Pakistan J. Zool. Suppl. Ser., No.9, pp. 55-60, 2009.

Effect of Pregnancy on Lactation Performance of Dairy Buffaloes

Sarzamin Khan*, Muhammad Subhan Qureshi, Ghulam Habib, Anila Mushtaq, Ihsanullah, Sohail Ahmad, Syed Muhammad Sohail and Shoaib Sultan Afridee
Faculty of Animal Husbandry and Veterinary Sciences, NWFP Agricultural University, Peshawar-25120, Pakistan

Abstract.- Dairy buffaloes are reared in the field with lack of practice of proper feeding, exposing them to post-conception decline in milk yield (MY). A series of studies were conducted to investigate the issue. Data of three large farms comprising 30912 MY records were analyzed. Post-conception (PC) MY decline was investigated at a private dairy herd on 23 pregnant and 17 non–pregnant buffaloes. Role of milk progesterone levels (MPL) with the PC decline in MY was investigated in 40 adult lactating dairy buffaloes belonging to three groups: i) PRT (pregnant-ration traditional); ii) PRS (pregnant-ration supplemented); iii) NPRT (non-pregnant- ration traditional). Reduction in MY was effected by location, conception season, lactation week, gestation month and parity. Gestation month contributed to the reduction in milk yield by 1.4%. Third parity showed the least reduction. The predicted reduction was highest (-4.48 L/wk) in high than moderate and low yielders. In the high yielders the cost of this supplementation was ten times less than the loss due to MY decline. It may be concluded that the onset of pregnancy in dairy buffaloes results in drastic decline in MY at an early stage. Concentrates supplementation induced a raise in progesterone levels which in turn, affected the milk yield negatively (r=-0.61, P<0.001).

Key words: Buffalo, milk yield, pregnancy, reproduction, nutrition, progesterone

INTRODUCTION

During the seven months of gestation about 40% of fetal growth occurs while the remaining 60% occurs during the last 2 months of gestation (Battaglia and Meschia, 1978). Later on, an early effect of pregnancy was reported in dairy cows on milk production through a combination of hormonally mediated partitioning of nutrients away from milk production (Oltenacu *et al*., 1980) and increased fetal demands for energy from 190 d of gestation onwards (NRC, 2001). Eley *et al*. (1978) and Prior and Laster (1979) reported an exponential growth of fetal tissues, with growth rapidly increasing after 90 d of gestation in seasonal herds. In lactating bovines, a complex interaction of several key metabolic hormones *viz.* growth hormone, prolactin, thyroid hormones and glucocorticoids leads to mobilization of major substrates for milk synthesis *e.g.* acetate, glucose, amino acid and fatty acids during galactopoiesis (Tucker, 1981). Although prolactin is galactopoietic in nature, it has also been attributed to be antigonadotrophic (Rolland *et al.*, 1975).

The above studies have generated useful information on pregnancy – lactation interaction in dairy cows but these can not be applied exactly to dairy buffaloes due to the species variation and the difference in climatic and socio-economic conditions of the farmers. Under the traditional farming system buffaloes are not bred with the fear that the milk production will decline and thus they remain open for longer period, hindering the replacement of lactating animals at the farm. The code of belief amongst farmers and extension people is that the post-conception metabolic adaptation in buffaloes is affecting their milk production more than the body conditions. The extent to which the pregnancy in buffaloes is affecting the production with traditional feeding is not known. This paper reports the decline in milk production of buffaloes after getting conceived and the role of feed supplementation to prevent the decline.

MATERIALS AND METHODS

Decline pattern in milk yield

Complete milk yield records for 48 weeks of lactation were obtained for 465 pregnant and 179

* Corresponding author: dr.zaminaup@gmail.com

non-pregnant buffaloes from three locations and thus a total of 30912 weekly milk yield records of pregnant and non-pregnant buffaloes were analyzed. The models adopted by Olori *et al*. (1997) were modified as follows. Model-1, involved gestation stage in months was fitted using all the 30912 records. Then a reduced model-2 was fitted excluding gestation stage. The reduction in milk yield due to pregnancy was worked out relative to their non-pregnant counterparts. Model 3 was used to analyze the factors affecting milk yield reduction due to pregnancy:

$$Y = L + P + LxP + LW + GM + E \quad (1)$$
$$Y = L + P + LxP + LW + E \quad (2)$$
$$RY = L + CS + P + LW + GM + E \quad (3)$$

Where *Y* is milk yield, *RY* is the reduction in milk yield ; *L* is location, *P* is parity, *LW* is lactation week, *GM* is gestation month, *CS* is conception season *E* is the residual term associated with the model.

Modeling and managing decline in milk yield

Animals selection and feeding

Forty lactating Nili-Ravi buffaloes, 2-3 months post partum were grouped as high yielders (HY) 66 to 75 liters/week, moderate yielders (MY) 56 to 65 liters/week and low yielders 46 to 55 liters/week on the basis of daily milk yield. All the animals were provided green fodder *ad libitum*. The experimental period lasted for 23 weeks. The rations were grouped into: i) Traditional Ration: in addition to the green fodder, the non-pregnant and one group of pregnant animals were provided commercial concentrate (18% crude protein and 72% TDN on dry matter basis) at the rate of 1.5 kg per animal, as practiced under the conventional farming system in the region; ii) Supplemented Ration: in addition to the basal ration of green fodder, the same commercial concentrate was provided @ 1 kg per 2 liters of milk as recommended by Ranjhan (1994) for lactating buffaloes.

Estrus synchronization, milk sampling and analysis

The selected animals were synchronized with Lutalyse (Pfizer, Belgium) @ 5 ml per animal and inseminated. Pergnancy was diagnosed per rectum after two months. Milk yield was recorded daily and sampled fortnightly for milk progesterone levels (MPL) using the procedure of Qureshi *et al*. (1992).

Statistical analysis

Reduction in milk yield due to pregnancy was calculated as the difference between milk yield of 23 pregnant and 17 non–pregnant buffaloes. MS Excel workbook was programmed to fit different models. Two straight lines model (Draper and Smith, 1981, Neter et al. 1985) with a joining point at 8 weeks had good fit and R^2 of 0.9629. For dairy cows, Coulon et al (1995) modeled the effect of pregnancy stage on milk yield. In the present study the correction term was modified to ***Pw – 5***, because the effect of pregnancy was noted after 5th week post-conception. The modified model was applied as follows:

$$Y = -e^{0.9602}\{(PW-5)\}\, e^{-0.15\ PW} \quad (4)$$

Where Y is the decline in milk yield, PW is the postpartum week and e is the base of natural logarithm.

Post conception milk progesterone pattern

MPL at various weeks postpartum as affected by groups, treatments, post-conception weeks, and their interactions was worked out using the following model:

$$Y = \mu + G + T + GT + W + GW + TW + GTW \quad (5)$$

Where Y is MPL; μ is overall mean, G is milk production class, T is treatment, W is post-conception week and GT, GW and GTW are the respective interactions.

Progesterone interacts with milk yield

The trends of milk yield as affected by progesterone concentration were analyzed using the following regression model based on joining point of the two phases:

$$Y = a + bP + cP' \quad (6)$$

Where Y is decline in milk yield, a, b and c are constant: P is progesterone; P' is 1 for P ≤ JP and P-JP for P> JP. JP is joining point.

RESULTS

Decline pattern in milk yield

Analysis of variance in model 1 showed a significant affect of location while in model 2, excluding the pregnancy, the effect was non-significant. The other factors affected milk yield significantly in both the models. The GM (gestation month) effect was calculated as described by Olori et al., (1997).

GM effect = Residual SS model 2 - residual SS model 1)/Total SS
= 1934555 - 1854829) / 5541076 x 100 = 1.44 %.

Analysis of variance for reduction in milk yield showed a significant effect of location, conception season, parity, and lactation week and gestation month on milk yield reduction after conception. Parity 3 showed the least reduction followed by parity 2, 4, 1, 5, and 6, indicating it as the best phase for milk production in dairy buffaloes (Fig. 1)

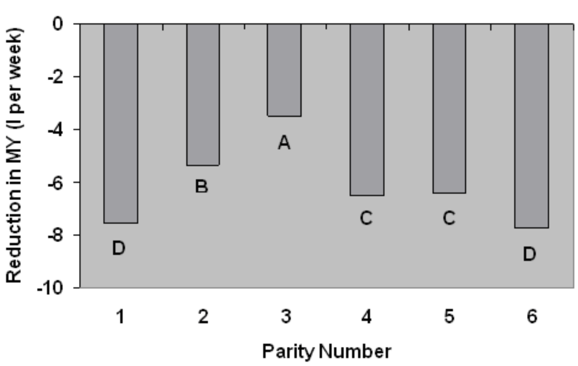

Fig. 1. Parity wise reductions in yield with pregnancy. Bars followed by the different letters are significantly different using LSD test (P<0.05).

The data in Table I indicates that post-conception reduction in milk yield was earlier in the buffaloes that conceived during 11-28 weeks of lactation, followed by those conceived during 29-36 and 37-48 weeks of lactation, respectively. Noticeable reduction in milk yield was found during 3rd, 5th and 6th month of pregnancy in the animals conceiving at early, mid or later stages of lactation.

Table I.- Reduction in milk yield at different months after conception for the three subsets of data (Mean ± SE).

Month after Conception	Lactation stage when the animal conceived		
	Weeks 11-28	Weeks 29-36	Weeks 37-48
1	0.94±0.43	5.28±1.017	8.62±3.89
2	-0.75±0.71	3.34±0.79	4.94±1.57
3	-3.11±1.08	0.50±0.72	4.19±0.87
4	-3.73±1.58	-1.95±0.80	1.92±0.56
5	-4.35±3.06	-3.91±0.97	-1.05±0.40
6	--	-4.44±1.28	-3.15±0.42
7	--	--	-4.98±0.57

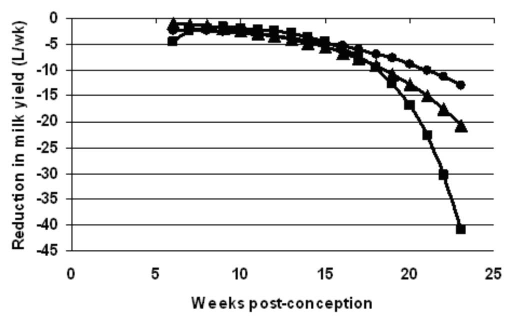

Fig. 2. Change in milk yield with the onset of pregnancy in dairy buffaloes in high (HMY ■), moderate (MMY ●) and low (LMY ▲) yielding groups

Modeling decline in milk yield

Figure 2 shows post-conception reduction in milk yield in the high, moderate and low milk yielding buffaloes. In the high yielder, the predicted reduction was the highest (-4.48 L/wk) followed by the moderate and low yielder (-2.37 and -0.94 L/wk), respectively during 6th week post-conception. It shows the higher sensitivity of the high yielding buffaloes to the onset of pregnancy. Total predicted reduction in milk yield due to pregnancy in the various production groups (6-23 weeks post conception) was 173.97, 100.81 and 129.14 liters, respectively.

Managing decline in milk yield

Milk yield of the high, moderate and low production groups of buffaloes, averaged over the 23 weeks period as affected by ration and pregnancy are presented in Figure 3. The average weekly yield of the high yielding animals was 50.0, 45.8, 50.9 L in the pregnant-ration-supplemented (PRS), pregnant-ration-traditional (PRT) and non-pregnant-ration-traditional (NPRT) buffaloes, respectively. For the moderate yielding buffaloes the values were 38.7, 36.0 and 40.6 L/wk, respectively, showing a decline in milk yield in animals, both on supplemented and traditional rations. The low yielder showed a decline pattern similar to the high yielder.

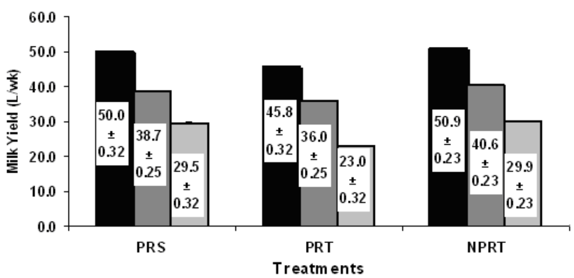

Fig. 3. Milk yields of the high (black), moderate (grey) and low yielding (light grey) buffaloes, in pregnant-ration-supplemented (PRS), pregnant-ration-traditional (PRT) and non-pregnant-ration-traditional (NPRT).

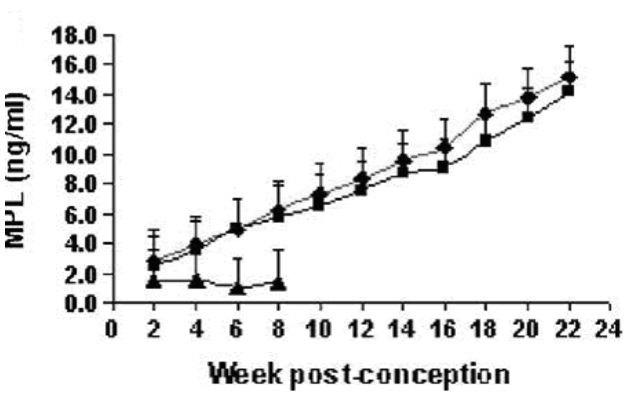

Fig. 4. Changes in progesterone concentrations in the three treatments pregnant-ration-supplemented (PRS), pregnant-ration-traditional (PRT) and NPRT animals.

Post conception milk progesterone pattern

Figures 4 report the changes in MPL in the three treatments PRS, PRT and NPRT animals. The non-pregnant animals showed a lower MPL which was sampled only up to 8 week post-conception. Pregnant buffaloes offered with PRS in HMY and LMY groups showed greater MPL than the animals provided with traditional ration ($P<0.001$). These findings suggest that concentrates supplementation raises progesterone levels in high and low yielders. Negative correlation of MPL with milk yield was found which was probably due to the dilution effect of progesterone with the increasing milk volume.

DISCUSSION

Decline in milk yield

A noticeable reduction in milk yield was found during 3rd, 5th and 6th month of pregnancy in the animals conceiving at earlier, mid or later stages of lactation. It demonstrates that early pregnancy results in drastic decline in milk yield at an early stage as compared to those conceived at later stages. Similarly Olori *et al.* (1997) reported that the adverse effects of pregnancy were higher in mid-lactation than in late lactation.

In our studies the pregnancy occurred after the period when the physiological decline in milk yield was already in progress. It is suggested that the occurrence of pregnancy shared the nutritional partitioning and buffaloes prioritize these activities as follows: i) maintaining its body condition score; ii) meeting the development requirements for fetus; iii) and milk synthesis. Thus, the natural increase in milk yield was prevented by the early pregnancy occurrence.

The period of noticeable decline

The reduction in milk yield initiated after 5th week post-conception. This reduction is noted at a stage much earlier than the cows which is 20th week of pregnancy (Coulon *et al.*, 1995). The present study shows the higher sensitivity of the high yielding buffaloes to the onset of pregnancy. Obviously, the high yielders are more sensitive to conception due to higher energy loss and poor nutritional status. In previous studies Khan and Lurdi (2002) reported that pregnant goats had lower blood glucose than non-pregnant after day 84 of pregnancy. It was suggested that there may be competition for glucose between the mammary gland and the gravid uterus which would result in milk yield losses due to pregnancy in high yielder. The resource constrained-poor-unaware farmers under the conventional buffalo farming in this region are unable to provide sufficient feeding and management support to these animals.

Preventing post-conception decline in milk yield

The present study shows that concentrate supplementation of the high yielding pregnant animals maintained higher milk production levels post-conception which may be due to their larger feed requirements of the growing fetus coupled with the milk synthesis. In the moderate yielders the feed requirements were less and so the feed supplementation effect was also smaller. In the low yielders the reduction in feed intake was not parallel with the decline in milk yield, leading to adverse effects of excess intake of feed. It may be explained in light of findings (Qureshi *et al.*, 2002) where excess intake of protein associated with high levels of urea, was found as the cause of reduction in milk yield in dairy buffaloes. This effect of pregnancy was lacking in the moderate yielders as the nutrient intake was probably utilized for milk synthesis and there was no excess intake of protein which could exert adverse effect on milk yield. The farmers under field conditions practice same scale feeding irrespective of milk yield or pregnancy status (Qureshi, 1995). The present study has confirmed that under such conditions the pregnant non-supplemented animals are unable to maintain higher milk yields post-conception. Resultantly this decline in milk yield post-conception discourages farmers for rebreeding their animals.

Feed supplementation and MPL

The present results indicate that concentrates supplementation raises progesterone levels in dairy buffaloes. In the HMY animals there may be production stress which may lower the MPL and this lowering trend is prevented by the concentration supplementation. In LMY buffaloes there seemed to be the stress of overfeeding of degradable protein (Qureshi *et al*., 2002) as they were fed at the same scale under conventional feeding regime, at par with the high and moderate yielders; and they could not utilize the excess intake of protein. In the supplemented buffaloes the animals were fed according to the feed requirements, there was no question of overfeeding which resulted in enhanced MPL. In line with our findings, Lucy (2001) has reported that under-nutrition or negative energy balance may compromise pregnancy through its effect on the corpus lutem. Higher milk yielding cows had lower progesterone concentrations, associated with infertility.

CONCLUSIONS

Milk yield in buffalo decreases with pregnancy earlier than in cattle. This decline in milk yield was maximum during parity 3.Feed supplementation corrected the loss due to pregnancy. MPL increased linearly with pregnancy and its level was raised in supplemented pregnant animals.

ACKNOWLEDGEMENT

Financial sponsorship of the Higher Education Commission, Islamabad Pakistan is gratefully acknowledged.

REFERENCES

BATTAGLIA, F.C. AND MESCHIA, G., 1978. Principal substrates of fetal metabolism. *Physiol. Rev.,* **58:** 499-527.

COULON, J.B., PEROCHON, L. AND LESCOURRET, F., 1995. Modeling the effect of the stage of pregnancy on dairy cows' milk yield. *Anim. Sci.,* **60:** 401-408.

DRAPER, N.R. AND SMITH, H., 1981. *Applied regression analysis*. 2nd Ed. John Wely and Sons Inc. New York. pp. 250-257.

ELEY, R.M., THATCHER, W.W., FULLER, W.B., WILCOX, C.J., BECKER, R.B., HEAD, H.H. AND ADKINSON, R.W., 1978. Development of the conceptus in bovines. *J. Dairy Sci*., **61**: 467–473.

KHAN, J.R. AND LURDI, R.S., 2002. Hormone profile of crossbred goats during the peri-parturient period. *Trop. Anim. Hlth. Prod.,* **34:** 151–162.

LUCY, M. C., 2001. Reproductive loss in high producing dairy cattle: where will it end? *J. Anim. Sci.,* **84**:1277–1293.

NETER, J., WASSERMAN, W. AND KUTNER, M.H., 1985.

Applied linear statistical models. Richard D. Irwin. Inc. Homewood Illinois. pp: 346-351.

NRC, 2001. *Nutrient requirements of dairy cattle*. 7th ed. Publ. Natl. Acad. Press, Washington, DC.

OLORI, V. E., BROTHERSTONE, S., HILL, W.G., AND MCGUIRK, B.G., 1997. Effect of gestation stage on milk yield and composition in Holstein-Friesian cattle. *Livestock Prod. Sci*., **52**: 167–176.

OLTENACU P.A., ROUNSVILLE, T.R., MILLIGAN, R.A. AND LINTZ, R.L., 1980. Relationship between days open and cumulative milk yield in cows. *J. Dairy Sci.,* **63:** 1317–1327.

PRIOR, R. L. AND LASTER, B.D., 1979. Development of bovine fetus. *J. Dairy Sci.,* **48**: 1546–1553.

QURESHI, M.S., 1995. Conventional buffalo farming system in NWFP Pakistan. *Buffalo Bull.,* **14:** 38-41.

QURESHI, M.S., HABIB, G., SAMAD, H.A., SIDDIQUI, M.M., AHMAD, N. AND SYED, M., 2002. Reproduction-nutrition relationship in dairy buffaloes. I. Effect of intake of protein, energy and blood metabolites levels. *Asian-Australian J. Anim. Sci.,* **15:** 330-339.

QURESHI, M.S., KHAN, I.H., CHOUDHRY, R.A., KHAN, M.H. AND SHAH, S.N.H., 1992. Comparative efficiency of rectal palpation and milk progesterone profiles in diagnosing ovarian contents in buffaloes. *Pak. J. agric. Res*., **13:** 196–200.

RANJHAN, S.K., 1994. *Animal nutrition in tropics*. 4th Edition Waqas Publications. New Delhi. India.

ROLLAND, R., DE JONG, F.H., SCHELLEKENS, L.A. AND LEQUIN, R.M., 1975. The role of prolactin in restoration of ovarian function during early post-partum period in human female. II. Study during inhibition of lactation by bromergocryptine. *Clin. Endocr.,* **4:** 27-38.