Reproductive and Productive Performance of Iraqi Buffaloes as Influenced by Pre-Mating and Pre-Calving Concentrate Supplementation

Talal Anwer Abdulkareem*, Sawsan Ali Al-Sharifi, Sajeda Mahdi Eidan and R.G. Sasser

Department of Animal Resources, College of Agriculture, University of Baghdad, Baghdad, Iraq, 1BioTracking LLC, Moscow, Idaho, USA

*Corresponding author: talal200320032000@yahoo.com

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ABSTRACT
The objective of the present study was to investigate the influence of pre-mating and pre-calving concentrate supplementation of Iraqi buffaloes on some of the reproductive (estrus, mating, pregnancy and calving rates) and productive (daily milk yield and calves birth weight) traits. This study was carried out in 4 Iraqi South-central governorates using 596 pre-mating and 628 pregnant buffaloes (during the last two months of gestation). Pre-mating buffaloes were divided randomly into 496 concentrate-supplemented buffaloes (Flushing) and 100 control ones. Additionally, pregnant buffaloes were also divided into 528 concentrate-supplemented buffaloes (Steaming up) and 100 controls. Each buffalo within the flushing and steaming up groups were fed daily on 7 Kg of concentrate diet (13% crude protein and 1.70 Mcal of net energy) for 60 days. The control buffaloes were nourished only on low-quality roughages of the area and wheat bran. Higher estrus (+15%, P<0.01), pregnancy (+23.8%, P<0.05) and calving rates (+30.8%, P<0.01) were observed in concentrate-supplemented buffaloes as compared with controls. An obvious increase in (P<0.05) calving rate (+14.7%), daily milk yield (+44.8%) and calf birth weight (+25.6%) were noted in steaming up buffaloes in comparison with control buffaloes. Results indicated that improvement in feeding schedule of Iraqi buffaloes during pre-mating and late gestation periods enhanced the reproductive performance and increased milk production of subsequent lactation and calf birth weight. These improvements increased owner income ($174=209,000 Iraqi dinar/buffalo) from the sale of meat and milk.

INTRODUCTION
Buffalo (Bubalus bubalis) is an important source of animal protein in many countries of the world including Iraq. In Iraq, it contributes significantly to the food supply in the form of milk (5-8%), meat (1.3%) (FAO, 2009) and leather (Sarwar et al., 2009). During the last five years, there has been a pronounced decline in the population of Iraqi buffaloes to a mere 98 thousand (Cruz, 2010). Feed shortage and reduced fertility are the main reasons of this decline (Abdulkareem, 2008). Inadequate nutrition has a negative effect on the buffalo productive and reproductive efficiency as well as the overall health of buffaloes herd in Iraq.

Most buffalo owners nourish their animals on wheat bran and cotton seeds, and in most cases on only small amounts of green roughages (Juma, 1997; Baghdasar et al., 2010). Poor nutrition is one of the main factors for low milk production, long calving intervals and delay in the onset of puberty, all of which contribute to low reproductive performance and productive losses leading to reduced income (Abdulkareem, 2008).

Improved nutrition during pre-mating period stimulates ovulation and conception rates (Robinson et al., 2006). Folliculogenesis is a nutritionally responsive process that adapts to direct and indirect nutritional signals. Increased nutrition stimulates folliculogenesis, and there is now strong evidence to show that follicles respond to direct action of nutrition. There is little evidence to show that nutrition stimulates folliculogenesis indirectly by increasing the secretion of gonadotrophins (Scaramuzzi et al., 2010a). On the other hand, enhancing nutrition by supplementary...
concentrate diet during the late gestation period increases birth weights of calves and milk production from the dam (Sanh, 2009). Reproductive and productive traits of pre-mated and pregnant Iraqi buffaloes were examined in this study as affected by nutrition.

**MATERIALS AND METHODS**

**Animals and treatments**: This study was carried out in four Iraqi South-central governorates (Baghdad, Muthanna, Thi-Qar and Basra) from August 2005 to November 2007. The study involved 596 pre-mated and 628 pregnant buffaloes (during the last two months of gestation). Pre-mated buffaloes were divided randomly into 496 flushed and 100 controls. Pregnant buffaloes were also divided into 528 nutrient enhanced (Steaming up) and 100 controls. The control buffaloes were nourished on traditional low-quality roughages and wheat bran. Each buffalo within the flushing and steaming up groups were fed the control diet plus 7 Kg (1.5% of live body weight, NRC, 2001) of concentrate daily (13% crude protein, 6.52% ether extract, 10.24% crude fiber, 7.11% ash and 1.70 Mcal of net energy) for 60 days. The concentrate consisted of barley grains, wheat bran, maize, cottonseed, soybean meal and mixture of salts, vitamins and minerals at percent levels of 35, 30, 17, 10, 5 and 3, respectively. All animals were vaccinated against brucellosis, foot and mouth disease, hemorrhagic septicemia and rinderpest. Pre-mated buffaloes were naturally mated following estrus detection. Pregnancy was detected by rectal palpation between 45 and 60 days post-mating. Pregnancy rate was defined as the proportion of all buffaloes that were pregnant at days 60 post-mating. Calving rate was determined as the buffaloes that calved successfully. Milk yield of buffaloes was obtained by hand milking at 0600 and 1800 h and using the amount produced between these times. Milk yield was recorded beginning from post–calving period until one month later. Calf birth weights were obtained directly after calving.

**Statistical analysis**: Statistical computations were performed using one-way classification of SAS program (SAS, 2001) to examine the effect of treatment on milk yield and body weight of newborn calves. The statistical model for analysis of variance was:

\[ Y_{ij} = \mu + T_i + e_{ij} \]

Where:

\[ Y_{ij} = \text{dependent variable (Milk yield and birth weight of calves)} \]

\[ \mu = \text{overall mean}, \]

\[ T_i = \text{effect of period (T=Feeding group; Control group)}, \]

\[ e_{ij} = \text{error term}. \]

Differences among means of milk yield and birth weight of calves were computed using the Duncan multiple range test. The Chi-square test was employed to compare the differences among percentages of estrus, pregnancy and calving rates of pre-mating buffaloes as well as calving rate of pregnant buffaloes (Steel and Torrie, 1990).

**RESULTS**

**Reproductive performance**: The concentrate supplementation positively affected the overall reproductive performance of Iraqi buffaloes (Table 1). There was a difference in rate of estrus (P<0.01) percentage, pregnancy rate (P<0.05) and calving rate (P<0.01), with concentrate -supplemented buffaloes performing better than the control group. The increased differences of the respective reproductive traits for the enhanced fed group were 15, 23.8 and 30.8% compared with control group. On the other hand, greater (P<0.05) calving rate was observed in supplemented pregnant buffaloes with increased rate of 14.7% compared with traditionally fed buffaloes (Table 2).

**Productive performance**: The concentrate supplementation program during the last stage of pregnancy (steaming up) had obviously increased calving rates from 65.25% in control buffaloes to 76.50% in concentrate–supplemented buffaloes (Table 2). Abortion related to physiological and management reasons remained the same in both the groups. The concentrate supplementation improved (+44.8%, P<0.05) daily milk yield of calved buffaloes (8.93±3.88 Kg) compared to controls (4.93±2.71 Kg; Table 2). In the same manner, treated buffaloes exhibited higher (+25.6%, P<0.05) calves birth weight in comparison with controls (43.00±2.82 vs. 32.00±2.82 kg; Table 2).

**DISCUSSION**

The effects of nutritional supplementation on folliculogenesis and ovulation rate have been widely investigated in farm animals where there is a strong evidence for the use of target nutritional supplementation as a non-hormonal means of increasing prolificacy and fertility of farm animals (Scaramuzzi and Martin, 2008). Higher estrus, pregnancy and calving rates of concentrate-supplemented group (85, 76.65 and 75%, respectively)

### Table 1: The effects of pre-mating concentrate supplementation on reproductive performance of Iraqi buffaloes

<table>
<thead>
<tr>
<th>Trait</th>
<th>Concentrate–supplemented group</th>
<th>Control group</th>
<th>Increasing percentage (1)</th>
<th>( \chi^2 ) and level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estrus rate (%)</td>
<td>85.00</td>
<td>72.25</td>
<td>15</td>
<td>3.41 **</td>
</tr>
<tr>
<td>Pregnancy rate (%)</td>
<td>76.65</td>
<td>58.37</td>
<td>23.8</td>
<td>4.62 *</td>
</tr>
<tr>
<td>Calving rate (%)</td>
<td>70.50</td>
<td>48.75</td>
<td>30.8</td>
<td>5.66 **</td>
</tr>
</tbody>
</table>

(1) Calculated as higher value – lower value / higher value × 100.

### Table 2: The effects of pre-calving concentrate supplementation on calving rate (%), milk yield (Kg) and calf birth weight (Kg) of pregnant Iraqi buffaloes

<table>
<thead>
<tr>
<th>Trait</th>
<th>Concentrate–supplemented group</th>
<th>Control group</th>
<th>Increasing percentage (1)</th>
<th>( \chi^2 ) and level of significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calving rate (%)</td>
<td>76.50</td>
<td>65.25</td>
<td>14.7</td>
<td>3.14 **</td>
</tr>
<tr>
<td>Milk yield (Kg)</td>
<td>8.93 ± 3.88 (^a)</td>
<td>4.93 ± 2.71 (^b)</td>
<td>44.8</td>
<td>*</td>
</tr>
<tr>
<td>Calf birth weight (Kg)</td>
<td>43.00 ± 2.82 (^a)</td>
<td>32.00 ± 2.82 (^b)</td>
<td>25.6</td>
<td>*</td>
</tr>
</tbody>
</table>

(1) Calculated as higher value – lower value / higher value × 100.
may explain the role of pre-calving nutritional supplementation (13% CP and 1.70 Mcal of net energy in this study) to assure good body condition at calving and suggested that it is effective at increasing cholesterol availability to maintain ovarian follicle function and favor earlier resumption of ovarian activity (Oliveira Filho et al., 2010) and consequently enhance pregnancy and calving rates. Nutrition enhances ovulation rates, fetal gonads and calf post-natal development (Robinson et al., 2006). Higher calves body weight of concentrate-treated group (34.3±2.82kg) may confirm this hypothesis. In contrast, feeding of control buffaloes pre-mating on low quality roughages and small amounts of wheat bran resulted in a shortage in protein and energy during these critical physiological stages (Al-Haboby et al., 1999) and led to deterioration in estrus, pregnancy and calving rates of these buffaloes. Protein is required for adequate conception rate, establishment of pregnancy and fewer abortions in animals (Armstrong et al., 1990). Furthermore, the physiological link between energy intake and fulliculogenesis most probably involves several metabolic hormones and growth factors including insulin, insulin-like growth factor–1 (IGF-I), leptin and growth hormone. Insulin-glucose system may also have effects specific to granulose and theca cells (Scaramuzzi et al., 2010a). The concentrations of glucose in ovarian venous blood are lower than in carotid arterial blood (Scaramuzzi et al., 2010b), indicating that the ovary actively takes up the glucose from circulation. On the other hand, the addition of 10% cottonseed as a rumen undegradable protein (RUP) to concentrate diet may play a role in improving the reproductive performance of treated buffaloes. The RUP was reported to increase ovulation rate in sheep (Hamra et al., 1992) and goats (Hamra and Hassan, unpublished data) and consequently improved pregnancy and calving rates.

It was clear that increase in milk yield in concentrate-treated buffaloes as compared with control group (8.93±3.88 vs. 4.93±2.71 kg) was related to increased crude protein and/or net energy used in the current study (Wright et al., 1998; Wang et al., 2007). The nutrient supplementa- tion may lower stress during early lactation, and this may be the reason for significant increase in milk yield in the present study. Moreover, the RUP may also have a crucial supporting role in high milk production in lactating buffaloes (Taquare et al., 2010). Milk yield was obviously increased (+44%) in concentrate-treated buffaloes as a result of RUP supplementation in the current study. Increased milk yield of Surti buffaloes (Patel et al., 2006) and increased milk yield and calf birth weight in Nili-Ravi buffaloes (Usmani and Inskpep, 1989) in response to concentrate diet supplementation during pre-partum period has been documented. Increased crude protein supplementation would increase the amount of nitrogen available to rumen microbes for microbial protein synthesis and increase the efficiency of utilization of absorbed amino acids for milk protein synthesis (Anonymous, 1993; Wang et al., 2007). Calves birth weight was improved in treated group (+25.6%). These results are in agreement with those reported by Usmani et al. (1987) in Nili Ravi buffaloes. Higher body weight of buffaloes at calving resulted in heavier birth weights and possibly higher growth rates of new born calves. Improved nutrition during late gestation related to the changes in the development of neonatal adipose tissue (Underwood et al., 2010) might have resulted in increased body weight at calving. Based on the data obtained in these experiments, it may be concluded that feeding pre-mating (flushing) and late pregnant buffaloes (steaming up) with concentrate supplementation of 7.0kg daily was appropriate for improving reproductive and productive efficiency of Iraqi buffaloes.

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