Effect of Parity and Calving Month on Milk Production and Quality of Greek Buffalo (*Bubalus bubalis*)

Vasileios A. Bampidis¹, Eleonora Nistor², Vasileios B. Skapetas¹, Vladimiros Christodoulou³, Dimitrios Chatziplis¹, Ioannis Mitsopoulos¹, Vassiliki Lagka¹

¹Alexander Technological Educational Institute (ATEI THE), Faculty of Agricultural Technology, Department of Animal Production, 57400-Thessaloniki, Greece
²Banat's University of Agricultural Sciences and Veterinary Medicine from Timișoara, 30064-Timișoara, Romania
³Animal Research Institute, National Agricultural Research Foundation (NAGREF), 58100-Giannitsa, Greece

Abstract
Forty lactating Greek buffalo cows were used in an experiment to determine effects of parity and calf birth month on productivity and milk composition. Buffalo cows gave birth on months June and August 2009, and were kept under semi closed system of management. From June to November, during the day the buffalo cows were allowed to graze on the surroundings from 10:00 h and flocked back at 16:00 h. In the experiment, which started on week 6 postpartum and lasted 24 weeks, buffalo cows were fed alfalfa hay, corn silage, wheat straw and concentrate, and were allocated, relative to parity, into treatments GBP1 (21 buffalo cows with parity 1, 2, and 3) and GBP2 (19 buffalo cows with parity 4, 5, and 6), and, relative to calf birth month, into treatments GBB1 (20 buffalo cows with June as calf birth month) and GBB2 (20 buffalo cows with August as calf birth month). Productivity and milk composition were not affected (P>0.05) by calf birth month. During the experiment, there were differences (P<0.001) between GBP1 and GBP2 treatments in average milk yield (4.1 vs. 5.3 kg/day), fat yield (0.33 vs. 0.41 kg/day), protein yield (0.19 vs. 0.24 kg/day), lactose yield (0.21 vs. 0.27 kg/day) and ash yield (0.033 vs. 0.044 kg/day). In contrast, milk fat (80.8 g/kg), protein (45.9 g/kg), lactose (51.2 g/kg) and ash (8.2 g/kg) contents, as well as somatic cell counts (82.9 ×1000/ml) and colony forming units (44.9 ×1000/ml), were not affected (P>0.05) by parity. Milk production and quality of Greek buffalo is generally satisfactory, and may be economically beneficial for local breeders.

Keywords: Greek buffalo, Milk composition, Milk yield

1. Introduction

The Food and Agriculture Organization (FAO) of the United Nations [1] refers to the Greek buffalo (*Bubalus bubalis*) population as a separate breed named “Ellinikos vouvalos (Greek buffalo)”, and characterizes this population as endangered-maintained. The Greek buffalo is part of biodiversity of many Greek wetlands, thereby enriching ecosystems with its aesthetic value [2].

It’s a food producing animal for Greek farmers, providing valuable services and products to the rural population living near the wetlands. With the development of tourism in rural areas, the buffalo is a pole of tourist attraction and its products (milk, meat) constitute exquisite dishes, contributing to economic growth in the surrounding areas of farming. The buffalo breeding has increased interest and there are about 3.000 buffaloes in Greece [3], of which 2.100 live around the lake Kerkini and Strymon river (Prefecture of Serres). Apart from lake Kerkini, buffaloes exist in lake Volvi (Appolonia), the delta of Axios river (Kalochori),
and lake Vistonida. Small populations exist in other wetland areas (lake Mikri Prespa, delta of Arathos river-Amvrakikos bay, and delta of Sperchios river). The only previous data that exist are those of Chatziolos from 1941 [4], who reported that milk production of the Greek buffalo was up to 4-8 kg/day (500-1.000 kg/year). However, there is no information on buffaloes’ productivity reared in Greece today, despite the increased interest of their breeding. Thus, the objective of this study was to determine effects of parity and calf birth month on milk yield and composition of Greek buffalo.

2. Materials and methods

2.1. Buffalo farming

The study was conducted at the Greek buffalo farm of Mr. A. Andreadis situated beside the shore of the lake Kerkini of Serres, Greece. Buffalo cows were kept under semi closed system of management. The breeding system was free housing to earth ground, and housing of animals used wooden sheds. Buffaloes were kept in separate pens, according to their age and physiological stage. Moreover, there were four individual tie stalls used to entrap buffalo cows for their milking. The duration of the lactation period ranged between 7 and 8 months.

From April to November, during the day, buffalo cows were allowed to graze on the surroundings of the farm, on the shore of the lake, from 10:00 h and flocked back at 16:00 h. The rest of the year, animals were not allowed to graze. In addition, during the whole year, buffalo cows were fed roughages (alfalfa hay, corn silage, and wheat straw) and water ad libitum in elongated troughs and drinkers, respectively, in the courtyard of the farm and a concentrate mixture (corn 790 g/kg, soybean meal 190 g/kg and vitamin and mineral premix 20 g/kg) also ad libitum (approximately 6-8 kg/buffalo cow/day) in individual troughs during milking. After parturition, the new-born buffalo calves were left with their dams for 5 days and, thereafter, they were left to suckle their mothers twice a day until weaning at the end of week 6 postpartum.

2.2. Experiment: Lactating buffalo cows

Forty lactating and clinically healthy Greek buffalo cows were used to determine effects of parity and calf birth month on milk yield and composition. All animals used in the experiment were cared for according to applicable recommendations of the U.S. National Research Council [5]. Overall, the experiment started from parturition and allocation of buffalo cows into groups and lasted from June 2009 until March 2010, until approximately the end of the lactation period. The 40 buffalo cows gave birth on months June and August 2009 and the 11, 3, 7, 1, 7 and 11 buffalo cows were at the 1st, 2nd, 3rd, 4th, 5th and 6th parity, respectively. The 40 animals were allocated at the beginning of the experiment, relative to parity, into two treatment groups (GBP1 and GBP2), and, specifically, in treatment GBP1 the 21 buffalo cows of the 1st (11), 2nd (3), and 3rd (7) parity and in treatment GBP2 the 19 buffalo cows of the 4th (1), 5th (7), and 6th (11) parity. Furthermore, these 40 animals were allocated at the beginning of the experiment, relative to calf birth month, into two additional treatment groups (GBB1 and GBB2), and, specifically, in treatment GBB1 the 20 buffalo cows who gave birth from June 1 to July 9, 2009 (the 12 belonged to treatment GBP1 and the 8 to treatment GBP2) and in treatment GBB2 the 20 buffalo cows who gave birth from July 22 to August 31, 2009 (the 9 belonged to treatment GBP1 and the 11 to treatment GBP2).

The buffalo cows who participated in the experiment were separated from the rest of the herd and housed in a separate floor pen. However, experimental buffalo cows received the same diet as the rest of the herd to meet their nutrient requirements as given by Terramoccia et al. [6]. During the experimental period, the health status and behavior of all buffalo cows was monitored on a daily basis.

After weaning, for a period of 24 weeks (i.e., 6th to 30th week postpartum), buffalo cows were machine milked twice daily at 07:00 and 18:00 h with an individual Alpha Laval (Thessaloniki, Greece) milking machine. Milk yield was recorded every four weeks (ie., 6th, 10th, 14th, 18th, 22nd, 26th and 30th week postpartum) on a morning and afternoon milking. Milking was conducted at a vacuum level of 50 kPa, pulsation rate of 60 min⁻¹ and pulsation ratio of 50/50. Each recording day, during morning and afternoon milking, samples, approximately 60 ml each, were collected from each buffalo cow, after cleaning the teats. The morning and afternoon milk samples
of each buffalo cow, taken in proportion to the different yield, were finally pooled and kept refrigerated (+4°C) until chemical analysis.

2.3. Milk chemical analyses
Milk samples were analyzed for fat, protein, lactose and solid-not-fat (SNF) with IR spectroscopy (Milkoscan 4000; FOSS, Denmark) according to method 972.16 of AOAC [7]. Ash was calculated as SNF minus protein and lactose. Milk samples were also analyzed for somatic cell counts (SCC) using a Fossomatic 400 cell counter (FOSS, Denmark), and for colony forming units (CFU) using a BactoScan FC (FOSS, Denmark).

2.4. Statistical analysis
Performance and milk composition of Greek buffalo cows were analyzed using analysis of variance procedures [8] with effect of parity, calf birth month, time, as well as their interactions, included in the model. As calf birth month effect was not significant, data were reanalyzed without including effect of calf birth month in the model. For all tests, a probability level of <0.05 was accepted as significant. Statistical analysis used the SPSS Statistical Software Package [9].

3. Results and discussion
All buffalo cows remained healthy until the end of the experiment without altering their behavior. The lactation period lasted at least 210 days. As already mentioned in paragraph 2.4., there was no effect (P>0.05) of calf birth month June or August in production, chemical composition, SCC and CFU of buffalo cows milk. Buffalo cows in GBP1 and GBP2 treatments declined in milk production as the study progressed (Figure 1). During the experiment (Table 1), there were differences between GBP1 and GBP2 treatments in average milk yield (4.1 vs. 5.3 kg/day, P<0.001), fat yield (0.33 vs. 0.41 kg/day, P<0.001), protein yield (0.19 vs. 0.24 kg/day, P<0.001), lactose yield (0.21 vs. 0.27 kg/day, P<0.001) and ash yield (0.033 vs. 0.044 kg/day, P<0.001). In contrast, milk fat (80.8 g/kg), protein (45.9 g/kg), lactose (51.2 g/kg) and ash (8.2 g/kg) contents, as well as SCC (82.9 ×1000/ml) and CFU (44.9 ×1000/ml), were not affected (P>0.05) by parity. There was a time effect (P≤0.001) for all response parameters, except for ash content, SCC and CFU (P>0.05), and no treatment (parity) by time interaction (P>0.05) for any response parameter.

The season of birth affects milk production [10] and milk quality [11]. However, milk production and quality of the Greek buffalo were not affected by the calf birth month in June or August, possibly because the time period between these two months was not far too long. The increase in milk production found in the present study as parity increased (GBP1 vs. GBP2) is in agreement with Rosati and Van Vleck [11] who reported that milk production in dairy buffalo cows increases from parity 1 to 6.

Figure 1. Lactation curves of Greek buffalo cows as influenced by parity during the experiment (week 6 to 30 postpartum); (▲) GBP1, (■) GBP2 (overall S.E.M. = 0.136 kg/day)
Table 1. Average milk yield, composition, somatic cells and colony forming units of lactating Greek buffalo cows during the experiment (week 6 to 30 postpartum)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>S.E.M.</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>GBP1</td>
<td>GBP2</td>
<td></td>
</tr>
<tr>
<td><strong>Yield (kg/day)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk</td>
<td>4.1</td>
<td>5.3</td>
</tr>
<tr>
<td>Fat</td>
<td>0.33</td>
<td>0.41</td>
</tr>
<tr>
<td>Protein</td>
<td>0.19</td>
<td>0.24</td>
</tr>
<tr>
<td>Lactose</td>
<td>0.21</td>
<td>0.27</td>
</tr>
<tr>
<td>Ash</td>
<td>0.033</td>
<td>0.044</td>
</tr>
<tr>
<td><strong>Milk content (g/kg)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat</td>
<td>82.7</td>
<td>79.0</td>
</tr>
<tr>
<td>Protein</td>
<td>46.1</td>
<td>45.7</td>
</tr>
<tr>
<td>Lactose</td>
<td>51.0</td>
<td>51.4</td>
</tr>
<tr>
<td>Ash</td>
<td>8.2</td>
<td>8.2</td>
</tr>
<tr>
<td><strong>SCC3 (×1000/ml)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>84.2</td>
<td>81.7</td>
<td>4.16</td>
</tr>
<tr>
<td><strong>CFU4 (×1000/ml)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>47.3</td>
<td>42.6</td>
<td>1.87</td>
</tr>
</tbody>
</table>

1 GBP1 = treatment with parity 1 to 3, GBP2 = treatment with parity 4 to 6.
2 Numbers are probability values. Treatment × Time interactions for milk yield are illustrated in Figure 1.
3 Somatic cell counts.
4 Colony forming units.

Lactation curves of Greek buffalo cows that resulted from our study were similar to those lactation curves observed in Italian river buffaloes [12], with, however, shorter lactation period. Moioli et al. [13] reported that the Greek buffalo populations have a relatively low degree of genetic differentiation from those of the Italian buffalo.

When Bartocci et al. [14] used 258 buffalo cows to study milk production and quality of the Italian buffalo, they found that average daily milk yield was 9.3 kg/head/day, while the content of milk fat was 86.9 g/kg and that of milk protein 47.7 g/kg. In addition, milk samples examined in our study had higher fat content than that found in milk samples of Murrah buffalo breed in France [15], while, in contrast, had similar protein, lactose and ash content.

In Greek buffalo milk samples, SCC and CFU showed very low values throughout the experiment, although samples were collected from each buffalo cow only after cleaning with water, but not disinfecting, the teats. This indicates a good level of animal health and that buffalo cows were free from clinical and subclinical mastitis throughout the duration of the experiment. Bartocci et al. [14] found that average SCC was 220.3 ×1000/ml in the milk of 258 Italian buffalo cows. Moreover, Tripaldi [16] reported that European Union has established a limit of 400.000 SCC/ml and of 500.000 CFU/ml for buffalo milk.

4. Conclusions

Milk production and quality of Greek buffalo is generally satisfactory up to week 30 postpartum. Buffalo milk and derived dairy products constitute exquisite dishes, contributing to economic development in the surrounding areas of farming. Milk yield, as well as fat-, protein-, lactose-, and ash- yield, of Greek buffalo cows was affected by parity (1 to 3 vs. 4 to 6), but not by calf birth month (June vs. August). Buffalo cows with parity 4 to 6 produced daily higher quantities of milk and milk constituents compared to buffalo cows with parity 1 to 3.

Acknowledgements

This research was funded by the Research Committee of the Alexander Technological Educational Institute of Thessaloniki, Greece. The authors thank Mr. A. Andreadis, Vice-President of the Greek Buffalo Breeders Cooperation (GBBC, Vironia, Serres, Greece), for providing the facilities and the animals and Mr. T. Giantsidis, President of the GBBC, for his full support during the study and the provision of relevant
information. The authors also thank the staff of the Laboratory of Milk Quality Control, Hellenic Agricultural Organization “Dimitra” (Paralimni Giannitsa, Pella, Greece) for milk sample analysis.

References

1. Food and Agriculture Organization (FAO), Breeds currently recorded in the Global Databank for Animal Genetic Resources. Rome, Italy, 2007, 155 pgs.
2. Georgoudis, A. G., Population characteristics and production systems of water buffaloes in Greek wetlands (in Greek). Greek Biotope/Wetland Centre and Department of Animal Production, Faculty of Agriculture, Aristotle University of Thessaloniki, 1993, 64 pgs.
3. Greek Buffalo Breeders Cooperation (GBBC), Data concerning the Greek buffalo population. Vironia, Serres, Greece, 2011, Personal communication.