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PRODUCTION PERFORMANCE OF LACTATING NILI-RAVI BUFFALOES UNDER THE INFLUENCE OF BOVINE SOMATOTROPIC HORMONE WITH VARYING LEVELS OF DIETARY ENERGY

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ABSTRACT

The study was conducted to determine the effect of dietary energy on milk yield and its composition under the influence of bST in *Nili Ravi* buffaloes. Multiparous buffaloes (n=12) at early lactation and similar level of production were selected and randomly divided into three groups. Each group was fed one of the following three dietary treatments viz., low energy density + bST (LED + bST), medium energy density + bST (MED+ bST), and high energy density + bST (HED+ bST). The LED, MED and HED diets were furnished with energy densities of 85, 100 and 115% of NRC. standards, respectively. Four animals were allotted to each treatment following completely randomized design. All the experimental animals were injected bST at fortnightly intervals after 7±2 d. postpartum for a period of 60 d. The nutritional requirements of these animals were met through a total mixed ration with different densities of energy. The increase in milk yield on HED ration was significantly higher ($P<0.05$) than for the LED and MED diets. The difference in the milk yields between the LED and MED rations was non-significant ($P>0.05$). Feed efficiencies differ significantly ($P<0.05$) among treatments. Nutrient intake (except for ether extract) was significantly ($P<0.05$) higher on the LED ration than the other two other rations. However, milk composition and body weight gain were similar for all the rations. Results indicated that in early lactation bST administration with 15% higher dietary energy than recommended by NRC has favorable effect on the production performance of *Nili-Ravi* buffaloes.

Key words: Bovine somatotropic hormone; Nili-Ravi buffaloes; milk yield; dietary energy.

INTRODUCTION

Pakistan has approximately 31.7 million buffaloes, which contribute more than 62% of total milk production in the country (Anonymous, 2011). Nili- Ravi is the most popular breed of buffalo,which constitutes about 76.6% of the total buffalo population in Pakistan (Otto *et al*, 2003). In spite of this large number, per animal productivity is low as compared with western dairy cattle breeds. The average milk production is 7-8 kg/d at farm level, which needs to be increased to make this animal more profitable as well as to meet the protein requirements of the ever-increasing human population in the country. Breeding and genetic selection failed to increase much the amount of milk produced by buffaloes as did for cows (Otto *et al.,* 2003). The biotechnological treatment (bST) supported by appropriate nutrition can be a feasible substitute.

Bovine somatotropin (bST) improves efficiency of milk yield by partitioning nutrients toward the mammary gland for increased milk synthesis (Carriquiry *et al.,* 2008). A reduced response might be associated with the energy and metabolic status of the cow (Leonard and Block, 1997). In early postpartum, high yielding cows experience a negative energy balance because of low energy intake relative to energy demand for maintenance and milk yield, which may limit their ability to respond to exogenous bST. During periods of negative energy balance endogenous bST is high, but concentrations of Insulin Growth Factor-1 (IGF-I) and insulin are low and have ultimately effect on plasma level of leptin, which counteract on milk production of the cow (Block *et al*., 2001).

Usually energy requirements are increased as milk yields are elevated by bST. The requirements appear to be met primarily by an increase in feed intake. The dietary fat supplements fed in early lactation and during bST treatment may help to increase the energy density of the ration and to improve the metabolic efficiency of energy utilization for milk production (Srivastava and Mudgal, 1984). However, some studies have shown that dietary energy concentration in excess of NRC recommendations does not significantly affect responses to bST for any variables measured (Tarazon-Herrera *et al.* 2000). The objective of the present study was to determine the optimum dietary energy level for early lactating buffaloes receiving exogenous bST.

MATERIALS AND METHODS

A 60 d feeding trial was conducted to determine the optimum level of energy in the ration of *Nili Ravi* buffaloes being administered bST. Twelve multiparous buffaloes in early-lactation having similar milk yield (8.0 ± 1 kg/d), parity and 500 ± 20 kg body weight were selected from the herd of Livestock Experiment Station, Rakh Dera Chahl, Lahore, Pakistan (31° 32' 59" North, 74° 20' 37" East). These animals were randomly divided into three groups, each having four animals. Each group was allotted to one of the experimental treatments as low energy density + bST (LED + bST); medium energy density + bST (MED+ bST); and high energy density + bST (HED+ bST). All of the experimental animals were injected with bST (Boostin -250™) @ 250 mg/animal on fortnightly intervals during 60-d study period. The body weights of the experimental animals were regularly recorded at fortnightly interval using weighbridge.

The maintenance and production requirements of individual animal were met through total mixed rations (TMR) with different levels of ME. The TMR was fed to individual animal twice daily with amount adjusted to approximately 10% in excess of appetite and water was offered *ad libitum.* The ingredients and nutrient composition of the experimental rations is presented in Table 1. The feed consumption was recorded daily to evaluate production efficiency of experimental groups.

Representative samples of TMR and orts were weekly collected and stored at room temperature prior to analysis. These samples were dried at 60°C and milled 1mm screen in hammer mill (Lab mill-1 QC-114, Hungary) for proximate analysis following the procedure of AOAC, (2000) and the cell wall constituents (NDF and ADF were analyzed according to the procedures described by Van Soest *et al.* (1991). The gross energy of the TMR was determined through the IKA C-2000 Bomb Calorimeter, while metabolizable energy (ME) was calculated as 63% of the gross energy (Mandal *et al.,* 2003). Feed efficiency of the experimental rations was determined with the help of following formula:

Feed efficiency = milk produced (kg) / dry matter intake (DMI): Buffaloes were hand milked twice daily at 03:00 and 1500 h. Milk production in the morning and evening was weighed and recorded. The recording of milk production commenced in the adjustment period (-1 week) prior to bST treatment and continued for two months (completion of the trial). Milk samples were collected on weekly basis and representative samples were used to determine fat and SNF contents by using Gerber and Rapid methods, respectively (FAO, 1986). Total solids (TS) and lactose percentage were determined according to the methods described by AOAC (1990), while crude protein (CP%) was analyzed with Kjeldahl methods portrated by Brtish Standards Institution (1990).

Statistical analysis: Data obtained on milk production, milk composition (fat, SNF, total solids, milk protein, ash and lactose), DMI, feed efficiency and weight gain were statistically analyzed using one way analysis techniques (CRD) with the help software *MINITAB* ®15.1.1.0. Least significance difference test was applied to compare the difference between the treatment means (Steel, *et al*., 1997). The statistical model used for all parameters:

$Y_{ij} = \mu + t_j + \varepsilon_{ij}$

Where Yij is the dependent variable, μ is the over all mean, tj is the treatment effect, and εij is the difference within treatment mean

RESULTS AND DISCUSSION

Milk production: The average daily milk yield of the bST administered animals fed LED, MED or HED was 7.90, 8.16 and 8.88 kg/d, respectively (Table 2). The weekly milk production trend of the three treatment groups is shown in Figure 1. The average daily milk yield of animals fed HED ration was significantly higher (P<0.05) than other rations but the difference was non-significant (P>0.05) between MED and LED. The increase in milk yield of HED group was due to the effect of their higher energy intake since the dietary protein level and management was the same for all three groups. Rosi *et al*. (2003), Shingu *et al.* (2009), Azza *et al.* (2010) and Chaiyabutr *et al.* (2011) reported that administration of bST causes a shift in partioning of available energy towards milk yield at the expense of body tissue, so that an energy dense diet may be needed. Contrary to the findings of the present study Tarazon-Herrera *et al.* (2000) found that milk yield response was greater for bST treated cows fed a low rather than a high-energy diet. Difference may be attributed to stage of lactation or type of animal used.

The increase in milk production started within a week of bST administration, as previously reported by the Bauman (1992), and this improved response was maintained throughout the study period. Similar results were reported by NRC (1994) with maximum milk yield being reached within a week of bST treatment and declining with the same rate when treatment was terminated. However, Chalupa *et al.* (1996) reported that bST treatment started to improve milk production efficiency five weeks after bST administration in dairy cows.

The average milk fat, SNF, total solids, protein and lactose percent are shown in Table 3. The energy density of the diet had no effect (P>0.05) on any of these parameters. Bauman, (1989) found that bST treatment did not affect milk composition due to the homeorhetic control involved in the metabolism of lipid, carbohydrates and amino acids. The results of present study are also consistent with previous findings of Terrazon-Herraera *et al.* (2000) and Khattab *et al.* (2008)

who did not record any effect of bST administration on milk composition (SNF, fat, protein and lactose) in western dairy cows with varying level of dietary energy. Contrary to the findings of the present study Carriquiry *et al.* (2008) found that milk fat and protein response was decreased for bST treated cows fed high-energy diet. Difference may be attributed to type of animal used.

Body weight change: The average weight gain of animals over the trial period fed rations LED, MED and HED was 5.75, 4.75 and 5.00 kg, respectively (Table 2) which did not differ significantly (P>0.05). Srinivasa-Rao and Rangandham (2000) and Jorge *et al.* (2002) reported that body weight was not affected on administering bST to buffaloes, whilst Huber *et al.* (1997) noted that body weight was increased up to 37% in cows injected with bST for four consecutive lactations. However, Moallem *et al.* (2000) observed a decrease in body weight in dairy cows despite an increased DMI after bST treatment.

Feed intake and feed efficiency: There was a significant decrease (P<0.05) in DMI as the energy density of the diet increased (Table 3). However, there was a concomitant improvement in average feed efficiencies (milk yield / kg DMI) as 0.61, 0.66 and 0.74 for LED, MED and HED, respectively (Table 2). The improvement in feed efficiency with energy density of the diet was linear with an improvement (P<0.05) of 8.2 and 21.3% for MED and HED groups, respectively compared to LED. Abo El- Nor *et al.* (2007) suggested that the magnitude of increase in feed intake depends upon milk yield and energy density of diet. Results of this study indicate that feed intake increases as energy density of the diet decreases. Drackley *et al.* (2003), Gully *et al.* (2004), and Carriquary *et al*. (2009) also found feed efficiency was improved in bST treated dairy cows fed a high-density ration. This was achieved by altering the nutrient in a manner that provides the mammary glands increased access to substrate supplies that may be utilized for milk production rather than increasing adipose tissue store. Bauman *et al.* (1992) observed that daily nutrient requirements were increased by an amount equal to the increase in milk, and productive efficiency (milk per unit of feed) was improved because a greater proportion of the nutrient intake was used for milk synthesis.

Table 1. Ingredients and chemical composition of total mixed rations offered to bST treated *Nili- Ravi* buffaloes during 60 d. postpartum.

Ingredients (%)	A	B	C
	LED	**MED**	**HED**
Corn gluten meal 30%	-	20.00	14.00
Corn gluten meal 60%	-	-	4.00
Corn grain (ground)	9.00	12.50	25.00
Rice polishing	-	11.00	20.00
Wheat bran	22.00	-	-
Cotton seed cake	16.00	8.00	-
Sun flower meal	4.00	5.00	-
Wheat straw	18.00	24.50	27.00
Molasses	19.00	15.00	-
Magalac	-	1.50	5.00
Mineral mix**	1.00	1.00	1.00
Calcium carbonate	1.00	0.50	-
Nutrient composition			
Dry matter	90.30	91.60	92.01
Crude protein	12.04	12.08	12.08
Metabolizable energy (Mcal/kg)	2.05	2.35	2.70
Neutral detergent fiber	35.40	35.10	35.32
Acid detergent fiber	20.45	20.07	20.63
Calcium	0.84	0.85	0.80
Phosphorus	0.45	0.45	0.45

*Magalac: Commercial protected fat

**Mineral mixture contained (per kg): Dicalcium phosphate 708g; Magnassium sulphate 86.4 g; Sodium choloride 189.2 g; Ferous sulphate 8.9 g; Manganese sulphate 4.9 g; Zinc sulphate 2.2 g; Copper sulphate 0.3 g; Potassium iodide 87.7 mg; Cobalt choloride 8.9 mg and Sodium selenate 15 mg.

Table 2. Effect of bovine somatotropic hormone (bST) administration on productive performance of Nili- Ravi buffaloes fed varying levels of dietary energy (mean± SE) during 60d. postpartum.

Variables	LED (+ bST)	MED (+ bST)	HED (+ bST)
Milk production (kg/d)	7.90 ± 0.11 [a]	8.16 ± 0.06[a]	8.88 ± 0.0.20[b]
Milk composition (%)			
Fat	7.00 ± 0.12	6.46 ± 0.16	7.09 ± 0.13
Solid not fat	9.02 ± 0.12	8.94± 0.09	8.95 ± 0.09
Total solid	16.07 ± 0.03	15.40 ± 0.09	16.05 ± 0.08
Crude protein	3.35 ± 0.05	3.27 ± 0. 10	3.24 ± 0.07
Lactose	4.65 ± 0.08	4.63± 0.08	4.86 ± 0.09
Body weight gain during 60 day postpartum period (kg)	5.75 ± 0.64	4.75 ± 1.10	5.00 ± 1.08
Feed efficiency (kg of milk yield/ DMI)	0.61 ± 0.01[a]	0.66 ± 0.01[b]	0.74± 0.01[c]

[abc]Means with different superscripts in a row differ significantly (P< 0.05)

Table 3. Effect of bovine somatotropic hormone (bST) administration on daily nutrient intake of *Nili- Ravi* buffaloes fed varying level of dietary energy (mean ± SE) during 60 d. postpartum.

Nutrients Intake (Kg/d)	LED (+ bST)	MED (+ bST)	HED (+ bST)
Dry matter intake	11.67 ± 0.06 [a]	11.17 ± 0.11[b]	10.85 ± 0.06[c]
Crude protein	1.40 ± 0.01[a]	1.34± 0.01[b]	1.30± 0.04 [c]
Neutral detergent fiber	4.77 ± 0.02[a]	4.00 ± 0.04[b]	3.73 ± 0.06
Acid detergent fiber	2.70 ± 0.01[a]	2.30 ± 0.02 [b]	2.02 ± 0.01[c]
Ether extract	0.37 ± 0.06[a]	0.39 ± 0.01 [b]	0.46± 0.01 [c]
Ash	1.56 ± 0.01[a]	1.55 ± 0.01 [a]	1.27 ± 0.00[c]

[abc]Means within a row bearing different superscripts differ significantly (P<0.05)

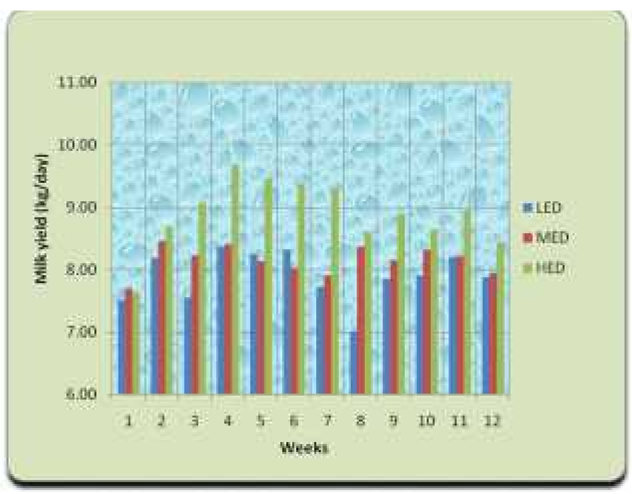

Figure 1 Trend of milk production Nili-Ravi Buffaloes fed low, medium and high-energy rations during 60 d postpartum.

Nutrients intake: The average daily nutrient intakes (crude protein, NDF, ADF, ether extract and Ash) are shown in Table 3. As the energy density of the diet decreased, individual nutrient intakes (with the exception of ether extract fraction) increased (P<0.05). This was to overcome the energy requirements in response to increasing milk yield with bST. The magnitude of increase in DMI depends upon the response in milk yield, the method of bST administration and the energy density of the diet Moallem *et al.* (2000), Dohoo *et al.* (2003) and Helal and Lasheen (2008) concluded that DMI increased linearly as milk production increased when animals are injected with bST. This increase in nutrients may be attributed to the homeorhetic regulation of bST. Results of the present study however, indicate that responses in DMI will be modified by the energy density of the diet being fed to the animals being administered bST.

Conclusion: The administration of bST with high energy density enhanced the milk yield with better feed efficiency in buffaloes. However, energy density did not have impact on milk composition and body weight. Present findings suggest that bST administration with high energy diet might be effective in allowing greater profits for buffaloes at early stage of lactation.

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