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Assessment of hormone status during complete lactation in Murrah buffaloes

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Haryana is the home track of the world-famous Murrah buffaloes, renowned for their high milk production capability. Still, graded Murrah buffaloes are found throughout the country owing to their nonpareil milk production potential coupled with acclimatization to broad ecological conditions and feed conversion proficiency (Kumar *et al.* 2017).

Growth hormone (GH) imparts an exceptional range of biological effects on growth and lactation. One well-corroborated biological action of GH is the stimulation of insulin-like growth factor-1 (IGF-1) production, and it is now postulated that many of the effects of GH are mediated by IGF-1. One of the crucial effects of GH and IGF-1 in ruminants is on mammary gland development and lactation. GH does not alter mammary glucose transporter capability but changes the intracellular glucose metabolism favouring lactose synthesis (Nielsen *et al.* 2001).

An imperative yardstick of a ruminant's energy status is its glucose concentration which is expended by the mammary gland to amalgamate milk lactose (Surya Prakash *et al.* 2018). It has been ascertained that in cows yielding 20 L of milk a day, glucose above 1 kg is converted by the mammary glands. This delivery and mammary gland uptake regulates milk synthesis proficiency. Ensuing the inception of lactation, it is thought that insulin-independent glucose uptake in the body except the mammary gland regresses, and insulin resistance in the whole body progresses (Komatsu *et al.* 2005).

Selection of animals: Out of the 20 animals, n=15 animals that completed 210 days of lactation were included in the study. All the experimental animals were healthy lactating Murrah buffaloes in their 2nd–4th lactation. Buffaloes having a BCS score of a minimum 2.5 and about to parturate were included in the study. These buffaloes were aged between 5–7 years, and their average milk yield was 8–16 L/day. The animals were neither artificially inseminated nor allowed to mate throughout the study.

Calculation of temperature humidity index: Dry bulb and wet bulb temperature was recorded on days 7th, 15th of parturition and after that on fortnight intervals on days 30th, 45th, 60th, 75th, 90th, 105th, 120th, 135th, 150th, 165th, 180th, 195th and 210th of lactation. The THI was calculated by using the National Research Council formula:

$$THI = (Tdb + Twb) \times 0.72 + 40.6$$

Blood sampling: Blood samples were collected aseptically, just after milking, on 7th and 15th day of parturition and after that at fortnightly intervals (days 30th, 45th, 60th, 75th, 90th, 105th, 120th, 135th, 150th, 165th, 180th, 195th and 210th of lactation) till 210 days of lactation (drying-off) from the same buffaloes throughout their lactation period by jugular vein puncture into serum clot activator tubes to separate the serum.

Hormone assay: The serum IGF-1 was estimated using KINESISDx Bovine IGF-1 ELISA kit, Cat No: K04 – 0046. The growth hormone and insulin concentration were estimated by Radioimmunoassay (RIA) method, whereas glucose was estimated by standard method. The assay procedure for evaluating the above hormones was followed as per the directives given in the leaflet enclosed within the kit by the manufacturer.

Statistical analysis: Data variance analysis was done according to Snedecor and Cochran (1998) using a complete randomized design. Differences in means were tested using the critical difference (CD) test.

The mean ± SE of serum THI, GH, IGF-1, insulin, and glucose concentrations from 7th-210th day of lactation in Murrah buffaloes are presented in Table 1.

It was observed that the GH varied significantly ($P<0.01$) in early lactation (up to day 45) and after that decreased gradually in the mid and late lactation phase and was found lowest on day 210. The growth hormone concentration diminished as lactation advanced and did not vary with the changes in THI. Similar results have also been observed by Djokovic *et al.* (2015). Growth hormone executes an imperative control in nutrient partitioning in the lactating cow. The growth hormone fulfills this role by increasing the supply of energy metabolites for milk synthesis rather than directly controlling the mammary gland. Hepatic gluconeogenesis is the fundamental glucose source in high-yielding dairy cows, and about 60–85% of

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Table 1. Mean±SE of serum THI, GH, IGF-1, insulin and glucose concentrations from 7th-210th day of lactation in lactating Murrah buffaloes

Days of lactation	THI	GH (ng/ml)	IGF-1 (ng/ml)	Insulin (µU/ml)	Glucose (mg/dl)
07	74.94	9.13^{a} ± 0.06	643.59^{a} ± 42.92	10.18^{l}±0.39	40.15^{h}±2.12
15	75.52	9.08^{ab}± 0.05	553.99^{abc}± 36.95	13.30^{k}±0.45	62.81^{def}±4.58
30	78.33	9.02^{bc} ± 0.04	586.29^{ab} ± 35.35	15.30^{j}±0.46	51.36^{fgh}±5.35
45	83.08	9.04^{bc}±0.03	503.60^{bcd}± 38.17	16.69^{ij}±0.49	50.62^{gh}±5.41
60	80.63	8.96^{c}± 0.02	463.91^{bcd}± 20.40	19.46^{efg}±0.63	71.03^{bcd}±5.92
75	81.57	8.86^{d}± 0.02	393.64^{d} ± 30.29	21.87^{cd}±0.88	56.05^{efg}±4.63
90	83.08	8.75^{e} ± 0.03	402.68^{d} ± 30.48	24.11^{ab}±0.59	48.53^{gh}±3.72
105	85.96	8.59^{f} ± 0.02	512.90^{bcd}± 78.20	25.47^{a}±0.61	50.10^{gh}±3.48
120	80.2	8.33^{g} ± 0.04	396.94^{d}± 63.86	23.95^{ab}±0.91	66.41^{de}±3.47
135	82.36	8.02^{h} ± 0.02	440.64^{cd}±35.15	22.87^{bc}±0.76	67.17^{cde}±5.17
150	81.64	7.92^{i} ± 0.02	421.62^{d}±40.92	20.92^{de}±0.61	81.70^{ab}±5.75
165	77.32	7.78^{j} ± 0.02	508.62^{bcd}±31.17	19.66^{ef}±0.35	90.60^{a}±3.17
180	78.76	7.53^{k} ± 0.02	447.23^{cd}±33.82	18.56^{fgh}±0.28	86.89^{a}±3.18
195	80.2	7.37^{l} ± 0.03	459.68^{bcd} ±77.68	18.04^{ghi}±0.25	45.13^{gh}±3.26
210	81.86	7.05^{m} ± 0.02	430.23^{cd}±46.33	17.75^{hi}±0.48	78.87^{abc}±2.80

Mean values within a column with no common superscript differed significantly (P<0.01).

this glucose is appropriated for milk synthesis (Bines *et al.* 1980).

The concentration of IGF-1 was highest on day 7 of lactation and lowest on day 75 of lactation. During early lactation, it decreased from day 7 to day 30 of lactation, significantly (P<0.01), and after that, its concentration in serum remained as such except increasing flutters on days 105, 135 and 165 of lactation is in accordance with Kirovski *et al.* (2012) in lactating cows. In ruminants, the action of growth hormone on the mammary gland is thought to be mediated mainly by the IGF-1 signalling axis (Etherton 2004). During the present research also, contemporaneous amendments were perceived between growth hormone and IGF1 concentrations. In this experiment, although IGF-1 concentration was low when the THI was high. No deducible relationship was perceived, validating that the key factor governing the level of IGF-1 is the stage of lactation and not the THI.

The serum insulin concentrations differed significantly (P<0.01), the concentration was steady up to day 90 and then started to fall from day 105 of lactation. However, the concentration did not go back to its starting minimum concentration. The sudy results of the serum insulin concentrations during the different lactational stages corresponded with the previous results of Fiore *et al.* (2018) in lactating buffaloes. Glucose homeostasis is the core of production physiology wherein the insulin and a cascade of hormones adapt to downgrade tissue metabolism to facilitate superior nutrient availability for mammary gland metabolism (Fiore *et al.* 2015). Herbein *et al.* (1985) pronounced that lower insulin in early lactation would facilitate substrate utilization to meet lactational glucose requirements during the negative energy balance. The low insulin concentration seen during early lactation in our experiment can be attributed to the negative energy balance during this phase, affirming the contention that cows in early lactation are physiologically under more production stress than in mid or late lactation.

Serum glucose was significantly (P<0.01) moderate during early lactation and mid-lactation. Serum glucose concentrations were troughed on days 30, 45, 90 and 105 and crested on 150, 165 and 180 days of lactation. Generally, the levels were marginal immediately after parturition at the beginning of lactation and augmented after that. Early lactation was marked with subsided and mid-lactation by surging serum glucose concentrations in the present study, which is in accordance with Naser *et al.* (2014). The stress of parturition and utilization of serum glucose for milk lactose biosynthesis can be attributed to low serum glucose on day 7 postpartum. During the present experiment, serum glucose values maintained an inverse relationship with THI, wherein it was perceived that serum glucose was low, whenever the THI was high.

The correlation coefficient between the THI and insulin was significantly (P<0.01) and positively (r = .798) correlated, whereas IGF-1 was also considerably (P<0.05) but negatively (r = -.570) associated with THI from day 7 to day 210 of lactation in lactating Murrah buffaloes.

Therefore, it is concluded that insulin was significantly and positively correlated with THI and IGF-1 was found to have a significantly negative correlation with THI. The concentration of GH during early lactation and insulin during mid-lactation was higher in the present study. However, glucose was low during early lactation, and its concentration increased as the stage of lactation moved towards late lactation.

SUMMARY

The present study was conducted on (n = 15) Murrah lactating buffaloes; the objective was to study the hormonal profile and its correlation with the temperature-humidity index (THI) during the complete lactation of the Murrah

buffaloes. The blood samples were collected on 7th and 15th day of parturition and thereafter at fortnightly intervals on days 30th, 45th, 60th, 75th, 90th, 105th, 120th, 135th, 150th, 165th, 180th, 195th, and 210th of lactation and on same days THI was recorded. The results showed significant variations in the concentrations of growth hormone (GH), insulin like growth factor-1 (IGF-1), insulin, and glucose during lactation period in Murrah buffaloes. However, Insulin was significantly and positively correlated with THI. Whereas, IGF-1 observed significant but negative correlation with THI.

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