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Research Article

ESTIMATION OF DRAUGHTABILITY AND RELATED BIOCHEMICAL PARAMETERS IN BARGUR AND KANGAYAM CATTLE

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Abstract- In the present study, draughtability and related biochemical parameters were estimated in two draught breeds of cattle *viz*., Bargur and Kangayam. The mean creatine kinase level in Bargur and Kangayam cattle were estimated as 128.00 ± 6.34 and 94.41 ± 3.84 units per litre respectively. The other parameter, lactic acid level averaged 30.86 ± 3.51 mg/dL in Bargur and 58.53 ± 4.11 mg/dL in Kangayam. The levels of creatine kinase and lactic acid were found to differ highly significantly (P<0.01) between Bargur and Kangayam. In Bargur, gender of the animal had significant (P<0.05) effect on the level of serum lactic acid. The means for draughtability parameters like speed and stride length of Kangayam cattle were 1.31 ± 0.03 m/s and 0.77 ± 0.01 m respectively. The respiration rate averaged 57.37 per minute. The level of bovine IGF1 in serum was 3.41 ± 0.30 ng/ml in Burgur and 3.11 ± 0.16 in Kangayam cattle. It was found that Kangayam cattle are superior and better adapted to all agricultural operations; while the medium-built Bargur is suitable for hilly areas.

Key words- *Draughtability, creatine kinase, lactic acid, Kangayam, Bargur*

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Introduction

Cattle represent the most significant development in village life. It not only provides more milk than required for its offspring, but its brute strength becomes an unprecedented addition to man's muscle power. In Tamil Nadu, Bargur and Kangayam are two popular draught breeds of cattle. Bargur cattle are light in built and are developed mainly for carrying out agricultural operations in uneven and hilly terrains of Bhavani taluk in Erode district [1]. Whereas, Kangayam cattle, an excellent draught breed, is suitable for all agricultural operations and hauling loaded carts; and well adapted to drought-prone areas of Coimbatore, Dindigul, Karur and Namakkal districts [2]. But, the draught power of Indian cattle is always a matter of research slackness despite their contribution of muscle power in all agricultural operations. However, based on 19th Livestock Census Report it becomes obvious that draught animal population in India has been steadily declining. There is a negative annual growth rate from 54.32 million in 2003 - 2007 to 39.85 million in 2012 [3]. Our native breeds of cattle have a compact body mass, physical structure and phenotypic adaptive changes, best suited for great pulling power much needed for our tropical agricultural work. When these draught animals are put into heavy work for prolonged period and/or under stressful condition, muscle damage occurs at different rates. The extent of damage and recovery from such damage could be associated with varying levels of certain biochemical parameters in the blood of cattle. The biochemical and haematological changes associated with short periods of work in draught oxen in three Brahman × Friesian cattle was studied [4]. They estimated various biochemical parameters but apart from lactate, no other parameter was identified useful for comparison of performances in animals. So, we considered lactic acid and creatine kinase levels in these two draught breeds, along with information on draughtability parameters to infer association between these parameters and the draught performance of the breeds considered for study.

Materials and Methods

Collection of serum samples and estimation of biochemical parameters

The levels of serum lactic acid and creatine kinase have long been used as markers of exercise intensity and training status. To estimate the level of these two parameters, 50 blood samples from each breed were collected separately without anticoagulant. These tubes were kept in slanting position till serum oozed out from the coagulated blood. For estimation of creatine kinase and lactate, commercially available diagnostic kits were utilised (Agappe Diagnostics kit-Catalogue No.11404002 and Trinity Biotech-Catalogue No.735-10 respectively). The kinetic determination of creatine kinase is based on the principle that creatine phosphate, combines with ADP to form creatine and ATP in presence of creatine kinase. While estimation of lactic acid is based on the principle that lactic acid is converted to pyruvate and hydrogen peroxide (H_2O_2) by lactate oxidase. In the presence of the H_2O_2 formed, peroxidase catalyses the oxidative condensation of chromogen precursors to produce a coloured dye with the maximum absorption at 540 nm.

The increase in absorbance at 540 nm is directly proportional to lactate concentration in the sample. The estimation of lactic acid and creatine kinase was carried out together in an automated spectrophotometer (AK15, Applied Biosystems) recommendations of the manufacturer. The samples were incubated for 18 minutes and absorbance was measured at 540 nm. The inbuilt software in the spectrophotometer estimated the levels of creatine kinase and lactic acid utilising the absorbance values of both standard and tests.

Estimation of draughtability data

Data on speed, stride length, respiration and time taken to cover a distance of 100 m were collected from 25 pairs of Kangayam bullocks with the cart load of river sand. These measurements were made when the animals were at peak of work. Whereas, these data could not be collected in Bargur animals as they were in grazing fields at the time of collection of blood samples. The speed of Kangayam bullocks was calculated by measuring the time taken to cover a particular distance of 100 m. Stride length was found by counting the number of steps taken to cover a known distance (100 m) and dividing it with the number of strides taken.

Estimation of serum IGF1 level

The serum Insulin-like growth factor (IGF-1) level was estimated using bovine insulin–like growth factor-1 (IGF1) ELISA kit (Catalogue No. CSB-E0889b), which employed the competitive inhibition enzyme immunoassay technique as the IGF-1 influences muscle gain, muscle mass and strength. The serum IGF1 levels were obtained by following the manufacturer's recommendations. Then the optical density of each well was determined within 30 minutes, using the microplate reader (Epoch, Biotek) set at 450 nm.

Statistical analysis

Differences in mean (±SE) biochemical changes in the two groups with unequal variances were tested with students' test [5]. Least-squares mean was calculated for both the biochemical parameters along with draughtability parameters [6]. Basic statistics like mean and standard error were computed from the draught power data.

Results and Discussion

The mean creatine kinase level in Bargur and Kangayam cattle were estimated at 128.00 ± 6.34 and 94.41 ± 3.84 units per litre respectively. The level of creatine kinase ranged from 71 to 189 and 52 to 117 U/L in the respective breeds. Creatine kinase (CK) is an enzyme that enables the regeneration of adenosine-5'-triphosphate (ATP) in contraction and transfer systems. CK becomes functional physiologically in the muscle cell. In each contraction cycle of the muscle, ATP is created by using creatine phosphate. This results in stabilising the ATP level in the muscle. In this reversible reaction, CK functions as a catalyser. Another enzyme used for the evaluation of the damage in skeletal muscle, is lactate dehydrogenase (LDH) that catalyses the transformation of pyruvate into lactate during glycolysis. The other parameter, lactic acid level averaged 30.86 ± 3.51 mg/dL in Bargur and 58.53 ± 4.11 mg/dL in Kangayam. The values ranged from 6.1 to 56.6; and 25.6 to 109 mg/dL in the respective breeds. The variations in the concentration of creatine kinase (CK) and lactate dehydrogenase (LDH) were found to exist in serum in response to skeletal muscle damage, resulting from exercise. It was stated that the serum LDH level in damage emerged after exercise, reached the highest level in the first 6th hour and returned to normal between 48th to 72nd hour after exercise [7]. Similarly, the recovery rate of CK after exercise was also reported to vary [8] according to the severity of damage. It was stated that CK reached the highest level at the end of 24 hours period after exercise; it began to decrease at about 48 hour later and returned to pre-exercise level at 72nd hour later. It was also found that creatine kinase in serum was of outstanding significance in enzymology of heart and skeletal muscle because of its high sensitivity and relative specificity [9]. According to their investigation, only skeletal muscle and heart muscle contained large amount of creatine kinase. Thus, considerable increase in the CK activity in serum almost exclusively reflected damage to skeletal muscle. Among these two parameters, the level of creatine kinase was more in Bargur; while the level of lactic acid was high in Kangayam cattle. The least-squares means for the pooled data revealed 113.453 ± 13.89 U/L of creatine kinase and 53.880 ± 10.10 mg/dL of lactic acid in the bovine serum [Table-1].

Table-1 General and least-squares means of biochemical and draughtability parameters

Parameters	No. of observations	General mean	Least-squares mean
Creatine kinase (U/L)	100	111.313 ± 4.42	113.453 ± 13.89
Lactic acid (mg/dL)	100	45.745 ± 3.26	53.880 ± 10.10
IGF-1 (ng/mL)	100	3.263 ± 0.17	2.735 ± 0.50
Speed (m/sec)	50	1.304 ± 0.03	1.280 ± 0.08
Stride length (m)	50	0.770 ± 0.01	0.745 ± 0.01
Respiration / min	50	57.375 ± 1.23	58.455 ± 3.85

The level of creatine kinase and lactic acid were found to differ highly significantly ($P<0.01$) between Bargur and Kangayam cattle. In Bargur, gender of the animal had significant ($P<0.05$) effect on the level of lactic acid in the serum since females were also used for agricultural work. But gender effect was not found in creatine kinase in Bargur. The normal values of creatine kinase and lactic acid in bovines usually lie between 213.4 and 367.5 units per litre [10] and 28.2 to 31 mg/dL [11] respectively. The values estimated for lactic acid in Bargur and Kangayam breeds are higher than the normal values mentioned above; because the samples were collected from Bargur animals while at grazing and from Kangayam while at peak of work. The biochemical parameters like serum creatine kinase and lactic acid of two Indian draught breeds, Nimari and Malvi was estimated with assessment of the overall draughtability of the two breeds [12]. Overall draughtability and estimation of the biochemical parameters revealed breed differences during oxidative stress. There was wide variation in the levels of creatine kinase and lactic acid among Indian draught cattle populations. The creatine kinase level in Bargur cattle is higher than the levels reported in Malvi and Nimari cattle before carting and ploughing. Since, the breeding tract of Bargur cattle is hilly and undulating terrain; the level of creatine kinase appeared to be more which would result from exhaustion of the animal while climbing in search of fodder. But the level of creatine kinase in Kangayam cattle (at peak of work) was lower than Malvi and Nimari (post-carting and post-ploughing). The lower value of creatine kinase in Kangayam indicates better adaptability of this breed to the kind of work they are put into (hauling heavy load, ploughing under extreme climatic conditions, *etc*). While the higher level of lactic acid found in Kangayam cattle (than Bargur cattle) indicates the intense muscular activity resulting from hauling heavy load of river sand (2 to 2.5 tonnes during summer months), that the circulatory system takes some time to cope up at once to bring enough oxygen and glucose to the muscle. But the value of lactic acid estimated in the present study is far (many fold) below the values reported for Malvi and Nimari cattle. The reason for such difference in the value could be attributed to the breed differences. Carting and ploughing are the two major types of work performed by the draught animals in agriculture. Any programme for genetic improvement of draughtability should be aimed at improving the capacity for both types of work [13]. In the present study, the draughtability parameters based on carting in Kangayam cattle was considered. The means for draughtability parameters like speed and stride length of Kangayam cattle were found to be 1.31±0.03 metres per second and 0.77±0.01 metres respectively. The respiration rate in Kangayam cattle during work averaged 57.37 per minute. While the least-squares means for the respective parameters were 1.280±0.08 metres per second, 0.745±0.01 metres and 58.455±3.85 per minute respectively [Table-1]. In the present study better performance of Kangayam bullocks was demonstrated when compared to the earlier study [14], who reported the corresponding values as 1.114 ± 0.028 m/sec and 0.88 ± 0.20 metres in Kangayam cattle. The speed of Kangayam cattle recorded in this study is higher than that of other indigenous cattle breeds reported such as 0.99 m/sec in Hariana bullocks [15], 0.93 m/sec in Jersey × Red Sindhi crossbreds [16], and lower than 1.59 m/sec in Ongole bullocks [17]. However, it was considered that each ox had a rate of movement best suited to its gait and an average of 0.88-1.20 m/sec was considered as the normal rate [18].

The serum levels of bovine IGF-1 estimated in the present research through enzyme linked immunosorbent assay (3.41 ± 0.3 ng/ml in Bargur and 3.11 ± 0.16 ng/ml in Kangayam cattle) is lower than the level in Andalusian horses (240 and 120 ng/ml) [19]. But the level of IGF-1 expressed in young and growing cattle will be many fold higher [253 ± 3 and 65 ± 3 ng/mL] for young males and females respectively, [20,21] .The least-squares means for the pooled data was 2.735 ± 0.50 ng/ml [Table-1]. However, the expression level of this gene did not differ between these two breeds. The level of serum IGF1 in cattle could not be compared due to lack of literature.

Conclusion

There was a wide variation in the levels of creatine kinase and lactic acid among the Bos indicus draught breeds. The lower level of creatine kinase in Kangayam cattle indicated better adaptation of this breed to heavy load hauling in extreme climatic conditions. Whereas, the higher level of lactic acid revealed the intense muscular activity of the Kangayam cattle. The results, however, need to be tested in a larger sample of animals for a better conclusion for the draught performance of the two breeds. The variations observed in this study at the biochemical level can be used to evaluate and compare oxidative stress in draught animal breeds. In general, Kangayam cattle have better performance with respect to biochemical parameters. It could be inferred that Kangayam is best suited for all agricultural operations in the dry, hot and harsh climatic zones, whereas the medium-built Bargur breeds made them more suitable for agricultural operations in the hilly and undulating terrain.

Application of research: This biochemical marker based approach would pave the way for selecting the animals with better draughtability and will also help in implementing rational decisions for conservation and improvement of our treasured indigenous genetic resources. Further, in today's mechanized carbon world, the effect of global warming is at an alarming rate. In this context, natural resource like Draught Animal Power (DAP) can reduce the demand on fossil fuel and can surely contribute to a better green world.

Research category: Animal Genetics

Abbreviations:

IGF-1 = Insulin like growth factor – 1
CK = Creatine kinase
LDH = Lactate dehydrogenase

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