Received: 27 April 2020 | Accepted: 22 September 2020

DOI: 10.1111/rda.13834

ORIGINAL ARTICLE

Reproduction in Domestic Animals WILEY

Factors affecting calving ease in Egyptian buffalo

Amin M. S. Amin[1] | Mohamed M. I. Salem[2] | Mohamed M. E. Ibrahim[1] | Samy A. Darweish[1] | Ayman G. EL Nagar[3]

[11]Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt

[2]Department of Animal and Fish Production, Faculty of Agriculture, Alexandria University, Egypt

[3]Department of Animal Production, Faculty of Agriculture at Moshtohor, Benha University, Egypt

Correspondence
Amin M. S. Amin, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, 12618, Egypt.
Email: amin_ama@yahoo.com

Funding information
STDF, Egyptian Ministry for Scientific Research, Grant/Award Number: This work was supported by the Egyptian Project en

Abstract

Calving ease (CE) is a trait of economic importance that affects animal welfare and farm profitability. The objective of present study was to investigate genetic and environmental factors affecting CE among Primiparous (PP) and multiparous (MP) buffaloes. A total of 9,627 records from 1999 MP and 2,110 PP recorded during the period from 1988 to 2018 were considered. Herd, season of calving, year of calving, birth weight, parity order and gestation length significantly affected CE rate, while age at first calving and sex of calf had no significant effects. Direct and maternal heritabilities of CE in PP and MP were 0.06 and 0.01, respectively. The low heritability of CE indicated that direct selection may not be an effective method to improve CE trait in Egyptian buffalo.

KEYWORDS

Bayesian analysis, buffalo, calving ease, genetic parameters

1 | INTRODUCTION

CE is a measure of dystocia, a complex reproductive trait of economic importance which is defined as prolongation and difficulty of parturition which usually requires technical assistance (Khan et al., 2009). The main problems associated with dystocia are the higher costs of labour, veterinary costs during calving, long postpartum interval and animal welfare issues (Eaglen & Bijma, 2009). The factors affecting this trait can be divided into maternal; for example, pelvic area, uterine influence, gestation length, cow size and age and foetal or direct causes; for example, calf's birth weight and shape of calf. Dystocia is less common in buffalo compared with cattle (Kaushik & Mathur, 2005). Khan et al. (2009) reported that the incidence of calving difficulties was ranged between 5.6% and 12.6% in Murrah, 8.94% in Jaffarabadi and between 4.6% and 5.4% in Surti buffaloes. The objective of this study was to assess the genetic and environmental factors affecting CE in primiparous and multiparous Egyptian Buffalo.

2 | MATERIALS AND METHODS

2.1 | Data and studied trait

Data were collected from three experimental buffalo herds (El-Nattafe El-Gadid, El-Nattafe El-Kadim and Gemiza) belonging to the Animal Production Research Institute, Ministry of Agriculture and Land Reclamation, Egypt. The approval of the animal care and use committee was not necessary in our study since all data were obtained from an existing database. Two data sets collected during the period from 1988 to 2018 were considered; the first one consisted of 9,627 records for 1999 MP (998 cases of calving difficulty between disposition, dystocia, metritis and vulvovaginitis). The second one consisted of 2,110 PP (417 cases of calving difficulty). Depending on the need of technical assistance during parturition, the studied trait was treated as CE categorical trait with two levels (0 for assisted animals and 1 for unassisted).

TABLE 1 Least square means (LSM) and their standard errors (SE) for environmental factors affecting calving ease in Egyptian buffalo

Factor	LSM ± SE					*p*-value
Herds	1st	2nd	3rd			
Primiparous	1.79 ± 0.30^{NS}	1.83 ± 0.29^{NS}	2.04 ± 0.31^{NS}			.240
Multiparous	2.60 ± 0.17^{b}	2.82 ± 0.16^{a}	1.93 ± 0.17^{c}			.001
Season of calving	(April to Sept.)	(Oct. to March)				
Primiparous	1.49 ± 0.29^{b}	2.28 ± 0.30^{a}				.001
Multiparous	2.18 ± 0.16^{b}	2.72 ± 0.16^{a}				.001
Year of calving	1980–1995	1996–2005	2006–2015	2016–2018		
Primiparous	1.80 ± 0.32^{abc}	1.91 ± 0.30^{ab}	1.66 ± 0.30^{c}	2.18 ± 0.36^{a}		.049
Multiparous	2.65 ± 0.21^{a}	2.60 ± 0.16^{ab}	2.06 ± 0.16^{d}	2.48 ± 0.19^{abc}		.001
Birth weight (Kg)	<=25	26–30	31–35	36–40	>40	
Primiparous	0.89 ± 0.10^{d}	1.85 ± 0.15^{a}	1.70 ± 0.12^{abc}	1.74 ± 0.13^{ab}	0.84 ± 0.16^{d}	.001
Multiparous	1.29 ± 0.07^{e}	2.15 ± 0.09^{cd}	2.35 ± 0.08^{abc}	2.41 ± 0.07^{ab}	2.47 ± 0.08^{a}	.001
Age at first calving (Months)	≤40	41–50	51–60	> 60		
Primiparous	1.41 ± 0.06^{NS}	1.39 ± 0.12^{NS}	1.18 ± 0.33^{NS}	2.64 ± 1.04^{NS}		.467
Gestation length (Days)	≤285	286–300	301–315	>315		
Primiparous	1.33 ± 0.10^{NS}	1.32 ± 0.11^{NS}	1.57 ± 0.12^{NS}	1.43 ± 0.11^{NS}		.369
Multiparous	1.93 ± 0.06^{d}	2.12 ± 0.07^{bc}	2.33 ± 0.07^{a}	2.30 ± 0.07^{ab}		.001
Parity order	1	2	3	4	>5	
Multiparous	1.57 ± 0.16^{e}	1.82 ± 0.17^{d}	2.56 ± 0.18^{c}	2.98 ± 0.21^{b}	3.30 ± 0.18^{a}	.001
Sex of the calf	Male	Female				
Primiparous	1.89 ± 0.30^{NS}	1.88 ± 0.29^{NS}				.901
Multiparous	2.41 ± 0.16^{NS}	2.484 ± 0.162^{NS}				.298

Note: 1st herd = El-Nattafe El-Gadid, 2nd herd = El-Nattafe El-Kadim, 3rd herd = Gemiza.

2.2 | Statistical analysis

A logistic regression using GENMOD procedure of SAS (SAS, 2014) was performed to assess the significance of the environmental effects of herds, season of calving (SC), year of calving (YC), birth weight (BW), age at first calving (AFC), parity order (PO), gestation length (GL) and sex of the calf (Sex). Two different threshold animal models were used; for PP the model included: Herd, SC, YC, BW, AFC, GL and Sex as fixed effects and direct additive, dam and residual effects as random effects. However, for MP the model involved; the same effects replacing AFC by PO along with the permanent environmental effects of the animal. A Bayesian approach using THRGIBBS1F90 software (Tsuruta & Misztal, 2006) was followed to estimate variance component and heritabilities. The Gibbs sampler algorithm comprised 1,000,000 iterations, discarding the first 100,000. Afterwards, one sample in each 50 was saved and features of interest of the marginal posterior distributions were obtained using the POSTGIBBSF90 program (Tsuruta & Misztal, 2006).

3 | RESULTS AND DISCUSSION

3.1 | Environmental factors

Herd, SC, YC, BW, GL and PO had significant effects on CE in PP and/or MP cows, while sex of the calf and AFC had no significant effects (Table 1). The herd had a significant effect on CE in MP but not in PP. These herd differences may be attributed to the changes in calving management. SC significantly affected CE rate in both PP and MP. Similar results were observed by Uematsu et al. (2013) who found that CE rates were higher in winter than those in summer, might be due to adequate temperature and availability of green forage in winter compared to summer. YC significantly affected CE, which may be related to changes in management and environmental conditions. BW and PO had significant effects on the CE rate. In PP, both light (≤25 kg) and heavy (>40 kg) calves were accompanied by calving difficulties. However, for MP, only light calves were associated with calving problems. Moreover, the CE rate increased as the PO advanced. The BW of calves and the PO are considered the most important factors affecting CE (Hohnholz et al., 2019). Decreasing CE for light calves in PP and MP may be attributed to the increased incidence of stillbirth (Salem & Amin, 2017). Additionally, decreasing CE in PP for heavy calves compared with older dams may be due to disproportionate pelvic dimensions of the dam and calf size (Hohnholz et al., 2019). The increased BW in MP did not decrease the CE rate as traditionally happens in cattle because of anatomical differences between buffalo and cattle, buffalo having more capacious pelvis and larger area of ileum (Purohit et al., 2012). GL had significant effects on CE in MP. CE rate was higher in buffaloes having GL between 305 and 314 days, resulting in calving after short or long GL so being weaker or bigger, respectively (Usmani et al., 1987).

TABLE 2 Posterior means and their standard deviations (*SD*) for variance components and genetic parameters for calving ease in Egyptian buffalo

	Genetic parameter	Posterior mean	*SD*
Primiparous	σ^2_a	0.146	0.066
	σ^2_m	0.155	0.063
	σ_{am}	−0.146	0.061
	σ^2_e	2.386	0.126
	σ^2_p	2.686	0.119
	h^2_a	0.056	0.023
	h^2_m	0.057	0.022
Multiparous	σ^2_a	0.026	0.007
	σ^2_m	0.025	0.007
	σ_{am}	−0.025	0.007
	σ^2_{pe}	0.006	0.004
	σ^2_e	2.189	0.046
	σ^2_p	2.246	0.047
	h^2_a	0.012	0.003
	h^2_m	0.011	0.003
	r	0.002	0.002

Note: σ^2_a = direct genetic variance, σ^2_m = maternal genetic variance, σ_{am} = direct × maternal genetic covariance, σ^2_{pe} = animal permanent variance, σ^2_e = residual variance, σ^2_p = phenotypic variance, h^2_a = direct heritability, h^2_m = maternal heritability, r = repeatability.

3.2 | Genetic factors

The estimates of direct and maternal heritabilities for CE in PP and MP were low (0.06 and 0.01, respectively, Table 2). These estimates are within the range of those previously reported by Eaglen and Bijma (2009). The results indicate that genetic improvement through direct selection may not be effective in improving CE in Egyptian buffaloes. Also, the repeatability value of CE for MP was low (0.002), indicating that information of the first parity is insufficient to predict the performance of later parities and the environmental factors playing an essential role in the occurrence and the control of CE.

4 | CONCLUSIONS

This study revealed that the herd, YC, SC, BW of calves, PO and GL had relevant effects on CE. Direct selection to improve CE in the studied buffalo populations is not recommended due to the low estimates of direct and maternal heritabilities.

ACKNOWLEDGEMENTS

This work was supported by the Egyptian Project entitled "A genomic approach to improve production and reproduction traits in Egyptian buffalo" from STDF, Egyptian Ministry for Scientific Research.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

DATA AVAILABILITY

The datasets of the current study are available from the corresponding author upon reasonable request.

ORCID

Amin M. S. Amin https://orcid.org/0000-0002-4491-9284

REFERENCES

Eaglen, S. S. E., & Bijma, P. (2009). Genetic parameters of direct and maternal effects for calving ease in Dutch Holstein-Friesian cattle. *Journal of Dairy Science*, *92*, 2229–2237.

Hohnholz, T., Volkmann, N., Gillandt, K., Wabmuth, R., & Kemper, N. (2019). Risk factors for dystocia and perinatal mortality in extensively kept Angus suckler cows in Germany. *Agriculture*, *9*, 85–96.

Kaushik, S. K., & Mathur, A. C. (2005). Time of parturition and incidences of calving abnormalities in Murrah buffaloes. *Indian Journal Animal Science*, *75*, 227–228.

Khan, H. M., Bhakat, M., Mohanty, T. K., Gupta, A. K., Raina, V. S., & Mir, M. S. (2009). Peripartum reproductive disorders in buffaloes - An overview. *Vet Scan*, *4*(2), 1–10.

Purohit, G. N., Barolia, Y., Shekhar, C., & Kumar, P. (2012). Maternal dystocia in cows and buffaloes: A review. *Open Journal of Animal Sciences*, *1*, 41–53.

Salem, M. M. I., & Amin, A. M. S. (2017). Risk factors and genetic evaluation of stillbirth trait in buffalo. *Livestock Science*, *206*, 132–134.

Tsuruta, S., & Misztal, I. (2006). THRGIBBS1F90 for estimation of variance components with threshold-linear model. In *Proceedings of 8th World Congress on Genetics Applied to Livestock Production*,

Uematsu, M., Sasaki, Y., Kitahara, G., Sameshima, H., & Osawa, T. (2013). Risk factors for stillbirth and dystocia in Japanese Black cattle. *The Veterinary Journal*, *198*(1), 212–216.

Usmani, R. H., Lewis, G. S., & Naz, N. A. (1987). Factors affecting length of gestation and birth weight of Nili-Ravi Buffaloes. *Animal Reproduction Science*, *14*, 195–203.

AUTHOR BIOGRAPHIES

Amin M.S. Amin has planned the study, performed the experimental procedures, cured the data, performed the data analysis, prepared and revised the manuscript, provided the funding resources.

Mohamed M.I. Salem has revised the experimental design, performed the data analysis, prepared and revised the manuscript, provided the funding resources.

Mohamed M.E. Ibrahim has executed the experimental work, collected and cured the data.

Samy A. Darweish has conceived the original idea, designed the experiment, supervised the experimental procedures, revised the manuscript.

Ayman G. EL Nagar has revised the experimental design, performed the data analysis, prepared and revised the manuscript, provided the funding resources.

How to cite this article: Amin AMS, Salem MMI, Ibrahim MME, Darweish SA, EL Nagar AG. Factors affecting calving ease in Egyptian buffalo. *Reprod Dom Anim*. 2020;00:1–4. https://doi.org/10.1111/rda.13834