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PRODUCTION PERFORMANCE O LACTATING NILI-RAVI BUFFALOES UNDER THE INFLUENCE OF SOMATOTROPIC HORMONE WITH VARYING LEVEL 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 bovine somatotropic (bST) hormone in Nili Ravi buffaloes. Multiparous buffaloes (n=12) at mid lactation and similar level of production were selected and randomly divided into three groups (A, B and C) with four animals in each group in a completely randomized design. All the experimental animals were injected bST at fortnightly interval after 60 ± 3 days postpartum for a period of 90 days. The nutritional requirements of these animals were met through total mixed ration with different densities of energy (high energy density, 115 %; medium energy density, 100 %; and low energy density, 80 % of NRC, 2001 standards). The increase in milk yield on high energy density (HED) ration was significantly higher (P<0.05) than medium energy density (MED) and low energy density (LED) diets. However, the difference was non significant between MED and LED rations. The values for feed efficiency were 0.61, 0.66 and 0.74 on LED, MED and HED diets and difference was significant (P<0.05) with best efficiency on ration HED. Difference in nutrient intake on LED ration was significantly higher (P<0.05) (except for ether extract) than other two other rations. However, the milk composition and body weight gain were similar on all rations. Results indicated that 15% higher energy than recommended by NRC, favored milk production in Nili-Ravi buffaloes when they were given bST hormone.

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

INTRODUCTION

Bovine somatotropin (bST) improves efficiency of milk yield by partitioning nutrients toward the mammary gland for increased milk synthesis (Santos *et al.,* 1999). Responses to bST are highly dependent on overall management practices before and after initiation of treatment (Bauman, 1992). Studies reported that dietary energy has vital role in response of bST because milk yield is dependent upon the increase of glucose supply to the gland, if bST is to increase milk yield, then it must act in way to direct glucose to gland. Sometimes the reduced response might be associated with the energy and metabolic status of the cow (Leonard and Block, 1997). Energy requirements are increased because milk yields are elevated by bST which appears to be met primarily by an increase in feed intake (Peel and Bauman, 1987). Because the restoration of body energy stores during late lactation is important to yield in subsequent lactations, 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). In contrast few of studies reported that dietary energy concentration in excess of NRC recommendations did not significantly affect responses to bST for any variables measured (Hemken *et al.,* 1991; Larmore *et al.,* 1990). In addition to that, most of the available literature on bST hormone is related to the cattle, whereas buffalo, which is the main dairy animal in Asia, has not been studied extensively with respect to dietary energy level during lactation with bST. Hence, the present study was planned to determine the optimum dietary energy level for lactating buffaloes receiving exogenous bST.

MATERIALS AND METHODS

Experimental design: A 90-days feeding trial was conducted to determine the optimum level of energy in ration under the influence of bovine somatotropic hormone in Nili-Ravi buffaloes. For this purposed 12 multiparous buffaloes in mid lactation and similar level of milk yield (8-10 kg daily) were selected from the herd maintained at Livestock Experiment Station Rakh Dera Chahal, Lahore. These animals were randomly divided in to three groups i.e. A, B and C with four animals in each group. All the experimental animals were injected with recombinant bovine somatotropic hormone (bST) with trade name of Boostin -250. The dose level was 250 mg per animal and injection was given at fortnightly interval during study period. The study lasted for three months. Individual feeding was carried out during the study.

Experimental rations: The maintenance and production requirements of individual animal were met through total mixed rations (TMR) with varying levels of metabolizable energy (ME). Three iso-nitrogenous experimental diets (TMRS) with varying levels of energy (15% below and 15% above) from the recommendations of NRC, (1989) were prepared (Table1). TMR was offered twice daily to fulfill the requirement according to schedule and water was offered *ad libitum*.

Table 1: Ingredients and Chemical Composition of Total Mixed Rations (TMRS) offered with administration of bST in Nili Ravi buffaloes

Ingredients	A	B	C
	LED	**MED**	**HED**
Corn gluten meal 30%	10.00	11.50	19.00
Corn grain	-	12.50	15.00
Rice polishing	-	10.50	19.00
Wheat bran	25.00	6.00	-
Cotton seed cake	15.00	11.00	-
Sun flower meal	5.50	7.50	6.50
Wheat straw	25.00	24.00	22.00
Molasses	17.50	14.50	13.00
Magalac+	-	1.00	4.0
Mineral mix.-	1.00	1.00	1.00
Calcium carbonate	1.00	0.50	0.50
Nutrituent compsition			
Dry matter %	90.30	90.60	90.80
Crude protein %	12.00	12.00	12.00
Metabolizable energy(Mcal/ kg)	2.03	2.35	2.69
Neutral detergent fiber%	40.88	35.90	33.88
Acid detergent fiber%	23.38	20.75	18.70
Calcium%	0.84	0.84	0.84
Phosphorus%	0.45	0.45	0.45

+Magalac: Commercial protected fat

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

Milk production and composition: Buffaloes were hand milked twice daily at 03.00 and 15.00 h. Milk production of morning and evening was weighed and recorded. The recording of milk production was started from adjustment period (-1 week) prior to bST treatment and continued till the completion of trial. Milk samples were collected on weekly basis and representative samples were used to determine Fat %, Solid not fat (SNF %) by using Gerber and Rapid methods, respectively described by FAO, (1986). Total solids (TS %) and lactose % were determined by using method no 925.21 and 930.28, respectively described by AOAC, (1990). Crude protein (CP %) was analyzed with Kjeldahl method according to BSI, (1990). The milk analysis was carried out at the Laboratories of Animal Nutrition Centre, Rakh Dera Chahl, and Lahore.

Feed consumption: The feed consumption data were recoded daily to evaluate production efficiency of the experimental groups whereas the representative samples of TMR and refusals (orts) were analyzed weekly for proximate analysis (DM, CP, EE, CF and Ash percentage) according to AOAC, (2001) and the cell wall constituents (NDF% and ADF%) according to Robertson and Van Soest, (1991). The gross energy of the TMRS was determined through the Bomb Calorimeter in Laboratories of Food and Nutrition department, University of Veterinary and Animal Sciences, Lahore.

The body weights of the experimental animals were regularly recorded at fortnightly interval using weighbridge available at the farm. The body weights were recorded just to check whether the animals were maintaining their body weights or not and particularly what is the effect of bST hormone on the body condition of the animals.

Statistical Analysis: Data thus obtained on milk production, milk composition (fat, solid not fat, total solids, milk protein, ash and lactose), dry matter intake, feed efficiency, weight gain and nutrient intake were statistically analyzed by using completely randomized designed (CRD). Least significance difference test was applied to compare the difference between the means (Steel *et al.,* 1997). The statistical model used for all parameters was:

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

Where

μ = Over all means

t_j= Effect of treatments (3 treatments)

ϵ_{ij} = Difference within treatments means

RESULTS AND DISCUSSION

Milk production: The average daily milk yield of experimental groups with low energy density (LED), medium energy density (MED) and high energy density (HED) treated with bST was 7.90, 8.16 and 8.88 kg /d, respectively (Table II), while the weekly milk production trend with in the groups is given fig. 1. Data showed that there were variations in milk yield among the groups and statistical analysis revealed that the difference was significant ($P<0.05$). Average daily milk yield on HED ration was significantly higher than MED however, difference was non significant between ration MED and LED. The significant difference revealed that the increase in milk yield of HED group might be due to the effect of high-energy intake for increased milk production in response to bST, since the dietary protein level and management was same for three groups. It may be mentioned that lower energy levels in MED and LED rations was unable to fulfill the energy requirement of buffaloes in response to milk yield increase with bST. Results of the present study are inline with the results of Larmore *et al.,* (1990) and McGuffey *et al.,* (1990) who reported that administration of bST causes a shift in portioning of available energy towards milk yield at the expense of body tissue, so that an energy dense diet may be needed. Contrary to the present finding Hemken *et al.,* (1991) reported that high energy concentration of the diet from the recommendation of NRC for dairy cows with bST had no significant impact on milk yield. Similarly the results of present study do not agree with the findings of Tarazon-Herrera *et al.,* (2000) who reported that milk yield response to bST was greater for cows fed on low than high-energy diet. Trend of increase in milk production indicates that it was started with in a week in treated group after bST administration as previously reported by the Bauman (1992). This improved response was maintained through out the study period. Similar results were reported by NRC (1994) where they found maximum milk yield reached with in a week of bST treatment and declined with the same rate when treatment was terminated. However, Chalupa *et al.* (1996) reported that bST started to improve milk production efficiency after 5th week of treatment in dairy cows.

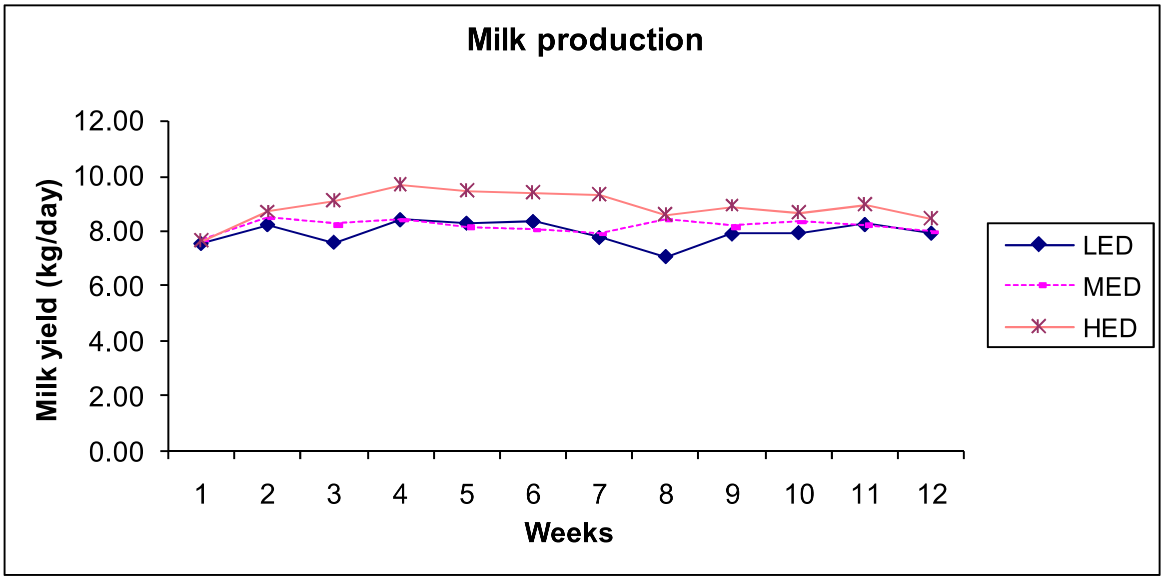

Fig I: Trend of milk production in animals given low, medium and high-energy diets.

Milk composition: The average milk fat, solid not fat (SNF), total solids (TS), Proteins and lactose percent was 7.00, 6.46; and 7.09; 9.02; 8.94 and 8.95; 16.07, 15.40 and 16.05, 3.35, 3.27 and 3.24 and 4.65, 4.63 and 4.86, respectively on LED, MED and HED rations (Table II). The numerical values of milk constituents were slightly variable among the groups but statistical analysis revealed that the difference was non significant (P>0.05). It may be due to homeorehtic control involved the metabolism of lipid, carbohydrates and amino acids because milk composition was not altered during treatment (Bauman, 1989). The relative higher fat% of LED and HED from MED ration might be due to high intake of dry matter and energy density of ration which temporary shifted during first few weeks of bST administration. Vanden Berg (1991) suggested that cows in negative energy balance might produce milk having higher fat content due to greater mobilization of body fat.

The solid not fat and milk proteins were found slightly higher on LED than that of MED and HED which depicts the energy status of the groups because Capuco *et al.,* (2001) reported that animals in negative energy balance treated with bST led to higher fat and lower SNF and proteins. In present trial relatively lower protein were observed with ration MED and HED where I.0 and 4.0 % Megalac was used, respectively as energy source. Lowered concentration may be due to calcium salt of long chain fatty acids, which was dietary source of both groups. Polidori *et al.* (1997) suggested that calcium salt long chain fatty acids depressed the milk proteins. The lactose contents on HED were found slightly higher compared to other groups it may be due to the Ca-LCFA (Megalac) source, which decreased the oxidation of dietary glucose ultimately the result of relatively higher concentration of lactose. The over all results of present study are consistent with previous findings of Terrazon-Herraera *et al.* (2000) 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.

Table 2: Effect of bovine somatotropic hormone administration on productive performance with varying level of dietary energy in lactating Nili Ravi buffaloes (Mean± SE)

Variables	LED (+ bST-)	MED (+ bST)	HED (+ bST)
Milk production+ (Kg/d)	7.90 ± 0.11 [a]	8.16 ± 0.06[ab]	8.88 ± 0.0.20 [c]
Milk composition (%)			
Fat	7.00 ± 0.12	6.46 ± 0.16	7.09 ± 0.13
SNF	9.02 ± 0.12	8.94± 0.09	8.95± 0.09
TS	16.07 ± 0.03	15.40 ± 0.09	16.05 ± 0.08
CP	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 (kg)	5.75 ± 0.64	4.75 ± 1.10	5.00 ± 1.08
Feed efficiency (DMI / kg of milk yield)	0.61 ± 0.01[a]	0.66 ± 0.01[b]	0.74± 0.01[c]

+Means with different superscripts in a row differ significantly (P< 0.05),
-bST = bovine somatotropic hormone.

Body weight change: The average weight gain over the trial period on ration LED, MED and HED was 5.75, 4.75 and 5.00 kg respectively (Table 3). The variations were observed in weight gain among the experimental groups but statistical analysis showed that difference was non significant (P>0.05). The results of the study were similar to the results of Srinivasa-Rao and Rangandham, (2000) and Jorge *et al.,* (2002) who found that body weights were not affected on administering bovine somatotropin in buffaloes. Results of present study partially agree with the findings of Huber *et al.,* (1997) who reported that body weights were increased up to 37% in cows injected with bST for four consecutive lactations. Present findings are not in agreement with that of Mollem *et al.,* (2001) who observed a decrease in body weights in dairy cows despite an increased DMI after bST treatment.

Feed efficiency: The average feed efficiency was 0.61, 0.66 and 0.74 kg (milk yield / kg of DMI) on rations LED, MED and HED respectively (Table II). There was improvement in production efficiency on MED and HED groups by about 8.2 and 21.3 % over LED. Statistical analysis showed that feed efficiency was significantly improved (P<0.05) on MED and HED groups compared to LED. Comparison of feed efficiency of rations having medium and high energy density revealed that there was significant difference between the groups and the improvement was linear with energy level of ration. Chilliard (1989) suggested that the magnitude of increase in feed intake depends upon milk yield and energy density of diet. The observations of present study are similar to the findings of Larmore *et al.,* (1990); Drackley *et al.,* (2003) who reported that feed efficiency was improved in dairy cows on high-density ration treated with bST. This would have 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. The results of present study are also in line with the results of Bauman *et al.,* (1992); Chalupa *et al.,* (1989) who observed that daily nutrient requirements are increased by an amount equal to the increase in milk, and productive efficiency (milk per unit of feed) is improved because a greater proportion of the nutrient intake is used for milk synthesis.

Nutrients intake: The average daily nutrients intake (Dry matter, Crude protein, Neutral detergent fiber, Acid detergent fiber, Ether extract and Ash) (Table 3) was studied with respect to LED, MED and HED with the administration of bST. Higher intake measures of these nutrients were observed on ration LED compared to MED and HED, which might be to overcome the energy requirements in response to increasing milk yield with bST because the magnitude of increase in dry matter intake depends upon the response in milk yield, the method of bST administration and the energy density of the diet (Chilliard, 1989). Statistical analysis showed that intake measures were generally decreased (P<0.05) except ether extract when dietary energy level was increased. This might be due to added level of fat in this diet. The results of present findings are in line with the Bauman *et al.,* (1985) Moallem *et al.,* (2000) and Helal and Lasheen, (2008) who 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.

Table III: Effect of bovine somatotropic hormone administration on daily intake of different nutrients with varying level of dietary energy in Nili Ravi buffaloes (Mean ± SE)

Variables	LED (+ bST)	MED (+ bST)	HED (+ bST)
Dry matter Intake (Kg/d)	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 ± 0.01c[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[b]	1.27 ± 0.00[c]

[+]Means with in row bearing different superscripts differ significantly ($p<0.05$).

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