Bb}	99.13^{A}	100.87^{Bb}	99.15^{A}	101.67^{Bb}	98.67^{A}	101.83^{Bb}	98.60^{A}	101.35^{Bb}	99.08^{A}	101.67^{Bb}
	±0.23	±0.14	±0.18	±0.15	±0.26	±0.15	±0.27	±0.18	±0.38	±0.39	±0.20	±0.11
Group 3	99.62^{A}	101.08^{Bb}	99.50^{A}	101.35^{Bb}	99.42^{A}	101.35^{Bb}	99.08^{A}	101.27^{Bb}	98.81^{A}	100.95^{Bb}	99.28^{A}	101.21^{Bb}
	±0.11	±0.15	±0.12	±0.11	±0.14	±0.11	±0.35	±0.11	±0.14	±0.20	±0.06	±0.05
Pulse rate (per minute)												
Group 1	49.04^{A}	49.00^{Aa}	50.33^{A}	55.67^{Ba}	48.08^{A}	50.33^{Ba}	45.83^{A}	52.67^{Ba}	43.67^{A}	49.00^{Ba}	47.32^{A}	51.33^{Ba}
	±0.34	±1.29	±1.41	±1.67	±0.61	±2.22	±0.98	±0.99	±0.96	±2.09	±0.55	±1.07
Group 2	49.00^{A}	61.30^{Bb}	49.33^{A}	64.00^{Bb}	49.67^{A}	61.33^{Bb}	43.67^{A}	61.00^{Bb}	43.67^{A}	58.00^{Bb}	47.44^{A}	61.13^{Bb}
	±0.45	±2.17	±0.67	±1.37	±0.62	±1.33	±1.50	±2.91	±1.89	±1.63	±0.56	±1.58
Group 3	50.67^{A}	54.30^{Bc}	50.67^{A}	57.33^{Ba}	49.96^{A}	58.33^{Bc}	45.58^{A}	56.05^{Bc}	46.00^{A}	54.00^{Bc}	48.78^{A}	56.43^{Bc}
	±1.61	±1.49	±1.23	±1.50	±1.10	±1.67	±0.58	±0.72	±0.73	±0.73	±0.76	±0.70
Respiration rate (per minute)												
Group 1	11.67^{A}	13.17^{Aa}	12.16^{A}	12.58^{Aa}	12.25^{A}	12.67^{Aa}	14.25^{A}	14.33^{Aa}	13.79^{A}	15.17^{Aa}	12.83^{A}	13.98^{Aa}
	±0.73	±0.40	±0.25	±0.58	±0.24	±0.42	±0.76	±0.62	±0.23	±0.54	±0.12	±0.23
Group 2	11.25^{A}	72.33^{Bb}	12.08^{A}	84.75^{Bb}	12.50^{A}	66.33^{Bb}	14.17^{A}	60.67^{Bb}	14.75^{A}	53.67^{Bb}	12.97^{A}	67.55^{Bb}
	±0.44	±3.70	±0.67	±2.46	±0.71	±5.23	±0.67	±7.76	±0.48	±1.75	±0.23	±1.70
Group 3	11.58^{A}	47.67^{Bc}	12.42^{A}	40.00^{Bc}	12.42^{A}	42.33^{Bc}	14.75^{A}	41.00^{Bc}	13.67^{A}	32.67^{Bc}	12.97^{A}	40.43^{Bc}
	±0.28	±1.96	±0.61	±1.16	±0.61	±1.74	±0.50	±1.53	±0.56	±0.84	±0.32	±0.47

Means bearing different superscripts (A, B) differ significantly (P<0.05) in a row at respective day for respective parameters; means bearing different superscripts (a, b, c) differ significantly (P<0.05) in a column for respective parameters. BE, before exposure; AE, after exposure.

conditions of high heat load, RR is responsible for only about 15% of heat loss (Finch *et al.* 1984), the bulk of heat must be lost through conduction, convection, radiation and evaporation from body surface. Increase in PR helps into reduction of heat load in animals by transferring heat from the core of the body to the skin by convection due to vasodilation (Blackshaw and Blackshaw 1994). Decreased PR of group 3 may be attributed to lowering of thermal stress by yeast supplementation. The study indicated that yeast supplementation prevented drop in DMI and significantly lowered physiological responses in heat exposed animals however these values were still significantly higher compared to control group.

REFERENCES

Blackshaw J K and Blackshaw A W. 1994. Heat stress in cattle and the effect of shade on production and behaviour. A review. *Australian Journal of Experimental Agriculture* **34**: 285–95.

Das S K, Upadhyay R C and Madan M L. 1999. Heat stress in Murrah buffalo calves. *Livestock Production Science* **61**: 71–78.

Finch A, Virginia B I L and Holmes C R. 1984. Coat color in cattle: Effect of thermal balance, behavior and growth and relationship with coat type. *Journal of Agricultural Sciences* **120**: 141–47.

Gangwar H. 1988. 'Studies on some physiological parameters of blood in crossbred bulls under tropical environment.' M.V.Sc. thesis submitted to Deemed University IVRI Izatnagar.

Higginbotham G E, Bath D L and Butler L J. 1993. Effect of feeding Aspergilus oryzae abstract on milk production and related responses in a commercial dairy herd. *Journal of Dairy Science* **76**: 1484–89.

Huber J T, Higginbotham G E, Gomez-Alarcon R A, Taylor R B, Chen K H, Chan S C and Wu Z. 1994. Heat stress interactions with protein, supplemental fat and fungal culture. *Journal of Dairy Science* **77**: 2080–90.

Huber J T. 1998. Yeast products help cattle handle heat. *Hoard's Dairyman* **143**: 367–72.

Joshi B C, Joshi H B, Guha S and Ahmad M S. 1982. Physiological responses of Murrah buffalo heifers to hot arid and hot humid micro environment. *Journal of Veterinary Physiology and Allied Sciences* **1**: 34–40.

Jouany J P and Morgavi D P. 2007. Use of natural products as alternatives to antibiotics feed additives in ruminant production. *Animal* **1**(10): 1443–66.

Kamra D N and Pathak N N. 2005. Improvement in livestock productivity by use of probitics. A review. *Indian Journal of Animal Sciences* **75**: 128–34.

Koul Veenta, Kumar Umesh, Vijay K and Singh S. 1998. Mode of action of yeast culture for stimulation of rumen fermentation in buffalo calves. *Journal of Food Science and Agriculture* **77**: 407–13.

Meena J P, Gupta Lokesh, Tiwari G S and Garg R. 2011. Effect of feeding probiotic mixture with untreated or urea treated wheat straw on nutrient utilization in growing crossbred males. *Indian Journal of Animal Nutrition* **28**: 39–43.

Raeth-Knight M L, Linn J G and Jung H G. 2007. Effect of direct fed microbials on performance, diet digestibility and rumen characteristics of Holstein dairy cows. *Journal of Dairy Science* **90**: 1802–09.

Sanchez W K, McGurie M A and Beede D K.1994. Macro mineral nutrition by heat stress interactions in dairy cattle. *Journal of Dairy Science* **77**: 2051–79.

Schingoethe D J, Linke K N, Kalscheur K F, Hippen D R and Yoon I .2004. Feed efficiency of mid lactation dairy cows fed yeast culture during summer. *Journal of Dairy Science* **87**: 4178–81.

Silanikove N, Maltz E, Nalvi A and Schinder D. 1997. Metabolism of water, sodium, potassium and chloride by high yielding dairy cows at the onset of lactation. *Journal of Dairy Science* **80**: 949–56.

Shwartz G, Rhoads M L, Vanbaale M J, Rhoads R P and Baumgard L H. 2009. Effect of supplemental yeast culture on heat stressed lactating Holstein cows. *Journal of Dairy Science* **92**: 935–42.

Snedecor G W and Cochran W G. 1994. *Statistical Methods*. 9th edn Oxford and IBH Publications. Publishing Co., New Delhi.

Verma D N, Lal S N, Singh S P and Prakash O. 2000. Effect of season on biochemical responses and productivity of buffaloes. *International Journal of Animal Sciences* **15**: 237–44.

Vijay Kumar P. 2005. 'Effect of thermal stress management on nutritional, physiological and behavioral responses of buffalo heifers.' Ph.D. Thesis Deemed University IVRI Izatnagar.

Williams P E V, Tait C A G, Innes G M and Newbold C J. 1991. Effect of inclusion of yeast culture in the diet of dairy cows on milk yield and forage degradation and fermentation patterns in rumen of steers. *Journal of Dairy Science* **69**: 3016–26.