

Physiological Responses of Hallikar Bullocks for Ploughing Work under Farming Conditions

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Abstract

The study was carried out in eight Hallikar bullocks aged three to five years maintained by the farmers for agricultural work at Manikikere Hosahalli, Tiptur taluk, Tumkur district, Karnataka which comes under the native tract of the breed. The pairs of bullocks were subjected to normal ploughing work followed for the cultivation of ragi crop, a small millet, using country made wooden plough with iron blade attached. Four hours of ploughing work was carried out continuously during morning session. Physiological responses such as heart rate (HR), pulse rate (PR), respiratory rate (RR) per minute, ruminal motility (RM) per five minutes and rectal temperature (RT) in degree Fahrenheit were recorded before and after ploughing work. The mean values at pre work and post work were 66.38±0.42 and 90.75±0.98 for HR, 62.92±0.37 and 88.33±0.99 for PR, 26.46±0.64 and 56.75±1.87 for RR, 4.75±0.14 and 4.33±0.13 for RM and 101.10 ± 0.06 and 103.70±0.10 for RT, respectively. The results showed significant ($P<0.05$) increase of all the physiological parameters except ruminal motility. It was concluded that the physiological changes during ploughing work could be associated with increased metabolism which is required to provide adequate energy and oxygen to the working muscles and also to dissipate heat. Further, the present study throws some light on the welfare measures to be followed for working animals, such as providing adequate nutrition, drinking water facility, shelter and as well as restricting the working hours to four during morning session.

Keywords: Hallikar bullocks; Ploughing work; Physiological responses

Introduction

Draught animal power is widely used in Indian farms along with mechanized agriculture since the majority of the farmers possess small and scattered land holdings (Singh, 1999). Hallikar is known as champion of draught purpose breeds distributed in southern districts of Karnataka such as Bangalore rural, Mysore, Mandya, Tumkur, Hassan, Chitradurga and Kolar (Narayana Swamy, 2008 and Singh *et al.*, 2008). Most of the farmers in these districts still depend largely on this breed for rou-

tine agricultural operations like ploughing, tilling, hauling and rural transportation.

The efficiency of physical work is the collaborative achievement of various organ systems such as musculoskeletal system, respiratory system, cardiovascular system, digestive system etc. The physical work could cause increased physiological responses to maintain homeostasis in terms of supply of nutrients and oxygen to the working muscles.

Since there was paucity of information, the present work was designed to study the physiological responses such as heart rate, pulse rate, respiration rate, rectal temperature and ruminal motility in Hallikar bullocks in their native tract for ploughing work under farming conditions.

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Materials and methods

The study was conducted at Manikikere Hosahalli, Tiptur taluk, Tumkur district, Karnataka, from June 2012 to August 2012 during rainy season wherein the bullocks were used for ploughing work of agricultural land by the farmers. Geographically, the place is situated at a longitude of 76.48oE, latitude of 13.26oN and the altitude of 861 meters above the mean sea level. Eight Hallikar bullocks trained and maintained by the farmers, aged three to five years were used in pairs for ploughing work.

The pairing was performed by the farmers on the basis of similarities in their body size and temperament and was yoked together. The ploughing work was carried out continuously for a period of four hours on each day of observation from 8.00 AM to 12.00 noon. Local traditional wooden ploughs with fixed iron blade, which are light weight, were used in every day ploughing work which was suitable for the cultivation of ragi crop. All the physiological parameters were recorded from the bullocks at three trials of ploughing work with an interval of ten days between each trial.

Recording of physiological parameters

Physiological parameters such as heart rate (HR), pulse rate (PR), respiratory rate (RR) per minute, rectal temperature (RT) in degree Fahrenheit and the number of ruminal motility (RM) per five minutes were recorded as per standard methods with-

out causing excitement to the animal. Initial readings were recorded before the start of the ploughing work. The readings after work were recorded within ten minutes of completion of ploughing work.

Statistical analysis

Data were analyzed with GraphPad Prism version 5.01 (2007) by using paired t- test. Significant or non-significant differences between the mean values were determined at P value of 0.05.

Results

The values of various physiological parameters are presented in Table 1. The per cent changes in the parameters are presented in Table 2. All the values increased significantly ($P < 0.05$) at post-work compared to pre-work except ruminal motility.

Discussion

There was significant ($P < 0.05$) increase in the heart rate and pulse rate at post work compared to pre work condition. The increase in heart and pulse rate due to four hours of ploughing work was 36.71 and 40 per cent, respectively (Table 2). The increase in HR and PR at a particular work load is an indicator of physiological response of cardiovascular system. The findings of the present study were in agreement with the reports in Sahiwal cattle (Singh *et*

Table 1. Mean \pm SE values of various physiological parameters in Hallikar bullocks used for ploughing work (n=8)

Sl. No.	Parameters	Pre-work	Post-work
1	Heart rate (beats per minute)	66.38 \pm 0.42 ^a	90.75 \pm 0.98 ^b
2	Pulse rate (numbers per minute)	62.92 \pm 0.37 ^a	88.33 \pm 0.99 ^b
3	Respiratory rate (numbers per minute)	26.46 \pm 0.64 ^a	56.75 \pm 1.87 ^b
4	Rectal temperature ($^{\circ}$ F)	101.10 \pm 0.06 ^a	103.70 \pm 0.10 ^b
5	Ruminal motility (numbers per five minutes)	4.75 \pm 0.14 ^a	4.33 \pm 0.13 ^a

Mean \pm SE values with different superscripts in a row differ significantly ($P < 0.05$)

Table 2. The per cent increase or decrease in physiological parameters in Hallikar bullocks after ploughing work

Sl. No.	Parameters	Mean of differences	Percent increase or decrease
1	Heart rate (beats per minute)	24.37	36.71 (increase)
2	Pulse rate (numbers per minute)	25.41	40.00 (increase)
3	Respiratory rate (numbers per minute)	30.29	114.00 (increase)
4	Rectal temperature ($^{\circ}$ F)	2.55	2.55 (increase)
5	Ruminal motility (numbers per five minutes)	0.42	8.77 (decrease)

al., 1970), Kangayam cattle (Sreekumar and Thomas, 1990; Kumaravelu *et al.*, 1997), Karan Swiss cattle (Panjeta and Verma, 1995), Haryana cattle (Yadav and Dhaka, 2001; Yadav *et al.*, 2001), Deoni X HF crossbreds (Pawar *et al.*, 2012) and Malvi bullocks (Singh *et al.*, 2013).

The increase in HR and PR during work could be attributed to providing of sufficient redistribution of blood to working muscles. Working muscle receives eighty per cent of total cardiac output as against the fifteen per cent of the resting muscle. In order to transport enough oxygen from lungs to the tissues, to meet increased energy requirements of muscles and to dissipate the extra heat load there will be increased heart rate which in turn results in increased cardiac output and pulse rate (Erickson and Poole, 2005).

The mean resting RR of Hallikar bullocks was 26.46 ± 0.64 , which got increased to 56.75 ± 1.87 per minute after work that accounted to 114 per cent increase in RR. The increase in RR due to ploughing work was in agreement with the findings of Singh *et al.* (1970) in Sahiwal cattle, Sreekumar and Thomas (1990) and Kumaravelu *et al.* (1997) in Kangayam cattle, Panjeta and Verma (1995) in Karan Swiss cattle, Yadav *et al.* (2001) and Yadav and Dhaka (2001) in Haryana cattle, Pawar *et al.* (2012) in Deoni X HF crossbreds and Singh *et al.* (2013) in Malvi bullocks. Physical work also increases metabolic rate and oxygen requirement wherein the chemical energy is converted to thermal energy. The increased RR could be due to thermal stress during working conditions and it is the compensatory effort to facilitate heat dissipation through respiratory route by evaporative mechanism. Further, in order to meet the oxygen demands of the working muscles, the respiratory rate and depth of respiration are increased (Karpovich and Sinning, 1971).

The mean pre work and post work rectal temperature were 101.10 ± 0.06 and 103.70 ± 0.10 , respectively, which was 2.55 per cent increase in rectal temperature. The increase in rectal temperature due to work was in conformity with the reports of Singh *et al.* (1970) in Sahiwal cattle, Sreekumar and Thomas (1990) and Kumaravelu *et al.* (1997) in Kangayam cattle, Panjeta and Verma (1995) in Karan Swiss cattle, Yadav *et al.* (2001) and Yadav and Dhaka (2001) in Haryana cattle, Pawar *et al.* (2012) in Deoni X HF crossbreds and Singh *et al.* (2013) in Malvi bullocks. As the body temperature

increases in response to the increased metabolism associated with work, the same is conducted to the periphery of the body by vasodilatation in peripheral veins thereby increasing the rectal temperature (Erickson and Poole, 2005).

The mean resting ruminal motility before the start of ploughing work was 4.75 ± 0.14 and immediately after four hours of ploughing work it was 4.33 ± 0.13 per five minutes. There was non significant ($P > 0.05$) difference between pre and post work values of ruminal motility.

The strength of the rumen contraction and the frequency of rumination are sensitive indicators of the well-being of the ruminant (Sjaastad *et al.*, 2003). The numerical decrease in ruminal motility observed in the present study might be due to inhibition of motor activity and secretory functions of the gastro intestinal tract during work due to stress and also due to decreased blood supply to viscera as hypothesized by Rasch and Wilson (1968) and Leak (2005). During heavy physical work the effective redistribution of blood takes place to different organs. The magnitude of blood supply to splanchnic organs was 30 per cent of cardiac output during rest which got reduced to only 3 per cent during physical work (Erickson and Poole, 2005).

Conclusion

It was concluded that the increase in physiological responses such as heart rate, pulse rate, respiratory rate, rectal temperature during ploughing work in Hallikar cattle in their native tract could be attributed to increased metabolism which is necessary to supply adequate energy and oxygen to the working muscles and to dissipate the heat to maintain thermal steady state. Since all the responses noticed in this study were within the normal physiological range, it also throws some light on the measures to be followed with respect to the welfare of the working animals, such as providing adequate nutrition, drinking water facility, shelter and as well as restricting the working hours to four during morning session.

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