

A study on Calf's Behavior and Growth Performance in Relation to Gestation Period and Lactation Season

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Abstract

The present study aimed to assess the impact of the length of the gestation period (GPL) and number of lactation season of cows on behavior and growth performance in calves from birth until weaning. The presence of abnormal behavior during 1st twelve hours of the calf's life as delayed Sternal recumbancy and standing or abnormal suckling was not significantly affected by GPL. Also, the duration and frequency of behavior related to respiratory, digestive or mixed disorders had a non-significant variation between groups of different gestation period length. However, the increase in GPL had the lowest percentage and duration of behavior related to respiratory and digestive disorders. Calves with the longest GPL had a significantly higher birth weight and it had a significant effect on pre-weaning growth rate. On the other side, the presence of abnormal behavior during the first twelve hours of the calf's life as delayed Sternal recumbancy and standing or abnormal suckling were higher in 3rd parity. The number of lactation season had no significant effect on the duration and frequency of behavior related to respiratory, digestive or mixed disorders. The birth weight of calves was higher in third parity group (36.73 kg) than other parities, but the differences didn't reach the significance, moreover, the weaning age and pre-weaning growth rate did not affect by the lactation season number. There was a negative correlation between abnormal behavior and the pre-weaning growth rate. There was a positive correlation between duration of abnormal behavior and the weaning age.

Keywords: Behavior, Calf, Gestation, Lactation, Performance.

Received: September 23, 2018 **Accepted:** November 6, 2018 **Published:** November 6, 2018

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Citation: Mohammed HH et al., A study on Calf's Behavior and Growth Performance in Relation to Gestation Period and Lactation Season. SVU-IJVS 2018, 1 (2): 60-68.

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Competing interest: The authors have declared that no competing interest exists.

Introduction

The aim of calf's management is to produce well grown, healthy calves developing steadily after weaning. The calf weaning period covers the time from birth to weaning age. The best management practices for calves raising starting from birth and followed by colostrum feeding, housing then management. Pre-weaning feeding, diseases and vaccination were also evaluated to ensure a healthy calf. Stress factors experienced by pregnant cows have detrimental effects on the offspring behavior and productivity (Funston et al., 2010). Many studies have been reported to define the best management in different aspects of a calf's life and there were no 'quick fix' solutions, but getting the basics right is the way for proper calf rearing. The weaning period, which is the critical stage of the calf's life will deal with a multi-factorial approaches which are required to ensure healthy and well grown calves. A vigor of the newly born calves has been assessed immediately after calving through monitoring indicators such as sucking reflex, time to head lift then trials for standing and time of the first standing (Sorge et al., 2009). The morbidity in calves was estimated and revealed that 75% of prenatal calves losses happened within the first hour postpartum (Nagy, 2009). The morbidity and mortality rates were even higher in the absence of adequate management (Marques, 2003), which resulted in impairment of animal performance. The colostrum in newborn calves is the main source of immunoglobulin, which was important for increasing the calf's immunity and decreasing the mortality rates in neonatal and pre-weaned calves. Colostrum management is a critical point to calf health, survival and welfare, as inadequate colostrum intake leads to increased mortality rate and diseases such as diarrhea

and respiratory illnesses (Mellor and Stafford, 2004). In the first few hours of the calf's life the absorption level of immunoglobulin is the greatest and then starts to decrease progressively after 4 to 6 hours, and ceases after 24 hours from birth time. Calves should be given 2-3 liters of colostrum by esophageal tube or by nipple feeding within four hours of birth with a total of 4 liters within 12 hours of birth especially those born after dystocia as this was a major cause of calf mortality. Extended periods of labor, uterine contractions, and trauma during difficult parturitions lead to increasing acidemia and hypoxia in the neonate. Finally, raising calves on most dairy farms in Egypt and worldwide is a very important, complex and expensive task. Having a successful calf raising operation is not only important financially, but also important for the future of the herd. For that reason, the objectives of this study were assessed the impact of gestation periods and a lactation season of cows on calf's behavior and performance from birth till weaning.

Materials and Methods

I. Animals used and management:

This study was carried out at a private dairy farm close to Cairo-Ismailia road, Egypt. Eight hundred and eighty Holstein calves (429 female and 451 male) which have been born during one year started on 1st July 2016 delivered from apparently healthy dams (Calves from diseased dams have been excluded from sample population) and stilled alive till weaning (Abortion, stillbirth and death cases have been excluded). All calves were reared and monitored under the same general management system that ensures good health situation, including separation from the dams on the first day after birth, and then they were reared in individual littered hutches till weaning. Calves received fresh

colostrum collected from their dam as soon as possible after birth (within 1 hour) with an average amount of 2 liters then increased to 8 liters within the first 24 hours. Calves fed milk ad libitum by artificial teat with a plastic bottle that was fitted in front of the hutches at a height of 40 cm above the ground during the experimental period (Zábranský et al., 2015). All calves are fed whole milk mixed with non-saleable milk after pasteurization. Milk fed at an amount of 5 L/d divided into 2 portions offered in the morning (3 L) and evening (2 L) for 56 days (Ribeiro et al., 2009) and increase to 2.0 % of the body weight until weaning. The calves had a free access to drinking water for the entire experimental period.

A Starter ration has been offered right away from 3 days of age (Jami et al., 2013) till weaning. At the beginning of calf starter feeding, calves received 115 g of starter twice per day (Orellana and Ruth, 2016). The starter ration consisted (according to standard procedures of NRC (2001) (Table. 1).

Table (1): The ingredients of starter ration of calves.

Feed stuff	Percentage
Crushed corn	57%
Soya bean meal	16%
Alfalfa	20%
Molasses	5%
Dicalcium Phosphate	0.9%
Limestone	0.8%
Yeast, Salt and vitamins	0.3%

Calves only be weaned after they can consistently consume 1kg of starter daily (Drackley, 2008 and Stamey et al., 2012) and for 3 consecutive days (Nussio et al., 2003) with a minimum body weight at weaning not less than 55 kg. Once after weaning, calves were moved in a small

group (15-20 calves) into a small barn with a different nutritional material of dry feed and high quality hay.

II. Experimental design:

Data for all calves under study were recorded from direct observation and computer records on the dairy farm during the period of the experiment. The calf groups have been classified according to:

1- Gestation period length:

- a) From 268 to 275 days (below average)
- b) From 276 to 280 days (Average)
- c) From 281 to 303 days (above Average)

2- Number of parity (dams lactation season):

Animals were divided according to the number of parity into; 1st parity, 2nd parity, 3rd parity and 4th parity or more (Stádník et al., 2013).

III. Behavioral observations:

III. A. Behavioral observation during the first twelve hours postpartum:

The calves have been observed for vitality and health immediately after calving and within the first 12 hours postpartum for performing natural behaviors for survival, which include standing up and suckling colostrum after birth (Barrier et al., 2012) and time for Sternal recumbancy (Mee et al., 2011, Nagy, 2009) or a combination of indicators (Sorge et al., 2009).

III. B. Behavioral observation from birth till weaning:

In order to identify sick calves, careful behavioral observation were performed to determine the calves' behavior which related to digestive and/or respiratory disorders as the most common problems in pre-weaned calves, both of which can

affect calf performance and welfare (Marce et al., 2010).

IV. Calves performance:

Calf Birth Weight (CBW) was recorded for all calves within two hours after birth and Live Body Weight (LBW) were recorded regularly every month. At the time of weaning, the pre-weaning growth rate was calculated by the following equation: both live weaning weight and weaning age were recorded

$$\text{Growth rate} = \frac{(W2-W1)}{(T2-T1)}$$

Where W2 is the calf weaning weight and W1 is the calf birth weight.

T2 – T1 = weaning age which is the time interval from birth (T1) till weaning (T2)

V. Statistical analysis:

All statistical procedures were performed using the SAS statistical system Package V9.2 (SAS, 2009). One-factorial analysis of variance (ANOVA) was performed. The analysis of data distribution suggested that all traits analyzed followed a normal distribution ($P>0.05$). Pearson correlations were performed to compute the relationship of the abnormal behavior and performance parameters.

Results

This study showed that the behavioral disorders were significantly decreased with increase in the length of the gestation period, where the durations of respiratory and digestive disorders (0.14, 0.34 days respectively) were significantly lower in group 3 than other groups as shown in

Table (2). Nevertheless, the calves in group (1) showed high percentage of these abnormal behaviors (1st 24 hours, digestive and respiratory) in comparing to other groups, but the difference did not reach the significance. Moreover, the data in table (3) revealed that the growth rate and body weight of calves were significantly higher in the highest gestation period ($38.23\pm 0.62a$, $0.55\pm 0.007a$, respectively) in compare to other groups. The results in table (4) showed the effect of lactation season number of dam on calf's behavior. When considering the lactation season number of the dams, the presence of abnormal behavior during the 1st 12 hours of the calf's life and respiratory disorders were notable in 3rd parity (1.31% and 11.11% respectively), while there was increase in % of digestive and mixed disorders at 4th season (23.56% and 4.19%, respectively) in compare to other seasons, but the differences among experimental groups did not reach the significance. The birth weight of calves was significantly higher in 3rd lactation season (36.73 kg) than others, while the increase in the growth rate (0.543 ± 0.009^a) was significantly in Calves born in the second season, as mentioned in table (5). The data in table (6) showed the correlation between abnormal behavior in experimental calves and growth performance, where the respiratory disorders were negative correlated with birth weight (-0.091) and pre-weaning growth rate (-0.066). Furthermore, there were negatively correlations between digestive disorders, birth weight, and pre-weaning growth rate. The increase in weaning age was correlated positively with abnormal behaviors, as shown in table (6).

Table (2): Effect of the length of the gestation period on calf's behavioral disorders.

Gestation periods (days)	Behavioral disorders					
	1 st twelve hrs abnormal Behavior (%)	Respiratory Disorders (%)	Digestive Disorders (%)	Mixed Disorders (%)	Respiratory Disorders Duration (days)	Digestive Disorders Duration (days)
Group (1) (268-275)	1.68%	9.80%	21.96%	3.38%	0.26±0.05 ^a	0.52±0.06 ^{ab}
Group (2) (276-280)	0.25%	8.50%	22.75%	2.75%	0.19±0.03 ^b	0.55±0.05 ^a
Group (3) (> 280)	0.00%	6.58%	16.45%	3.95%	0.14±0.04 ^c	0.34±0.06 ^b

^{abc} Means in the same column with different superscripts are significantly different at ($P \leq 0.05$).

Table (3): Effect of the length of gestation period on cows on calf's performance.

Gestation periods (days)	Growth performance		
	Birth weight (Kg)	Age of weaning (days)	Growth rate (Kg/day)
Group (1) (268-275)	33.75±0.33 ^c	70.44±0.68	0.50±0.118 ^b
Group (2) (276-280)	36.93±0.031 ^b	70.13±0.69	0.51±0.006 ^b
Group (3) (>281)	38.23±0.62 ^a	69.76±1.23	0.55±0.007 ^a

^{abc} Means in the same column with different superscripts are significantly different at ($P \leq 0.05$).

Table (4): Effect of the lactation season number of dams on calf's behavioral disorders.

Lactation season	Behavioral disorders					
	1 st 12 hrs. abnormal behavior (%)	Respiratory disorders (%)	Digestive disorders (%)	Mixed disorders (%)	Respiratory disorders duration (days)	Digestive Disorders Duration (days)
1 st season	0.73%	6.55%	20.73%	2.18%	0.16±0.03	0.48±0.06
2 nd season	0.44%	7.42%	20.09%	3.06%	0.17±0.04	0.46±0.06
3 rd season	1.31%	11.11%	21.57%	3.92%	0.24±0.05	0.57±0.10
4 th -10 th season	0.52%	10.99%	23.56%	4.19%	0.27±0.06	0.52±0.07

Table (5): Effect of the lactation season number of dams on calf's performance.

Lactation season	Growth performance		
	Birth weight (Kg)	Age of weaning (days)	Growth rate (Kg/day)
1 st season	35.97±0.35 ^{ab}	71.35±0.78	0.519±0.007 ^{ab}
2 nd season	35.31±0.47 ^b	69.09±0.86	0.543±0.009 ^a
3 rd season	36.73±0.54 ^a	70.06±1.13	0.513±0.011 ^b
4 th -10 th season	36.52±0.48 ^{ab}	69.87±1.00	0.516±0.008 ^b

^{ab} Means in the same column with different superscripts are significantly different at ($P \leq 0.05$).

Table (6): The relationship between duration of calf's behavioral disorders and growth performance parameters.

Performance parameters	Respiratory disorders duration		Digestive disorders duration	
	Correlation coefficient	P-Value	Correlation coefficient	P-Value
Birth weight	-0.091	N.S	-0.009	N.S
Age of weaning	0.186	N.S	0.131	N.S
Growth rate	-0.066	N.S	-0.094	N.S

N.S = Non-significant

Discussion

Understanding the behavior of calves and the factors that affect them helps to improve their management during the pre-weaning period, which is the most important period of their life and can reduce the negative consequences on their health and productivity performance.

Our results as shown in table (2), revealed that the gestation period length (GPL) had the effect on calf's behavior with significant differences in its duration, which is likely due to the change in cow's age is factor affecting in cow and calf health (Przysucha and Grodzki, 2009). These results showed undesirable effects on calf's behavior and health with the shorter gestation period length, which agreed with that obtained by Norman et al. (2009) who reported that both longer and shorter gestation periods contribute to a higher number of complications and still births. Funston et al. (2010) cited that the offspring from late gestational nutrient restricted mothers became susceptible to a variety of neonatal health issues including respiratory conditions, diarrhea, cold stress, and morbidity in general.

Regarding the data in table (3), the birth weight (kg) of calves from more than 281 days of gestation period was significantly higher than the calves from other groups, as mentioned before in Hansen et al. (2004), who reported that the increase in calf weight significantly related with an increase in gestation length values.

The significance in CBW in the different gestation periods may be due to the direct gestation length has positively correlated with direct birth weight (Crews, 2006). Kumar et al. (2016) cited that the increase in calf birth weight significantly ($p < 0.01$) contributed to a linear increase in gestation length value. Moreover, Hansen et al. (2004) mentioned that in the heaviest calves group (> 40 kg), gestation period was 3.9 days longer on average in comparison with the group of the lightest calves (≤ 34 kg). Furthermore, the growth rate was significantly affected by the length of the gestation period, which may be due to the increase of entry birth weight (38.23 kg) and decrease of age weaning (69.76 days). This result was agreed with Pempek (2015) who reported that calves with shorter gestation length may contribute to the compromised fetal growth in late gestation.

The results in table (4) showed the effect of lactation season number of dams on calf's behavior, where the percentages and duration of abnormal behaviors was higher in 3rd season, but the differences did not reach the significance. The obtained results agreed with Elizondo et al. (2012), who cited that off springs born to cows with third lactation season showed the lowest percentage of calves with inadequate transfer of immunity. Kamal et al. (2014) reported that occurrence of calf diarrheas and the growth of live body weight were influenced by the dam's parity and the season of birth. Nerveless, Asmare and Kiros (2016) showed that calves born from

multiparous cows had significant ($p < 0.05$) increase in the morbidity and non-significant increase in the mortality ($p = 0.819$) comparing to calves born from primiparous cows.

Concerning to data in table (5), these results revealed that the increase of number of lactation seasons may be leading to increase of calve birth weight, as shown before in Nogalski (2003), who noted that calves delivered by heifers were lighter and characterized by non-significantly lower values of all body measurements. Bayou et al. (2015) reported that the calf body weight have been increased as the dam lactation season number increased from the first lactation season to the third lactation season after that there was a declining trend for the fifth lactation season and these traits attain their maximum at the third lactation season. The age of weaning was higher in primiparous dams than other groups, but the differences did not reach the significance. The decrease of birth weight in primiparous cows reflected increase the age of weaning, as shown Záborský et al. (2015) who cited that calves from primiparous dams showed significantly lower live body weights at birth, also at the last weighing on day 28 compared to calves from older cows. The growth rate, as shown in table (6) was significantly affected by lactation season, where it was the highest in 2nd season (Dhakal et al., 2013). The significance in growth rate among the experimental groups reflected effect the number of parity on the calf health, as shown previously in Kamal et al. (2014), who mentioned that the occurrence of calf diarrheas and the growth of live body weight were influenced by the dam's parity and the season of birth. Asmare and Kiros (2016) cited that the calves born from multiparous cows had significant ($p < 0.05$) high morbidity compared to calves born from primiparous cows.

The obtained results in table (6) showed the non-significant correlation between abnormal behavior and growth performance, where it was agreed with Civelek et al. (2008); Barrier et al. (2012) and Murray et al. (2015) who concluded that the increase in the risk of morbidity and respiratory diseases associated with a decrease in weight gain in stressed calves after birth.

Conclusion

In conclusion, the duration of the behavioral disorders were significantly decreased with increasing the length of the gestation period. Moreover, the growth rate and body weight of calves were significantly affected by the changes in the gestation period. There were differences in behavioral disorders due to changes in lactation season, but the differences did not reach the significance. The birth weight of calves was significantly higher in 3rd lactation season than others, while growth rate was significantly higher in 2nd season than other season. There was significant correlation between growth parameters and behavioral disorders.

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