The Effect of Location and Parity in The Body, Udder Conformation and Milk Production Traits in Buffaloes

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Abstract

Seventy two adult lactating Iraqi buffaloes (Bubalus bubalis) were chosen randomly from two regions of Iraq, Baghdad (Abu Ghraib Ruminants Researches Station in the west of Baghdad, Iraq) and Al-Muthanna province (Alhilal township), during 2018/2019 lactating season. The effect of location and parity in the body, udder conformation and milk production traits were studied. The body conformation, body weight, udder measurements, and milk production traits were significant to high significant effect by both the location and the parity except there is the non-significant effect of location on body height at the shoulder, front teat diameter, rear teat length and rear teat diameter. Similarly non-significant effect of parity was observed on front teat diameter, rear teat length, distance between front and rear teats, fat%, lactose%, and SNF%.

Keywords: Buffaloes, Location, Parity, Conformation, Milk production

1. Introduction

Worldwide, this species, the water buffalo (Bubalus bubalis), which inhabits all of the world's continents, has a large population (approximately 202 million) and supports more livelihoods than any other domestic animal [1]. Buffaloes in Iraqi are varying in morphological variations, milk yield and have larger body dimensions compared to Egyptian, Indian, and Pakistani buffaloes [2]. It is critical to assess the amount of milk produced by a dairy animal in a lactation curve to increase milk productivity and acquire the quality customers are looking for, as both the quality of milk and its price are determined by its quality, milk producers and consumers need to know about the diverse chemical compositions of milk and the relevant health considerations [3]. It is important to pick the best of the best in terms of a herd's prospects, and in order to pick out a productive animal, first site that animal breeder is looking for is udder [4]. A variety of factors, such as parity, lactation stage, and the buffalo age, determine udder conformation features [5].

One of the critical phenotype indices that should be taken into account for genomic selection programs for buffaloes is the parity of the animals [6]. Many researchers have concluded that parity had significant effect (P≤0.05) on udder and teat measurements [5, 7]. Some characters like diameter for front teats and height of udder from the earth have highly significant affected (P≤0.01) by parity [2]. Considering the strong link with milk yield, these parameters in particular udder width and teat diameter may be utilized for selecting buffaloes for greater milk production in the field [8]. The effect of parity number on most of body dimensional measurements was highly significant (P≤ 0.001) [9, 10, 11], and significant (P≤ 0.05) for heart girth [12]. Milk yield increase up to 5th parity and decline thereafter indicating significant effect of parity on milk production [6, 13]. Lactation number were found to have highly significant effect (P≤0.01) on milk composition except lactose [6, 14, 15], and highly significant effect on lactation milk yield [16, 17]. The effect of location was significant (p≤0.05) on udder measurements [18], and highly significant (P≤0.01) on most of body conformation traits [19]. Moreover, the daily milk production, and milk composition were highly significant (P≤0.01) effected by location [2], and significantly (P≤0.05) in protein [1]. This research aims to examine the effects of location and parity in the body, udder conformation, and milk production traits in Iraqi buffalo herds.
2. Materials and Methods

2.1 Animals

Seventy two adult lactating buffaloes (Bubalus bubalis) were chosen from two regions of Iraq, Baghdad (Abu Ghraib Research Station of Sheep and Goats in the west of Baghdad, Iraq) and AL-Muthanna province (Alhilal township), during one lactating season 2018/2019.

2.2 Milk Yield, Body dimensions and Udder Measurements

Milk yield and some of the standard body and udder measurements were recorded. Milk samples were collected from individual animals every two weeks. Dams were hand-milked and milk yield was recorded after complete milking. Ten ml of milk sample was subjected to ultrasonic milk analyzer for fat, protein, solid non-fat, and lactose determination. The body dimensions include body length (BL), heart girth (HG), body height at the shoulder (HAS), and Bodyweight (BW) was estimated as described by [20]. Udder measurements included front (FTL) and rear teat length (RTL), front (FTD) and rear teat diameter (RTD) and Teat distance (TDIS) was taken between fore teats (FTDIS), rear teats (RTDIS), and the distance between fore and rear teats (FRTDIS) were taken using vernier caliper [21].

2.3 Statistical Analysis

Study parameters were examined with the SAS (2012) program and General Linear Model-GLM procedure, which identified the effects of various components using statistical analysis [22]. The Duncan multiple range test was used to perform significance comparisons between the means using the LSMEANS function. In this study, a Chi-square test was employed to examine the correlation of many variables, estimating the probabilities of results at 0.05 and 0.01 levels.

2.4 Statistical Model

The Statistical model used in this study was as below:

\[ Y_{ijk} = \mu + L_i + P_j + e_{ijk} \]

Where:
\[ Y_{ijk} = \text{Observed value} \]
\[ \mu = \text{Overall mean of the trait} \]
\[ L_i = \text{Effect of location (Muthanna, Baghdad).} \]
\[ P_j = \text{Effect of parity (1 to 6).} \]
\[ e_{ijk} = \text{Random error that is distributed naturally in an average equal zero and variation equal to } \sigma^2e. \]

3. Results and Discussion

3.1 Effect of location and parity in body measurements and weight of buffaloes

3.1.1 Effect of location

As shown in (Table 1), it appears that location has highly a significant effect (P≤0.01) on heart girth (HG), body length (BDL) and body weight (BW). Whereas, it shows a non-significant effect for location on body height at shoulder (HAS). The highest values of HG, BDL and BW were recorded in Baghdad with (209.97 ±1.98cm), (154.88 ±1.93cm) and (622.52 ±18.74Kg) respectively, while the lowest values were recorded in AL-Muthanna province with (201.80 ±1.37cm), (122.89 ±1.80cm) and (479.57 ±14.00Kg) respectively. With respect to (HG) and (BDL), this result is compatible with previous results achieved by Baghdasar et al. [12] and Al-Zarkan et al. [1]. The HG is an essential body dimension that reveals the productive ability of buffaloes. The significant effect of location on this trait may be due to the differences in management and feeding system [1, 9].
### Table 1. Effect of location and parity in body measurements and weight of buffaloes.

| Factors                      | No | Heart girth -HG (cm) | Body length -BDL (cm) | Body height at shoulder –HAS (cm) | Bodyweight (Kg) |
|------------------------------|----|----------------------|-----------------------|----------------------------------|-----------------|
| Overall means                | 72 | 205.75 ±2.59         | 134.00 ±2.25          | 142.79 ±2.59                     | 529.21 ±13.76   |
| Location                     |    |                      |                       |                                  |                 |
| Muthanna                     | 47 | 201.80 ±1.37 b       | 122.89 ±1.80 b        | 144.27 ±2.36                     | 479.57 ±14.00 b |
| Baghdad                      | 25 | 209.97 ±1.98 a       | 158.88 ±1.93 a        | 140.00 ±1.03                     | 622.52 ±18.74 a |
| Level of Sig.                |    | **                   |                       | **                               |                 |
| Parity                       |    |                      |                       |                                  |                 |
| 1                            | 8  | 181.25 ±2.19 d       | 125.00 ±6.33 c        | 133.37 ±4.90 b                   | 379.62 ±22.64 c |
| 2                            | 14 | 202.78 ±6.05 c       | 136.93 ±5.60 ab       | 141.14 ±2.62 ab                  | 525.64 ±34.04 b |
| 3                            | 13 | 204.46 ±2.94 bc      | 137.00 ±5.98 ab       | 141.30 ±1.90 ab                  | 532.00 ±32.05 b |
| 4                            | 13 | 212.69 ±2.19 a       | 142.54 ±5.04 a        | 144.54 ±2.56 ab                  | 599.39 ±24.58 a |
| 5                            | 8  | 214.12 ±3.80 a       | 132.25 ±2.67 bc       | 142.75 ±7.48 ab                  | 562.50 ±29.46   |
| 6 and more than              | 16 | 211.81 ±2.51 ab      | 127.44 ±4.36 bc       | 149.25 ±4.15 b                   | 531.18 ±26.85 b |
| Level of Sig.                |    | **                   |                       | **                               | **              |

Means with different letters in the same column differed significantly * (P≤0.05), ** (P≤0.01), NS: Non-Significant.

3.1.2 Effect of parity

A highly significant effect ($P<0.01$) of parity on heart girth (HG), body length (BDL) and body weight (BW), while the body height at the shoulder (HAS) had been affected significantly ($P<0.05$) as shown in (Table 1). These findings are corresponding with [9]. The data showed a progressive rising in HG, BDL, HAS and BW from the first to the fourth or fifth lactations. These outcomes get along with that of [12,18]. Regarding to the (HG) and (HAS), the present result agrees with the findings of [1].

3.2. Effect of location and parity in daily milk yield and milk composition in buffaloes.

3.2.1 Effect of location

It is clear from the (Table 2) there was a highly significant effect ($P<0.01$) of location on daily milk yield (DMY), this finding was in conformity with Avadesian et al. (2012). The higher milk production showed in Baghdad location with (8.60 ±0.77 liter), while AL-Muthanna location presented the low one with (6.19 ±0.31 liter). The reason for the apparent superiority in daily milk production of buffaloes may be attributed to the association of milk yield with the quality and quantity of feed [23]. Milk production is also related to body dimensions and its health [24]. Here, the rates of body dimensions for animals in Baghdad were higher than in the buffaloes of the AL-Muthanna site (Table 1). Highly significant effect ($P<0.01$) of location on the milk protein percentage (P.P), fat percentage (F.P), lactose percentage (L.P) and significant effect ($P<0.05$) on sold non-fat percentage (SNF) were shown in (Table 2), this result get along with that of Al-Zarkani et al. [1], except (F.P) as they reported. The highest P.P was by buffaloes in Baghdad location with (4.38 ±0.12%), while the lowest was observed in AL-Muthanna location with (3.53 ±0.01%) which presented a higher fat percentage with (6.40 ±0.14%) while Baghdad buffaloes produced the lowest (F.P) with (5.72 ±0.13%). The lactose percentage reached (5.08 ±0.03%) and (4.69 ±0.08 %) of buffalo milk in AL-Muthanna and Baghdad locations respectively. The synthesis of lactose in milk and through biochemical pathways depends on the body’s supply of glucose surplus and the level of water osmosis of the udder glandular cells in the presence of energy [25]. In AL-Muthanna and Baghdad locations (SNF) percentage in buffalo milk were (9.30 ±0.04%) and (8.87 ±0.35%) respectively, the percentage of solids in milk is influenced to a high degree by the quality of the food and its content of mineral elements, factors such as genetics, environment, and the physiological state of the animal, also can influence milk constituent quantities [26].
Table 2. Effect of location and parity in daily milk yield and milk composition in buffaloes.

| Factors                   | Least square means ± SE |
|---------------------------|-------------------------|
|                           | Daily milk yield (liter) | Protein (%) | Fat (%) | Lactose (%) | Solid non-fat (%) |
| Overall means             |                         |             |         |             |                  |
| Location                  |                         |             |         |             |                  |
| Muthanna                  | 7.02 ±0.35              | 3.83 ±0.06  | 6.17 ±0.10 | 4.95 ±0.04  | 9.15 ±0.12       |
| Baghdad                   | 6.19 ±0.31 b            | 3.53 ±0.01 a| 6.40 ±0.14 a| 5.08 ±0.03 a| 9.30 ±0.04 a     |
| Level of Sig. Parity      | ---                     | **          | ***      | ***         | *                |
| 1                         | 3.50 ±0.16 d            | 3.85±0.23 acb| 6.24 ±0.37 | 4.91 ±0.13  | 8.69 ±0.37       |
| 2                         | 5.71 ±0.15 b            | 4.17±0.16 a | 5.66 ±0.15 | 4.95 ±0.11  | 8.84 ±0.29       |
| 3                         | 10.38±0.39 a            | 3.72±0.15 bc| 6.09 ±0.28 | 4.81 ±0.08  | 9.59 ±0.36       |
| 4                         | 10.42±0.72 a            | 4.03±0.18 ab| 6.28 ±0.22 | 5.03 ±0.14  | 9.41 ±0.34       |
| 5                         | 6.68 ±0.49 b            | 3.55±0.03 c | 6.87 ±0.41 | 5.06 ±0.04  | 9.34 ±0.07       |
| 6 and more than 5          | 4.62 ±0.27 c            | 3.57±0.05 c | 6.17 ±0.20 | 4.96 ±0.07  | 8.99 ±0.19       |
| Level of Sig.             | ---                     | **          | *        | NS          | NS               |
| Parity                    |                         |             |         |             |                  |

Means with different letters in the same column differed significantly * (P≤0.05), ** (P≤0.01), NS: Non-Significant.

3.2.2 Effect of parity

As shown in (Table 2), there was a highly significant effect (P≤0.01) of parity on daily milk yield (DMY), the highest rate (10.42 ±0.72 liter) was produced by buffaloes with the fourth lactation season, while their early counterparts with the first lactation season had the lowest rate (3.50 ±0.16 liter). The reason for that may due to the increase in milk production gradually with age until it reaches its maximum at different ages that vary according to the breed, site and then it begins to gradually decrease [27]. An increase in production with age leads to the increase in the weight of the buffalo and the expansion of its digestive tract, which makes it able to consume more feed, as well as the increase in the size of the mammary gland, and thus the birth sequence is one of the factors affecting milk production in cattle, including buffaloes [28]. While the percentages of fat, lactose and non-fatty solids in milk were not significantly affected by the different parity, the protein percentage in milk was significantly affected (P≤0.05), as this percentage was highest in the milk of mothers with a second parity (4.17 ±0.16%) and lowest in those of the fifth parity (3.55 ±0.03%). The increase in lactose ratio in the second parity and the reduction in it after the fifth parity may be due to the level of nutrition since the lactose production depends on the availability of glucose and water and the influence of the calcium to phosphorus ratio [29].

3.3. Effect of location and parity in Udder dimensions of buffaloes

3.3.1 Effect of location

Positive and highly significant (P≤0.01) effect for location on front teat length (FTL), the distance between front teats (FTDIS), distance between rear teats (RTDIS) and significant (P≤0.05) effect on distance between front and rear teats (FRDIS) (Table 3), the highest rates for all parameters were in Baghdad location with (6.13 ±0.02 cm), (12.51 ±0.23 cm), (6.63 ±0.48 cm) and (5.90 ±0.46 cm) respectively, while lowest were in Muthanna location with (4.12 ±0.02 cm), (9.60 ±0.29 cm), (5.24 ±0.30 cm) and (5.00 ±0.27 cm) respectively. The difference in the teat length may be due to the milking system, milk yield and feeding efficiency [30]. The outcomes concerning the distances between teats corresponding with those obtained by [31] each increase in distance between teats has resulted in milk yield improvement (De la Fuente et al., 1996). The non-significant effect was observed for location on front teat diameter (FTD), rear teat length (RTL) and rear teat diameter (RTD) as shown in (Table 3); this finding conformed to those of [32].

3.3.2 Effect of parity

Significant effect (P≤0.05) of parity on FTL and FTDIS (Table 3), the highest rate was 5.25 ±0.27 and 11.71 ±0.55 cm for mothers with the second and third parity, respectively while the lowest was 4.20 ±0.06 and 10.01 ±0.53 cm for mothers with fifth and second parity respectively, these findings are got along with that of [30]. Highly significant effect (P≤0.01) of parity on RTD and RTDIS, there was some kind of fluctuation in the dimensions of both of them, this is what [32] pointed out in their study on the Indian Murrah buffaloes, which means that the udder develops and increases in size with the advancement of the animal’s age, leading to udder drooping as well as the physiological state of the glandular tissue during the lactation process, as it leads to an increase in the teat length. The non-significant effect was observed for parity on (FTD), (RTL) and (FRDIS).
Table 3. Effect of location and parity in Udder dimensions of Buffaloes.

| Factors | No | Front teat length-FTL (cm) | Front teat diameter-FTD (cm) | Front teat distance -FRDIS (cm) | Rear teat length-RTL (cm) | Rear teat diameter-RTD (cm) | Rear teat distance-RTDIS (cm) | Front and rear teat distance-FRDIS (cm) |
|---------|----|---------------------------|-----------------------------|--------------------------------|--------------------------|-----------------------------|-------------------------------|----------------------------------|
| Overall means | 72 | 4.82 ±0.11 | 3.08 ±0.02 | 10.61 ±0.26 | 7.88 ±0.11 | 4.20 ±0.04 | 5.73 ±0.26 | 5.31 ±0.24 |
| Location Muthanna | 47 | 4.12 ±0.02 b | 3.08 ±0.02 | 9.60 ±0.29 b | 7.88 ±0.16 | 4.26 ±0.06 | 5.24 ±0.30 b | 5.00 ±0.27 b |
| Baghdad | 25 | 6.13 ±0.02 a | 3.07 ±0.02 | 12.51 ±0.23 a | 7.88 ±0.12 | 4.09 ±0.05 | 6.63 ±0.48 a | 5.90 ±0.46a |
| Sig. Parity | ** NS ** | ** NS ** | ** NS ** | ** NS ** | ** NS ** | ** NS ** |
| 1 | 8 | 4.90±0.37 b | 3.02 ±0.04 | 10.32±0.87 ab | 7.63±0.32 | 4.01±0.04 bc | 5.01±0.57 bc | 4.18±0.56 |
| 2 | 14 | 5.25±0.27 a | 3.05 ±0.02 | 10.01±0.53 b | 7.49±0.18 | 3.94±0.05 c | 4.42±0.51 c | 4.67±0.39 |
| 3 | 13 | 5.02±0.02 b | 3.08 ±0.02 | 11.71±0.55 a | 7.86±0.24 | 4.42±0.08 a | 6.84±0.49 a | 5.98±0.50 |
| 4 | 13 | 5.03 0.30 b | 3.11 ±0.03 | 10.92±0.78 ab | 7.74±0.28 | 4.10±0.09 bc | 6.47±0.75 ab | 5.81±0.61 |
| 5 | 8 | 4.20±0.06 d | 3.15 ±0.06 | 10.62±0.80 ab | 8.22±0.45 | 4.27±0.12 ab | 7.06±0.83 a | 4.93±0.43 |
| 6 and more than | 16 | 4.38±0.17 c | 3.08 ±0.04 | 10.14±0.46 b | 8.31±0.26 | 4.40±0.12 a | 5.04±0.51 bc | 5.68±0.69 |
| Sig. Parity | ** NS ** | ** NS ** | ** NS ** | ** NS ** | ** NS ** |

Means with different letters in the same column differed significantly * (P<0.05), ** (P<0.01), NS: Non-Significant.

Conclusion

The body conformations, body weight, udder measurements, daily milk yield and milk composition were significantly affected by both the location and the parity. The knowledge of such correlations is required for devising any breeding programs.

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