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Influence of Seasonal Variation on Biochemical Parameters in Murrah Buffalo

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The examination was carried out to study the effect of hot-humid and cold seasons on biochemical parameters in adult female Murrah buffalo (N=10). The blood samples were collected aseptically from jugular vein and serum was separated from each blood sample. All biochemical parameters i.e. serum metabolites including renal function tests were examined by the automated blood analyzer of biochemistry (Turbochem100). A highly significant impact of hot-humid and cold season was observed on the mean±SE values of Cholesterol, Uric acid and Urea whereas a non-significant effect was observed on Creatinine and Total Bilirubin concentrations.

Keywords: Murrah buffalo; biochemical; cholesterol; uric acid; urea; creatinine; bilirubin.

1. INTRODUCTION

"In the numerous developing countries, buffalo plays an important role in the agricultural economy that providing draught power, meat and milk. The greatest Asian buffaloes hold the ensure potential for production of all the domestic animals" [1]. "The Murrah Buffalo (*Bubalus bubalis*) is a domestic breed of water buffalo, kept for dairy production. Murrah breed of buffaloes have a massive body, comparatively long neck and head, short and tightly curved horns, well developed udder, broad hips and drooping fore and hind quarters. Behind tail is longer reaching up to the fetlocks. The body of color is usually jet black with occasionally found white markings on tail, face and extremities. Murrah breed has the best dairy cows of the world in performance. Since, it has been a known fact that a portion of the metabolizable energy used for production is diverted to assure thermal balance under uncomfortable environmental conditions, particularly beyond an animal's thermo-neutral zone. Therefore, under environmental stress, productivity is reduced. Both heat and cold stress affect the productivity in Cows as well as buffaloes, but very little information is available about physiological response of these animals to extreme seasonal conditions. The alteration of haemato-biochemical parameters is major marker for physiological and pathological states of the animal" [2,3]. Summer and winter stress causes rigorous changes in the blood biochemical and hormonal concentration and thereby reducing the production performance of the animals [4].

2. MATERIALS AND METHODS

2.1 Experimental Animals and Their Feeding and Management

Ten adult healthy females of Murrah breed of buffalo (higher up three years of age, weighing about 300-350 Kg) were included in our study, reared at Livestock farm complex (LFC) Buffalo farm at Post Graduate Institute of Veterinary Education and Research, (P.G.I.V.E.R.), Jaipur (Rajasthan). It is a hot semi-arid zone of northern India, located at 26.9° N and 75.8° E, 1417 feet above the sea level. "The experimental animals were maintained under uniform manage mental farm practices. They were housed in clean and ventilated sheds. Green fodder (Berseem/ Lucerne and Oat as per availability due to season) was provided in the shed along with concentrate mixture @ 5 kg per animal per day" [1].

2.2 Collection, Processing and Preservation of Samples

Blood samples of adult female Murrah buffalo were collected during the hot-humid and cold season from the same animals (N=10). Blood sample from each animal was taken on any single day of the month/season, to estimate the biochemical parameters in Murrah buffalo under seasonal variation. "Blood samples each (5 ml) were collected germfree from jugular vein with peaceful stress to animals, directly into the non-EDTA vials in order to analyze different biochemical parameters. Non-EDTA vials were kept undisturbed for 15–30 minutes in slanting position at 45˚ angles at room temperature allowing the blood to clot and removed the clot by centrifuging at 2500–3000 RPM for 15 minute. The resulting supernatant (serum) was harvested and used for estimation of serum metabolites including renal function tests and minerals. This serum samples were stored at -20°C temperature up to the performance of the assay" [1].

2.3 Details of Analytical Procedures

The present investigation was carried out at Department of V.P.B., P.G.I.V.E.R., Jaipur,

Rajasthan, India. Analytical procedure is presented in following sub-head:

2.3.1 Biochemical studies

The blood biochemical parameters were estimated from serum which was stored in deep freezer (-20°C). The kidney function tests (urea, uric acid and creatinine) and metabolites (bilirubin and cholesterol) were estimated by using automated TurboChem 100 blood biochemistry analyzer by using Jeva Diagnostic Kits in the Department of Veterinary Physiology and Biochemistry, P.G.I.V.E.R., Jaipur.

2.3.2 Statistical analysis

The results were presented as mean±SE. The data was analyzed statistically as per Snedecor and Cochran using t-test: Put together to Samples for Means and results were noted [5].

3. RESULTS AND DISCUSSION

3.1 Renal Function Test and Serum Metabolites

The mean±SE values of serum creatinine, uric acid and urea during hot humid and cold season are presented in Table 1.

3.2 Serum Creatinine

The mean±SE values of serum creatinine (mg/dl) in hot-humid and cold season were interpreted as 1.73±0.12 and 1.91±0.11, respectively. The mean±SE value of serum creatinine was non-significantly higher in cold season as compared to hot-humid.

Determining to the current study were suggested AL-Saeed et al. [6] who noticed significantly higher values during the winter season as compared to summer season in local cattle. Ghosh et al. [7] also reported the same results in Goat.

Current results were opposite to the findings of Dar et al. [8] who reported that serum creatinine levels were significantly increase during summer season in Badri cattle. Mazzullo et al. [9] revealed that the levels of creatinine were increased in summer season along with increased renal activity and increased protein catabolism as compared to cold season in cow. Pandey et al. [10] in Marwari goat, Rathwa et al. [11] in Indigenous sheep and Bargaa et al. [12] in Moroccan camel observed the similar results. Increased serum creatinine values in cold season could be due to increased activity of metabolic in the muscle and liver due to caused by heat stress. Creatinine stimulated metabolism in liver could result in increase creatinine formation.

3.3 Serum Uric Acid

The mean±SE values of serum uric acid (mg/dl) in hot-humid and cold season were measured as 0.78±0.16 and 18.02±0.68, respectively. The mean±SE value of serum uric acid was highly significantly increase in cold season as compared to hot-humid season.

The outcome of the current study regarding increase serum Uric acid during cold season cannot be compared with the outcome of the other scientist because no literature is available with that regard.

Current results were opposite to the findings of Giri et al. [13] who reported higher uric acid during summer season than winter season in dairy cows. Rathwa et al. [11] in Indigenous sheep also reported the same.

“Heat stress due to cause peripheral vasodilation to lose body heat and lower the blood flow to the internal organs that result in lowered blood flow to the kidney. In addition to that, dehydration may also cause lowered blood flow to kidney as hot environment due to cause dehydration in the animals. So, the lowered blood flow to kidney may lead decrease urine formation and thereby decrease excretion of uric acid. Higher serum uric acid levels may also be associated with useless rumen ammonia incorporation in to microbial protein or hepatic deamination of amino acids, mobilized from skeletal muscle” [1].

3.4 Serum Urea

The mean±SE values of serum urea (mg/dl) in hot-humid and cold season were noted as 13.40±3.27 and 49.28±7.31, respectively. The mean±SE value of serum urea was significantly increased in the cold season as compared to hot-humid season.

Determining to this study were observed by Abdou et al. [14] who reported significantly higher values during cold season compared to summer season in postpartum period in newly parturition female buffaloes. Giri et al. [13]

observed the higher BUN values during cold season as compared to summer season in the dairy cows. Shrikhande et al. [15] in cattle also observed the same results.

Current results were opposite to the findings of Dar et al. [8] who reported that the blood urea levels were significantly increase during summer season as compared to cold season in Badri cattle. Mazzullo et al. [9], Chandrashekhar et al. [16] and Rasooli et al. [17] in cattle, Urwat et al. [18] in the goats. Bargaa et al. [12] in the camel and Rathwa et al. [11] in Indigenous sheep reported similar results.

"As the case may be attributed to the lower in ruminal ammonia-nitrogen which is compensated by the higher absorption of urea nitrogen by rumen causing the lower of blood urea and the higher of urinary nitrogen excretion. The urea transport occurs by simple diffusion, but is more variable. A significant higher of urea influx due to caused by the fermentation products short-chain fatty acid and CO_2. High metabolic and immune parameters are noted during winter which suggests an adaptive significance in buffalo against ecological stress and pathogenic invasion. Higher serum urea noticed the increased activity of hepatocytes as a result of stress due to extreme seasons which could influence the urea cycle" [1].

The mean±SE values of the metabolites i.e. serum cholesterol and total bilirubin according to the effect of hot-humid and cold season in Murrah buffalo have been presented in Table 2.

3.5 Serum Cholesterol

The mean±SE values of serum cholesterol (mg/dl) in hot-humid and cold season were observed as 102.90±6.07 and 171.53±12.09, respectively. The mean±SE value of serum cholesterol was significantly increased in cold as compared to hot-humid season. Determining to the current study were observed by Rasooli et al. [17] in cattle, Pandey et al. [10] in Marwari goats, Urwat et al. [18] in Changthangi, Pashmina goats and Rathwa et al. [11] in Indigenous sheep. Dar et al. [8] observed that cholesterol levels were significantly higher during winter season as compared to summer season in Badri cattle.

Table 1. The effect of Hot-humid and cold season on Mean±SE values of Serum Creatinine, Uric Acid and Urea in the Murrah buffalo (N=10)

Parameter	Season	Mean±SE	Observation
Creatinine (mg/dl)	Hot-humid	1.73±0.12	NS
	Cold	1.91±0.11	
Uric Acid (mg/dl)	Hot-humid	0.78±0.16	**
	Cold	18.02±0.68	
Urea (mg/dl)	Hot-humid	13.40±3.27	**
	Cold	49.28±7.31	

N = *No. of Animals*
NS = *Non-significant (P>0.05)*
** = *Highly Significant (P≤0.01)*
* = *Significant (P≤0.05)*

Table 2. The effect of Hot-humid and Cold season on Mean±SE values of Cholesterol and Total Bilirubin in the Murrah buffalo (N=10)

Parameter	Season	Mean±SE	Observation
Cholesterol (mg/dl)	Hot-humid	102.90±6.07	**
	Cold	171.53±12.09	
Total Bilirubin (mg/dl)	Hot-humid	0.08±0.06	NS
	Cold	0.11±0.06	

N = *No. of Animals*
NS = *Non-significant (P>0.05)*
** = *Highly Significant (P≤0.01)*
* = *Significant (P≤0.05)*

Hozyen et al. [19] found that the serum cholesterol level was significantly lower during summer and autumn seasons when compared to winter and spring seasons. The effect of heat stress could be related to the low fertility in buffalo in the summer season. This variation may be attributed to lower liver activity during summer period. Decreased blood cholesterol in heat stressed animals was attributed to decreased thyroid activity resulting in lower metabolic rate. Current results were opposite to the findings of Bargaa et al. [12] in Moroccan camel. "The higher levels of circulating cholesterol during hot-humid might support the enhanced cortisol synthesis that occurs during heat stress as the cholesterol acts as a precursor for the synthesis of steroid hormones in the body. That increase in circulating cholesterol could also support hepatic gluconeogenesis during adaptive mechanisms" [1].

3.6 Serum Total Bilirubin

The mean±SE values of Serum total bilirubin (mg/dl) in hot-humid and cold season were showed as 0.08±0.06 and 0.11±0.06, respectively. The mean±SE value of Serum total bilirubin was non-significantly higher in cold as compared to hot-humid season. Determining to the current study were observed by AL-Saeed et al. [6] who reported that the levels of serum bilirubin were significantly lower in summer season as compared to winter season in local cattle. Mazzullo et al. [9] reported that the total bilirubin levels were lower in summer as then to winter season in the cow.

Current results were opposite to the findings of Dar et al. [8] in Badri cattle. Total bilirubin is often increased due to periods of anorexia under heat stress conditions.

"Determination of serum total bilirubin is valuable for the diagnosis of fatty liver in animals. Serum bilirubin occurs in the normal catabolic pathway breaking heme as a fate of RBC which is the excreted in bile and urine in higher concentration in blood were indicative of diseases. This seasonal variation might be due to different species, environmental and physiological conditions in the animal" [1].

4. CONCLUSION

The murrah buffalo does not adapted to seasonal weather changes in the environment it was found in research. A highly significant (P≤0.01) effect of hot-humid and cold season was observed on values of Uric acid, Cholesterol and Urea whereas, a non-significant (P>0.05) effect of season was observed on the Total Bilirubin and Creatinine concentration. It is concluded that seasonal variation also alters various renal functions as Uric acid, Urea and Creatinine are the markers of renal functions.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative artificial intelligence technologies such as Large Language Models (Chat GPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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