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Some factors associated with mortality rate of Friesian calves during first year of age in Egypt

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ABSTRACT

The objective of this study was to evaluate the effects of some factors on mortality rate of Friesian calves during the first year of age. A total number of 2637 records were studied for Friesian calves during the period from 1997 to2015. All Friesian calves ranged between 3 -365 days of age. The results cleared that the mortality rate was significantly ($P<0.05$) higher during the months of year from May to October of calving which ranged from 11.00 to 17.18 %, while the lowest rate of mortality observed during the period of January to April of calving (5.04 to 9.36%). Mortality rate during the experimental years was low especially during the period from 1997 to 2003 ranging between 3.8 and 6.91 %, while it seemed the high mortality rate started from 2004 and lasted until the end of the research in 2015. The overall mortality rate was increased significantly ($P<0.05$) during the summer season (14.59%), followed by the autumn season (10.19%), while the lowest value recorded in winter season (8.13%). Mortality rate was significantly ($P<0.05$) higher for calves weighed at birth ≤ 20 kg (16.16%) or ≥ 40 kg (17.51%) and the lowest mortality rate was noted when birth weight was 36 to 39 kg. Sex of newborn was not significant effect on mortality rate. Mortality rate was highly significant ($P<0.05$) during the first month and 31-105 days of age (40.65 and 36.63%, respectively) and the lowest value measured in calves above 106-180 days of age (11.72%). Calf mortality rate was significantly ($P<0.05$) lower for dams in the 2th parity (7.66 %) followed in order by the 5, 4 and 3 parities (9.04, 9.70 and 10.6%, respectively). Diseases cause in mortality rate was higher significantly in diarrhea (59.34%) followed in order by respiratory diseases (18.68%), epidemic diseases (15.01%) and other unknown conditions (6.95%).

Key words: Friesian Calves, mortality rate, diseases, season, parity and weighed of dam.

INTRODUCTION

Cows are very important source of animals' protein (meat and milk) in Egypt. Due to fast growing rate of population in the country, the gap between supply and demand for quality protein food is continuously widening. So, the early death of calves affects not only the milk and meat production but also result in reduction of genetic progress, and disruption of breeding programmes due to early mortality of male and female calves. Early mortality reduces the availability of males for the selection and production of quality sire and females for further replacement (Mahmood *et al*., 1995).

Calf losses are significantly reduced by introducing new techniques of management including on-time colostrum feeding, hutch housing, feeding and nutrition (Razzaque *et al*., 2009).

Generally, mortality rate of newly born dairy calves in the few postnatal months averaged from 3.7 to 32.1 % depending on many factors including farm, size of herd, birth month, age and sex of calves, birth weight and other factors (Mario *et al*., 1983 and Dodenhoff *et al*., 1998).

High losses of young calves were due to inadequate management practices leading to diarrhoea, pneumonia, dehydration and infection by *E. coli,* Rotavirus, Salmonella species and Pasteurella haemolytica (Razzaque *et al*., 2008).

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Therefore, the objective of this study was to measure the mortality rate of Friesian calves during the first year of age and to study the effects of various factors such as year and month of birth, dam parity, sex of calf, birth weight and diseases on calf mortality rate under the Egyptian condition.

MATERIALS AND METHODS

Experimental animals

A total of 2637 records for Friesian calves were born during the period from March 1997to April 2015. These data were collected from Sakha Animal Production Research Station belonging to Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt. All calves ranged between 3–365 days of age.

Feeding and management

Calves were separated from their dams after birth and allowed to receive colostrum for the first 5 days of their ages. Calves of 3 to 105 days (weaning age) of age were artificially fed whole milk in plastic bucket twice daily at 7 a.m. in the morning and 6 p.m. in the afternoon during the experimental suckling period (Table-1). From the beginning of the third week, calves were given the starter once daily at 9 a.m. and fresh berseem (winter ration) or berseem hay (summer ration) at 11 a.m. Water was available all the day round.

Post weaning the experimental calves (day 106) to 365 days of age were housed in semi-opened sheds and fed traditional summer ration consisting of concentrate feed mixture (CFM), berseem hay, rice straw with or without corn silage. While, the traditional winter ration consisting of concentrate feed mixture, fresh berseem, and rice straw. Animals were fed to cover their recommended requirements according to Animal Production Research Institute Recommendation (1997) in group feeding assigned according to live body weight. Feeding calves during post weaning period are presented in Table-2.

Collected data

The collected data included the study of born months calves and years of birth , calving seasons (Spring, Summer, Autumn and Winter), sex of born calves(males and females) ,live body weight and age of calf at dead on mortality rate for the different years. Also, data were collected for study the parity of dam and diseases on calf mortality.

Statistical Analysis:

The obtained data were statistically analyzed using SAS (2004) to determine the factor associated with the incidence of mortality rate in Friesian calves under the north Egyptian condition. The data were analyzed according to Snedecor and Cocharn (1980) and the statistical model was:

$$Y_{ij} = U + A_i + e_{ij}.$$

Where:

Yij = Observed values

U = Overall mean

Ai = Animals

e_{ij}= Random error

Chi-square was used to test the differences between the live and motility calves. Duncan Multiple Range Test (Duncan, 1955) was used to get the mean separations between the live and motility calves.

RESULTS AND DISCUSSION

Table-1. Daily amounts of feedstuffs (kg/head) fed to calves during suckling period.

Feedstuff (kg/day)	Age (week)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Whole milk	3.5	4.0	4.5	5.0	5.5	6.0	5.5	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0
Starter*	-		0.25		0.50		0.75		1.00		1.25		1.50		1.75
Fresh berseem	-		1.0		1.5		2.0		2.5		3.0		4.0		5.0
Berseem hay	-		0.25		0.50		0.75		1.00		1.25		1.50		1.75

***** Starter consisted of 15% soybean meal, 10% linseed cake, 34% ground yellow corn grain, 20% wheat bran, 15% rice bran, 3% molasses, 2% limestone and 1% common salt.

Table-2. Daily amounts of feedstuffs (kg/head) fed to calves during post weaning period.

Age (month)	CFM (kg/head)	Berseem hay (kg/head)	Fresh berseem (kg/head)	Rice straw (kg/head)	Corn silage (kg/head)
4 ~ 5	2	2.5	10	-	-
5 ~ 6	2.5	3.0	15	-	-
6 ~ 7	3.0	3.0	15	2	10
7 ~ 8	3.5	3.5	20	2	10
8 ~ 9	4.0	3.5	20	3	15
9 ~ 10	4.5	4.0	25	3	15
10 ~ 11	4.5	4.5	30	3	15
11 ~ 12	5.0	5.0	30	3	20

Months of calving:

Data in Table-3 showed that the mortality rate was significantly (P<0.05) higher during the period from May to October of calving which ranged from 11.00 to 17.18%. While, the lowest value of mortality of Friesian calves was determined during the period of January to April of calving which ranged from 5.04 to 9.36%. Similar findings were observed by Meyer *et al*. (2000), who found that the calf mortality rate was higher in summer months than those born in winter months. Whereas, heat stress in summer months can be reduce the calf resistance to disease as a result of increased corticoid levels inhibiting immunoglobulin absorption from colostrum (Wiersma *et al*., 1976). In contrast, Silva *et al*. (2007) found that the highest calf mortality rate was observed during the cold months when compared with warm months of years. Increases in the mortality rate during winter months may be due to cold, wet and windy weather (Martin *et al*., 1975).

Table-3. Summary of monthly counted calf mortality rate.

Birth weight (kg)	Total No. of born	Survival of calves		Calves mortality	
		No.	%	No.	%
January	218	207	94.95	11	5.04^{d}
February	264	241	91.28	23	8.71^{c}
March	299	271	90.63	28	9.36^{c}
April	226	205	90.70	21	9.29^{c}
May	183	168	91.80	15	8.19^{cd}
June	222	193	86.93	29	13.06^{ab}
July	200	178	89	22	11.00^{b}
August	192	159	82.81	33	17.18^{a}
September	176	153	86.93	23	13.06^{ab}
October	198	172	86.86	26	13.13^{ab}
November	227	204	89.86	23	10.13^{bc}
December	232	213	91.8	19	8.18^{cd}
Overall mean	**2637**	**2364**	**89.64**	**273**	**10.35**

a, b, …. and d: Means denoted within the same column, with different superscripts are significantly different at P<0.05.

Table-4. The calf mortality rate of Friesian calves as affected by years of birth

Birth weight (kg)	Total No. of born	Survival of calves		Calves mortality	
		No.	%	No.	%
1997	162	153	94.44	9	5.55^{ef}
1998	178	168	94.38	10	5.62^{ef}
1999	210	202	96.19	8	3.08^{f}
2000	215	204	94.88	11	5.12^{e}
2001	204	190	93.13	14	6.86^{e}
2002	251	240	95.61	11	4.38^{ef}
2003	188	175	93.08	13	6.91^{e}
2004	144	129	89.58	15	10.42^{d}
2005	143	125	87.41	18	12.50^{d}
2006	120	105	87.5	15	12.50^{d}
2007	101	87	86.13	14	13.86^{cd}
2008	112	91	81.25	21	18.75^{b}
2009	98	77	78.57	21	21.42^{a}
2010	91	75	82.41	16	17.58^{b}
2011	92	71	77.17	21	22.83^{a}
2012	82	66	80.48	16	19.52^{ab}
2013	90	77	85.55	13	14.4^{c}
2014	79	66	83.54	13	16.46^{c}
2015	77	63	81.81	14	18.19^{bc}
Overall mean	**2637**	**2364**	**89.64**	**273**	**10.35**

a, b …, and f: Means denoted within the same column, with different superscripts are significantly different at P<0.05.

On the other hand, Roy (1990) reported that mortality rates were recorded the highest value in February, March and April. This may be attributed to the hot weather, which may exert a negative effect on young calves and newborn calves produce more sweet per kilogram of body weight than do adult cattle. Consequently, this may lead to dehydration, which greatly reduces the ability of the calf to cool itself by the evaporative heat–loss process (Winchester, 1964).

Years of birth:

Number of born Friesian, total number of life calves and number of dead calves during the period from 1997 to 2015 are shown in Table-4. The experimental results were indicated that the overall average for the deaths of Friesian calves during the experimental period was about 10.35%.

Additionally, the current results indicated that the mortality rate during the early years of the research was low especially during the period from 1997 to 2003, whereas it was ranging between 3.8% and 6.91 %. On the other hand, the high mortality rate started from 2004 and lasted until the end of the research in 2015. Whereas, the mortality rate ranged between 10.42 % in 2004 and 22.83 % in 2015. These results are in accordance with those obtained by Umoh (1982), who found that the mortality rate during the period from 1975 to 1980 was 8.7%. Moreover, Meyer *et al*. (2000) found that the mortality rate of Friesian calves increased from 1985 to 1996 by 4% in primiparous and 2% in multparous in Holstein calves. In contrary, the mortality level rate was higher level when compared with the present study, Mee (2008) found that the mortality ranged between 23 to 27% during the period from 2002 to 2005, which might be due to better management practices given throughout these years. Finally, Yalew *et al*. (2011) observed that a significant effect of birth year on calves survival could be due to poor hygienic conditions of calf houses, nutritional stress, incidence of calves health problems and deprivation of colostrums feeding of calves.

Seasons of year:

The overall mortality rate was recorded the highest value in the summer season (14.59%), this may be due to excessive ambient temperature and scarcity of green feed and fodder, followed by the autumn season (10.19%), while the lowest value of Friesian calf mortality was recorded in the winter season (8.13%) (Table-5). These results are in agreement with those reported by Azizzadeh *et al*. (2012), who found that a higher risk of calves mortality in Holstein dairy herds in summer season than other seasons and these differences may be due to the difference in average ambient temperature and feed system in the different farms.

In contrast, Mishra *et al*. (2015) found that the mortality rate during the different four seasons was lower than observed in the present results, whereas the mortality rates were 6.73, 6.18, 2.74 and 2.82 % in winter, summer, autumn and spring seasons, respectively. In the same trend, Buttigieg *et al*. (2016) reported that the calf mortality rate was 7.04, 7.00, 7.16 and 7.12% in spring; summer; autumn and winter season, respectively. In this trend, Martin *et al*. (1975) indicated that a high temperature in the summer season were associated with an increased risk of death. Moreover, Gulliksen *et al*. (2009) reported that Norwegian dairy cows calving during winter months produced colostrums with a significantly lower Ig G content than cows calving during any other season of the year and colostrum of the highest quality was produced by cows calving during autumn. Thus, there seems to be a relationship between seasonal variation in colostrums quality and calf mortality rate.

Sex of calves:

Table-5. Effect of seasons on the mortality rate of Friesian calves

Sex of calves	Total No. of born	Survival of calves		Calves mortality	
		No.	%	No.	%
Spring	695	631	90.79	64	9.20^{b}
Summer	596	509	85.40	87	14.59^{a}
Autumn	608	546	89.80	62	10.19^{b}
Winter	738	678	91.86	60	8.13^{b}
Overall mean	**2637**	**2364**	**89.64**	**273**	**10.35**

a, b and c: Means denoted within the same column, with different superscripts are significantly different at P<0.05.

Table-6. Calf mortality rate as affected by sex of Friesian calves

Sex of calves	Total No. of born	Survival of calves		Calves mortality	
		No.	%	No.	%
Male	1311	1164	88.78	147	11.21
Female	1326	1200	90.49	126	9.50
Overall mean	**2637**	**2364**	**89.64**	**273**	**10.35**

Sex of calf was not significantly effect on the mortality rate. But, calf mortality rate was higher level for male calves (11.21%) when compared to the female calves (9.50%) within the experimental period from birth to the first year of life (Table-6). Hossein-Zadeh *et al*. (2012) observed that the overall ratio of males to females for mortality rate was 53.0:47.0. In general, who observed that there were no significant effects of sex of calves on mortality rate and it was increased in male than in female calves. In the same trend, Metwally *et al*. (2003) reported that the mortality rate was greater for male Friesian calves (55.6%) than female Friesian calves (44.4%) within the period from birth to weaning at 16 weeks of life. In contrary, Maltecca *et al*. (2006) observed that the mortality rate was significantly lower for female calves when compared with male calves. Also, in the buffalo, female calves are more prone to death than their male counter parts (Khatun *et al*., 2009 and Buttigieg *et al*., 2016). The reason for higher percentage of mortality in male calves than female calves may be due to the fact that for the want of milk, better care and management practices (Mishra *et al*., 2015). Also, Islam *et al*., (2005) reported that a higher concentration of immunoglobulins in female calves , a fact that may increase chance of survival of that gender or may be to the female calves show more resistance than males to the subtropical environment.

Live body weight of calves at birth:

Date in Table-7 showed that the mortality rate was significantly (P<0.05) higher for the Friesian calves weighed at birth ≤ 20 kg (16.16%) or ≥ 40 kg (17.51%), while it decreased at their birth weight was ranged from 36 to 39 kg. These results are in agreement with, Metwally *et al*. (2003), who indicated that the Calves mortality rates was recorded the highest value for calves weighed at birth ≤ 20 kg (22.7%) or ≥40 kg (36.0%) and the lowest value was noted when the birth weight was ranged between 26 and 39 kg. This may suggest that the proportionate size of dam to size of calf at birth is important in reducing calf losses. These results agreed with those of Mario *et al.* (1983), who found that more calf mortality for very small or very large calf birth weight at calving. Therefore, the effect of birth weight of calves on mortality rate may be from longer gestation period or vice versa. Furthermore, Roy (1990) reported that calf mortality rate was greater when calves weighed at birth < 36 kg or > 50 kg, so calf mortality was higher in calves of both low and heavier birth weight.

Age of the calves at death:

The experimental results are presented in Table-8. These results revealed that the Friesian calf mortality rate during the first year of life were a highly significantly (P<0.05) effect during the first month of age and during the period from 31 to 105 days of age (40.65 and 36.63%, respectively) and the lowest value was observes in calves above 106-180 days of age (11.72%) and about10.98% in calves aged181-365days. These results are in agreement with those reported by Bera *et al*. (2015), who reported that about 37.03% of calf mortality was observed within the first month of age followed by 33.33% in 1–3 months of age, 11.11% in calves of 3–6 months of age and 18% in calves above 6 months of age.

Table-8. Effect of age of calf at dead on mortality rate

Age at dead (day)	Calves mortality	
	No.	%
4-30	l11	40.65[a]
31-105	100	36.63[a]
106-180	32	11.72[b]
181-365	30	10.98[b]
Total	273	100

a and b: Means denoted within the same column, with different superscripts are significantly different at P<0.05.

Similar observations were recorded by Jenny *et al.* (1981) and Islam *et al.* (2005), who reported that maximum calf mortality occurred during first months of age and mortality percentage reduced as the age increased. Also, Gulliksen *et al.* (2009) reported that calf mortality rate was 4.6% in live born dairy calves up to 1

Table-7. Effect of Live body weight of calves at birth on mortality rate

Birth weight (kg)	Total No. of born	Survival of calves		Calves mortality	
		No.	%	No.	%
≤ 20	99	83	83.83	16	16.16[a]
21-25	354	302	85.31	52	14.68[ab]
26-30	709	639	90.12	70	9.87[b]
31-35	811	746	91.98	65	8.01[b]
36-39	390	368	94.35	22	5.64[c]
≥40	274	226	82.48	48	17.51[a]
Overall mean	**2637**	**2364**	**89.64**	**273**	**10.35**

a, b and c: Means denoted within the same column, with different superscripts are significantly different at P<0.05.

Table-9. Variations in calf mortality rate by parity of dam

Parity	Total No. of born	Survival of calves		Calves mortality	
		No.	%	No.	%
1	849	751	88.45	98	11.54^{bc}
2	652	602	92.33	50	7.66^{c}
3	459	410	89.32	49	10.6^{c}
4	309	279	90.29	30	9.70^{c}
5	188	171	90.95	17	9.04^{c}
6	101	86	85.14	15	14.8^{b}
7	79	65	82.27	14	17.72^{a}
Overall mean	**2637**	**2364**	**89.64**	**273**	**10.35**

a, b and c: Means denoted within the same column, with different superscripts are significantly different at P<0.05.

year of age in Norway ,4.0% in live born dairy calves up to 210 days of age in Sweden (Svensson *et al*., 2006) and an average of 2.0% to 6.9% on British cattle farms for calves followed up to 6months of age (Ortiz-pelaez *et al*., 2008).The neonate calves are generally known to have lower immunity and vulnerable to a variety of infection especially if they do not ingest adequate colostrum at the right time soon after birth (Radostitis, 2005). Higher calf mortality within age of 3 months may be due to lowered immunity, other management-related and environmental factors, which may lead to stress on these calves that exacerbates the occurrence of various infections and subsequently death (Gitau *et al.,* 1999, Wymann *et al.,* 2006 and Wudu *et al.,* 2008). Moreover, Yalew *et al*. (2011) observed that the calf mortality is higher during their early life a result of stresses and high infection in health cares.

Parity of dam:

Results from this study showed that calf mortality rate was recorded the lowest percentage for dams in the 2thparity (7.66 %) followed in order by the 5, 4 and 3 parities (9.04, 9.70 and 10.6%, respectively). While, the moderate percentage of calf mortality recorded in the first and six parities (11.54 and 14.8%, respectively). However, the highest mortality rate in the seven parity 17.72% (Table-9).

Table-10. Friesian calf mortality rate as affected by infection with various diseases

Cause of death	Calves mortality	
	No.	%
Diarrhea	162	59.34^{a}
Respiratory	51	18.68^{b}
Epidemic diseases	41	15.01^{b}
Injury and unknown conditions	19	6.95^{c}
Total	273	100

Shrivastava *et al.* (2014) reported that the overall mortality rate was recorded 50, 26.5, 23.07 and 15.2% in the 1st, 2nd, 3rd and 4th parities, respectively in buffalo calves, which are higher value of the mortality rate than the present study. On the other hand, Well *et al*. (1996) found that the mortality rate was recorded maximum in the 1st parity and it decreased in subsequent parities, which reveals that with an increase in subsequent parity decreasing trend of calf mortality, this may be due to that the dam become experienced in rearing the calves and may be also due to the improvement in quality and quantity of colostrums of their dams.

Cause of Diseases:

The main diseases detected during post-mortem examination are shown in (Table-10). The experimental results cleared that the major cause death of the young calves was diarrhea (59.34 %) followed in order by respiratory diseases (18.68 %), epidemic diseases (15.01 %) and other unknown conditions (6.95 %).

These results are in agreement with those reported by shrivastava *et al*. (2014), who found that the highest mortality in buffalo calves was recorded due to gastroenteritis (34.68) followed by worm infestation (24.06). On the other hand, Gulliksen *et al*. (2009) observed that the respiratory disease the main risk of death in all age groups with hazard ratios of 6.4; 6.5; 7.4 and 5.6 during the first week of life , 8 to 30 day of age, 31 to 180 day of age and 181 to 365 day of age, respectively. Metwally *et al*. (2003) found that a major cause of suckling calves disease was respiratory diseases (47.8%) followed in order by diarrhea (37.6%), septicaemia (3.4%) general weak (3.7%) and injuries and other unknown conditions (4.3). Additionally, diarrhea and respiratory disease increase the risk of new born calf death (Gulliken *et al*., 2009). In the other words, 78.01 % of calf mortality could be attributed to both respiratory and diarrhea diseases, which may reflect disproper rearing, housing, suckling and ventillation. Consequently, application of appropriate calf management could minimize the mortality rate.

CONCLUSION

The current study concluded that mortality rate of Friesian calves during the first year of age was a significantly affected by the months of calving, seasons of years, parity of dam and calves weighed at birth during the period from 1997 to 2015. As well as, diseases cause in mortality rate of Friesian calves within the first year of age. From this study, reduce calf mortality attention should be focused on those risk factors that are under management control. Efforts should be made to increase calving supervision, improve management of newborn calves and prevent respiratory diseases and diarrhea.

Conflict of Interests

Authors declare that there is no conflict of interests regarding the publication of this paper.

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