ASSOCIATION BETWEEN THE LACTOGENIC HORMONES AND MILK COMPONENTS IN MITHUN (*Bos frontalis*)

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To find out the association between major plasma lactogenic hormones and milk constituents in mithun, milk samples were collected from 11 mithun cows of 2-6 parity from the day of calving till dry off. Various milk constituents were estimated as per standard method. Serum growth hormone (GH), prolactin, cortisol and thyroid hormones (triiodothyronine, T₃ and thyroxine, T₄) were estimated by commercially available ELISA kits. A significant positive correlation (P<0.01) was found between total milk yield and lactogenic hormones except for T₄, which was negatively (P<0.01) correlated with milk yield. Milk protein content was found to be negatively correlated with cortisol (P<0.01), prolactin (P<0.05) and T₄ (P<0.05). Milk fat content was negatively (P<0.01) correlated with lactogenic hormones except T₄. Milk solid not fat (SNF) was positively correlated with lactogenic hormones where as milk total solids were negatively (P<0.01) correlated with the lactogenic hormones. In conclusions, this study confirmed the positive effect of lactogenic hormones (GH, prolactin, cortisol) on milk yield and negative effect on milk fat and protein content in mithun.

Key words: Hormone, Lactation, Milk constituents, Mithun

India ranks first in milk production in the world. Most of this milk is produced from cattle and buffalo. Though the per capita availability of the milk is more than the requirement as recommended by World Health Organisation (WHO), but the production level is not uniform throughout the country. In North-Eastern Hill region (NEHR) for difficult terrain and geomorphology, the population of cattle and buffalo is less, whereas the population of other bovine viz. mithun, yak are more.

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even they are reared in free range system. Therefore, it is important to standardize the milk production from nonconventional resources like camel (Sahani et al., 1998), yak (Das et al., 1998), llama and vicuna to meet the demand for milk in those areas. Mithun (Bos frontalis) is a rare bovine species, found mainly in the high altitude (300 to 3000 m mean sea level) of NEHR. Mithun has immense potentiality to produce milk with higher nutritive value compared to cattle (Mondal et al., 2001 and Mech et al., 2008). To explore the lactation potentiality and persistency, regulation of specific components of milk in response to hormones needs to be investigated. Therefore the present study was designed to find out the association between plasma lactogenic hormones and milk constituents in mithun (Bos frontalis).

The study was carried out in the farm of Indian Council of Agricultural Research (ICAR) - National Research Centre on Mithun (NRCM), Jharnapani, Medziphema, Nagaland. A total of 11 mithun cows of 2-6 parity were selected for the present study. Milk from all the experimental animals were collected in the morning at 07.00 AM and 03.00 PM in the afternoon from each animal in separate sterile container. The milk samples were collected from the day of calving till dry off. Various milk constituents viz. milk protein, milk fat, milk lactose, milk SNF, milk total solid (TS) along with total milk yield were estimated as per standard methods.

The blood samples were collected aseptically from jugular vein in a sterile vacutainer without anti coagulant. The samples were collected in the early morning fortnightly from all the animals. The samples were immediately transferred to laboratory in an ice container and the extracted serum was preserved in deep freezer (- 20°C) until further processing. Serum growth hormone, prolactin, cortisol and thyroid hormones (T<sub>3</sub> and T<sub>4</sub>) were estimated by commercially available ELISA kits (LDN Labor diagnostic Norb GmbH & Co) as per manufacturers’ protocol.

The correlation between the lactogenic hormones and milk constituents was obtained by Spearman rank order correlation by using the software SPSS. The significance was tested at 5% level (P<0.05) and 1% level (P ≤ 0.01).

The association between lactogenic hormones and milk constituents has been presented in Table 1. A significant positive correlation (P<0.01) was found between total milk yield and lactogenic hormones, except for T<sub>4</sub> which is negatively (P<0.01) correlated with milk yield. Milk protein content was negatively correlated with cortisol (P<0.01), prolactin (P<0.05) and T<sub>4</sub> (P<0.05). Milk fat content was negatively (P<0.01) correlated with lactogenic hormones, except T<sub>3</sub>. A non significant positive correlation was observed between lactogenic hormones and milk lactose content. Milk SNF was found to be positively correlated with lactogenic hormones where as milk total solids were
Table 1. The association between lactogenic hormones and milk components in mithun (*Bos frontalis*)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Cortisol</th>
<th>GH (uIU/mL)</th>
<th>PRL (uIU/mL)</th>
<th>T3 (nmol/mL)</th>
<th>T4 (ng/mL)</th>
<th>Milk protein (gm/dL)</th>
<th>Milk fat (%)</th>
<th>Milk lactose (%)</th>
<th>Milk SNF (%)</th>
<th>Milk TS (%)</th>
<th>Milk ash (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total milk collection (mL)</td>
<td>0.79**</td>
<td>0.73**</td>
<td>0.78**</td>
<td>0.76**</td>
<td>(-)0.30**</td>
<td>(-)0.28*</td>
<td>(-)0.58**</td>
<td>0.18</td>
<td>0.33**</td>
<td>(-)0.30**</td>
<td>(-)0.21**</td>
</tr>
<tr>
<td>Cortisol</td>
<td>0.80**</td>
<td>0.87**</td>
<td>0.77**</td>
<td>(-)0.21*</td>
<td>(-)0.34**</td>
<td>(-)0.80**</td>
<td>0.11</td>
<td>0.48**</td>
<td>(-)0.39**</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>GH</td>
<td>0.78**</td>
<td>0.72**</td>
<td>(-)0.20</td>
<td>(-)0.27</td>
<td>(-)0.70**</td>
<td>0.11</td>
<td>0.23</td>
<td>0.23</td>
<td>(-)0.50**</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>PRL (uIU/mL)</td>
<td>0.78**</td>
<td>(-)0.26**</td>
<td>(-)0.33*</td>
<td>(-)0.74**</td>
<td>0.26</td>
<td>0.43**</td>
<td>(-)0.38**</td>
<td>(-)0.04</td>
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<tr>
<td>T3 (nmol/mL)</td>
<td>(-)0.11</td>
<td>(-)0.30*</td>
<td>(-)0.64**</td>
<td>0.13</td>
<td>0.32*</td>
<td>(-)0.37**</td>
<td>0.04</td>
<td></td>
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<tr>
<td>T4 (ng/mL)</td>
<td>(-)0.03</td>
<td>(-)0.01</td>
<td>0.02</td>
<td>0.09</td>
<td>0.06</td>
<td>0.21</td>
<td></td>
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<tr>
<td>Milk protein (gm/dL)</td>
<td>0.62**</td>
<td>(-)0.09</td>
<td>(-)0.11</td>
<td>0.51**</td>
<td>0.11</td>
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<tr>
<td>Milk fat (%)</td>
<td>(-)0.18</td>
<td>(-)0.35**</td>
<td>0.68**</td>
<td>0.04</td>
<td></td>
<td></td>
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<tr>
<td>Milk lactose (%)</td>
<td>0.01</td>
<td>(-)0.16</td>
<td>(-)0.02</td>
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<tr>
<td>Milk SNF (%)</td>
<td></td>
<td>0.44**</td>
<td>0.03</td>
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<tr>
<td>Milk TS (%)</td>
<td></td>
<td>0.07</td>
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*P<0.05 and **P<0.01
negatively (P<0.01) correlated with the lactogenic hormones.

The pituitary - thyroid axis is an important physiological factor for controlling metabolic processes and milk secretion (Schams et al., 1991). In lactating bovines, a complex interaction of several key metabolic hormones (GH, PRL, thyroid hormones and glucocorticoids) leads to mobilization of major substrates for milk synthesis during galactopoiesis (Tucker, 2000) which support the significant positive correlation between the lactogenic hormones and total milk yield in this study. The action of growth hormone in milk production in concern with this study may be due to the production of IGF-I from either the liver or from cells in the mammary stroma via endocrine, paracrine, or autocrine mechanisms (Forsyth, 1996).

In this study, plasma T₄ was negatively correlated with milk yield which may be due to higher activity of de-iodinase in the mammary gland results in local production of T₃ from T₄ and stimulates metabolism in the gland leads to reduction in T₄ level in blood (Tucker, 2000).

Present study showed that the milk fat and milk protein were negatively correlated with GH, prolactin and cortisol. Similar opinion was made by Bauman et al. (1985), who observed that though all these hormones had positively correlation with total milk yield, but milk fat and milk protein either not altered or not showed any significant relationship when used exogenously; Eppard et al. (1985) observed that a slight decrease in milk protein percentage was occurred when exogenous GH introduced. Plaut et al (1987) also observed no correlation between exogenous prolactin administration and concentration of milk constituents. Some studies reported that suckling induced release of glucocorticoids in cows which was found to be persistent throughout lactation (Koprowski and Tucker, 1973) and cortisol levels showed a significant negative relationship with nitrogen balance (Motil et al., 1994).

However, species specific variations in endocrine control of mammary growth and function were documented earlier (Forsyth, 1996). This was also supported by Linn (1988), who stated that milk fat percentage and composition can be changed through feeding, whereas milk protein percentage is best changed through genetics.

In present study no significant correlation was observed between milk lactose content and levels of lactogenic hormones, which was in accordance with the earlier reports of Shao et al. (2013) in cows.

In conclusions, our study confirmed the positive effect of lactogenic hormones (GH, prolactin, cortisol) on milk yield and negative effect on milk fat and protein content in mithun.
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