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THE IMPACT OF MANAGING REARING CALVES ON THEIR PERFORMANCE IN A COMMERCIAL HOLSTEIN FRIESIAN FARM

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ABSTRACT: This study was conducted in a commercial cattle farm named El-Baiomy dairy farm located in Gamasa- Dakahlia province-Egypt to evaluate the effect of management system on calves performance. Records of 3691 Holstein Friesian calves were used in this study from 2013 up to 2019. This study included management factors such as dam effect (dry period, parity, calving interval and previous milk production) and calves management (housing system, suckling system, season and gender) and their effects on birth weight (kg), weaning weight (kg), weaning age (day) and daily gain (kg).

There was significant effect (P ≤ 0.05) of housing system, suckling system and season of calving on weaning age and daily gain of calves. The lowest birth weight was reported in winter (31.34 kg) however, the heaviest one was reported in winter (93.88 kg). The heaviest birth weight was reported in male (32.93 kg) but female was 31.63 kg only. On the other hand weaning age found to be 81.31 and 79.14 days in female and male, respectively. There were no significant effects (P> 0.05) in dry period length, parity, calving interval and previous milk production of dam on calf's performance. The lowest birth weight was found to be in first parity cows (31.63 kg), while the heaviest one was found to be in third parity cows (33.00 kg).

Key words: Rearing calves, housing system, season, gender.

INTRODUCTION

Calves are the future income of the farm and sustainability of farm depend on them. Calf management are important as they help calves in reaching their full genetic potential and can produce healthy herd replacement animals (Thakur and Gupta, 2016). Animals should be kept in a management system, which allow them to express natural behaviour.

Some farms fulfill low mortality rates, it indicates that losses can be avoided when good management practices are in place.

The early phase of the young animal's life is so crucial because the calves are very susceptible to the environmental and housing factors such as floor and bedding materials (Kartal and Yanar, 2011). Birth weight is an early and easy indicator of prenatal growth. The birth weight is commonly used as an early selection criterion in cattle breeding (Kaygısız *et al*., 2012). Concrete floors were preferable to individual dairy calves' pens, weights at weaning and 4 months of age were not significantly influenced by the type of floor (Kartal and Yanar, 2011).

Growth rate, disease incidence, and mortality are among the most important parameters to monitor during a calf's pre weaning period as they reflect the overall outcome of farm management practices and husbandry. Elsohaby *et al*. (2019) reported that two measures of success for a calf rearing program are body weight and average daily gain.

Calf suckling is an interesting as well as extremely important area of research, because it involves such different

aspects as behaviour, physiology and management (De passille, 2001).

This study was conducted in a commercial cattle farm using records including some factors such as season of birth, birth and weaning weights, gender of calves and dam calving number, to study the impact of different management systems on a growing calf.

MATERIAL AND METHODS

Records of 3691 growing Holstein Friesian calves raised in a commercial farm named El-Baiomy dairy farm located in Gamasa-Dakahlia province, Egypt were used in the present study. This farm specialized in milk production, consisted of 2000 Frisian dairy cattle and their consequent, daily milk production ranges between 30-32 ton/day of fresh milk in average.

Management

Housing system

This farm included two management systems (two stations). Dairy cows in both management systems were housed in a similar pens as loosing housing system in open half-shaded pens (Fig.1), while the calves were housed in different housing systems. In the 1stmanagement system, the calves were housed individually in special boxes for the first 21 days after birth (Fig. 2) and then they were relocated in conventional boxes (Fig. 3) on sand bedding till weaning. The boxes were placed in parallel rows in special contiguous boxes, with a floor of iron insulated with a plastic layer, under a large galvanized iron sheet with a height of 5 meters and raised from the ground 20 cm. Boxes were installed on concrete floors with tendencies to facilitate the drainage of feces and urine away from the calves. The dimension of these boxes were 110×70×100 cm for long, wide and height respectively. Scalded metal barrier was provided between each animal to prevent calves licking behavior. After the first period of calving (starting from 22 day up to weaning) the calves were relocated on sand bedding in iron conventional boxes (Fig. 3). These boxes measured 200×100×115cm for long, wide and height, respectively and were sheeted entirely and individually by galvanized iron. The starter vessels were available allover 24 hours. On the other hand, calves in 2ndstation were housed directly after birth in the conventional calf's boxes, as illustrated previously, till weaning (Fig.3).

Suckling and feeding systems

The same suckling and feeding systems were applied in both stations, they differ only according to year strategies (Table 1).

Statistical analysis

The effect of management related factors on calves' performance were statistically declared using the general linear model of IBM SPSS (statistical package) according to the following model:

$$Y_{ijklm} = \mu + H_i + G_j + S_k + K_l + HGSK_{ijklm} + e_{ijklm}$$

Where:

- Y_{ijklm} Criteria studied for animals in the ijkl subclass;
- μ Overall mean;
- H_i The fixed effect due to the i_{th} calves housing system, i = 1, 2; where:
  1= semi indoor system in 1st station,
  2= outdoor system in 2nd station;
- G_j The effect due to the j_{th} calf gender, j = 1, 2; where:
  1= female,
  2= male;
- S_k The effect due to the k_{th} season, k = 1, 2, 3,4; where:
  1=winter,(December-January-February)
  2= spring, (March-April-May)
  3= summer, (June-July- August)
  4=autumn; (September –October-November)
- K_l The effect due to the l_{th} suckling systems, l = 1, 2, 3,4; where:

e_{ijklm} Random error.

Fig. (2): Calves semi-indoor housing systems in the first station (first management system)

1= 1st suckling system, (1st SS at 2013),
2= 2nd suckling system (2nd SS at 2014),
3= 3rd suckling system (3rd SS at 2015 and 2016,
4= 4th suckling system (4th SS at 2017 – 2019)

Fig. (1): Housing systems of dairy cows (open half-shaded pens) in El-Baiomy dairy farm

Fig. (3): Calves outdoor housing systems in the second station (second management system)

Table 1: Suckling and feeding systems applied during the study (2013-2019).

Time from parturition (00)	Year	Calves suckling and feeding systems
00:00 -00:30	2013 - 2019	2-3 kg colostrum
00:30 -03:00		2 kg colostrum
03:00 -06:00		2 kg colostrum
06:00 -72:00 (for 3 days)		7.5 kg colostrum per day on 3 times with an average 2.5 kg/times
72:00 -96:00 (day 4)		4 kg mixture of whole milk and colostrum (1:1 resp.) on 2 times with an average 2 kg/times
96:00 -120:00 (day 5)		4 kg mixture of whole milk and colostrum (3:1 resp.) on 2 times with an average 2 kg/times
120:00 -144:00 (day 6)		4 kg of whole milk on 2 times with an average 2 kg/times & starter
Day 7 - day 21	2013 - 2016	5 kg of whole milk/day offered on twice & ad-lib starter
Day 21 - day 50	2013	6 kg of whole milk/day offered on twice & ad-lib starter
day 50 – weaning		7 kg of whole milk/day offered on twice & ad-lib starter
Day 21 – weaning	2014	Male: 6 kg of replaced milk (1kg of powder solve in 6 kg of water)/day offered on twice & ad-lib starter female: 6 kg of whole milk/day offered on twice & ad-lib starter
Day 21 – weaning	2015-2016	Male: 6 kg of antibiotic milk (waste milk)/day offered on twice & ad-lib starter female: 6 kg of replaced milk /day offered on twice & ad-lib starter
Day 7 - day 14	2017-2019	5 kg of whole milk/day offered on twice & ad-lib starter.
Day 14 – weaning		the amount of milk that offered to calves were elevated 1 kg every 7 days up to day 56 the amount was decreased 1 kg weekly up to weaning

RESULTS AND DISCUSSION

Managing housing systems

There was a significant effect (P< 0.05) of housing systems on weaning weight, weaning age and daily gain (Table 2). It could be seen that the greatest weaning weight was been 94.59±4.99 kg in outdoor system, while it was 90.40±8.35 kg in semi indoor system. Accordingly, the highest weaning age was 84.51±8.79 days in outdoor system and 76.46±10.64 days in semi indoor system. Furthermore, it is clearly appearing that daily gain was 0.77±0.11 kg/day and 0.79±0.07 kg/day in semi-indoor and outdoor systems, respectively.

Table (2): Means ± standard deviation ($\bar{X}$±SD) for calves' performance in different housing systems

Housing systems	№	calves' performance			
		Birth weight (kg)	Weaning weight (kg)	Weaning age (day)	Daily gain (kg/day)
		$\bar{X}$ ± SD	$\bar{X}$ ± SD	$\bar{X}$ ± SD	$\bar{X}$ ± SD
Semi-indoor system	1964	32.32 ±4.20	90.40[b] ±8.35	76.46[b] ±10.64	0.77[b] ±0.11
Outdoor system	1727	32.24 ±3.71	94.59[a] ±4.99	84.51[a] ±8.79	0.79[a] ±0.07
Overall Means	3691	32.28 ±3.98	92.49 ±7.29	80.22 ±10.61	0.78 ±0.09

a,b within each column means differ significant (P<0.05).

These results are in agreement with that observed by (Razzaque *et al*., 2009) who found, the average daily live weight gain was significantly (P< 0.05) higher in calves housed in hutches than conventional housing system (closed houses) (413 vs. 113 g/h/d; P≤0.0001). Stull and Reynolds (2008) revealed that housing calves individually has been recognized as a housing practice that optimizes care for young calves by maximizing the ability of farm workers to identify sick calves quickly, reduce the spread of pathogens in the calf herd by minimizing physical contact between calves. On the other hand, calves housed in pairs tended to have greater average daily gain compared with calves housed individually (0.63 vs. 0.59 ± 0.02 kg/d, respectively) by Pempek *et al*. (2016).

Chua *et al*. (2002) said that there were no differences between groups or individual housing in the amounts of milk, starter, or hay consumed, or in the incidence of scouring.

Managing suckling systems

There was significant effect (P <0.05) of suckling systems on weaning weight, weaning age and daily gain (Table 3). The highest weaning weight was94.47±5.64 kg in 4th SS followed by 88.43±7.95 kg in 3rd SS, then 86.81±9.63 kg in 1st SS and finally 85.34±8.57 kg in 2nd SS. Dramatically, the average daily gain accounting 0.80±0.10 kg/day and 0.78±0.08 kg/day in 3rd SS and 4th SS respectively, followed by 0.74±0.12 kg/day in 1st SS and finally 0.66 ±0.12 kg/day in 2nd SS.

These results were in agreement with that observed by Yavuz *et al*. (2015) who reported that, high level of milk feeding enhanced live weight and body frame size, growth rate of calves and improved feed efficiency, but evidently 8 L milk per calf per day increased stress of transition from liquid to dry feed at weaning. It seems that increasing the transition period to dry feed to two weeks will avoid any slump in growth. Level of milk feeding did not affect health status of calves pre- and post-weaning. Yavuz *et al*. (2015) added that the growth and development of calves after weaning did

not depend on the level of milk feeding before weaning.

Table (3): Means ± standard deviation ($\bar{X}$±SD) for calves' performance in different suckling systems (SS)

Suckling systems (SS)	№	Calves' performance		
		Weaning weight (kg)	Weaning age (day)	Daily gain (kg/day)
		$\bar{X}$ ±SD	$\bar{X}$ ±SD	$\bar{X}$ ±SD
1st SS	58	86.81^{g} ±9.63	73.34^{fg} ±12.87	0.74^{g} ±0.12
2ndSS	254	85.34^{f} ±8.57	74.99^{g} ±12.17	0.66^{f} ±0.12
3rdSS	832	88.43^{h} ±7.95	72.11^{f} ±8.27	0.80^{h} ±0.10
4th SS	2547	94.47^{i} ±5.64	83.55^{h} ±9.27	0.78^{h} ±0.08
Overall means	3691	88.76 ±7.28	76.00 ±10.61	0.75 ±0.09

$^{f, g, h, i,}$ within each column means differ highly significant (P<0.01).

The best suckling system was found for calves weighing ≤ 30 kg at birth was the 1st suckling system who showed the highest daily gain 0.85±0.19kg/day. However, calves reared under the 4th suckling system with higher birth weight (≥ 35 kg), represents the highest daily gain (0.75±0.09 kg /day). These results shown in Table 4.

A high daily gain obtained through a high milk intake is not necessarily beneficial, because it results in a decreased intake of roughage, and hence delayed rumen development, and increases the difficulties associated with weaning-separation (Jonasen and Krohn, 1991). As maintained earlier, the daily gain of suckling calves will depend on the amount of milk available per calf (Krohn, 2001).

Managing calving seasons

There was significant effect (P <0.05) of seasons of calving on weaning weight, weaning age but only significant effect (P <0.05) on daily gain, while it didn't have any significant effect (P>0.05) on birth weight. Fig. 4 and 5 showed that the lowest birth weight of calves found in winter (31.34±3.86 kg), while it was almost equal in the other seasons, spring, summer and autumn (32.67±4.03 kg, 32.73± 3.99 kg and 32.70±3.92 kg, respectively). Calves weaning weight reach the highest value with 93.88±6.53 kg in winter followed by 92.54±6.47 kg, 91.78±8.36 kg and 90.47±8.21 kg in autumn, spring and summer respectively. The lowest daily gain was found in spring (0.74±0.11 kg/day) while calves born in winter, summer and autumn had the same trend (0.78±0.09 kg/day).

Table (4): Means ± standard deviation ($\bar{X}$±SD) for calves' performance with different birth weight and different suckling systems

		Calves performance	Birth weight			Overall means
			≤ 30 kg	30-35 kg	≥ 35 kg	
Suckling strategy	1st.SS	weaning weight (kg)	85.33 ±10.59	87.39 ±9.43	85.45 ±10.56	86.81 ±9.62
		weaning age (day)	74.16 ±15.61	73.44 ±11.61	72.54 ±16.78	73.34^{ab} ±12.87
		Daily gain (kg/day)	0.85 ±0.19	0.75 ±0.11	0.65 ±0.07	0.74^{g} ±0.12
	2nd.SS	weaning weight (kg)	85.82 ±7.99	85.48 ±8.49	85.08 ±8.80	85.34 ±8.57
		weaning age (day)	80.00 ±15.87	75.53 ±11.79	73.69 ±12.19	74.99^{g} ±12.17
		Daily gain (kg/day)	0.77 ±0.12	0.69 ±0.11	0.62 ±0.11	0.66^{f} ±0.11
	3rd.SS	weaning weight (kg)	87.66 ±7.28	88.60 ±7.91	90.14 ±10.06	88.43^{f} ±7.95
		weaning age (day)	72.18 ±8.05	72.07 ±8.27	72.05 ±9.08	72.11 ±8.27
		Daily gain (kg/day)	0.84 ±0.09	0.78 ±0.09	0.69 ±0.08	0.80^{h} ±0.10
	4th.SS	weaning weight (kg)	93.11 ±5.48	94.49 ±5.30	95.88 ±7.22	94.47^{g} ±5.64
		weaning age (day)	86.19 ±10.15	82.93 ±8.58	81.31 ±8.74	83.18^{h} ±8.93
		Daily gain (kg/day)	0.81 ±0.09	0.78 ±0.08	0.75 ±0.09	0.78^{h} ±0.08

SS=suckling systems- a,b,c within each column means differ significant (P<0.05).
$^{f, g, h, i,}$ within each column means differ highly significant (P<0.01).

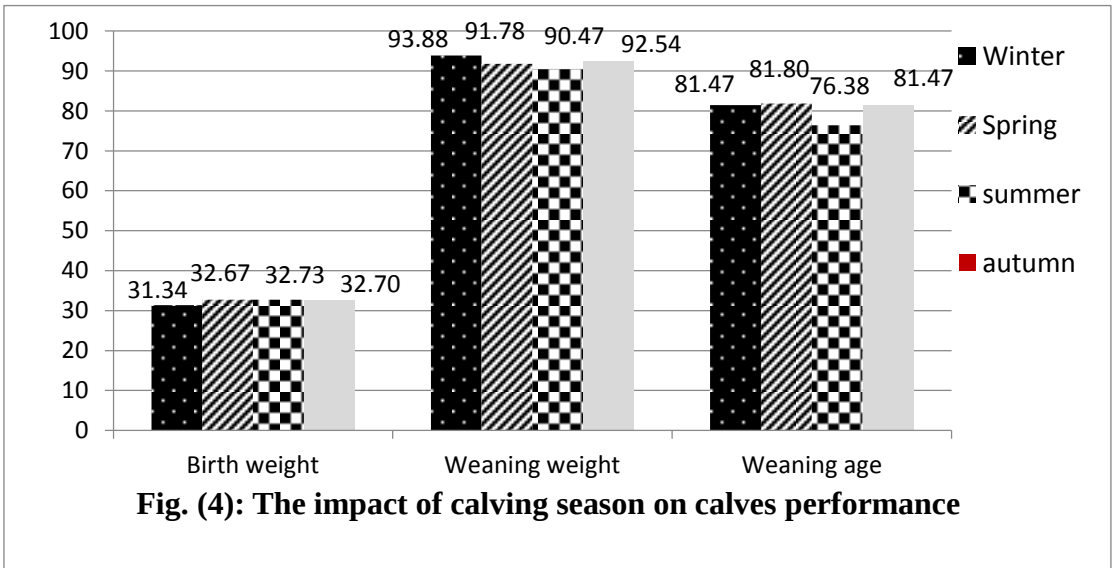

Fig. (4): The impact of calving season on calves performance

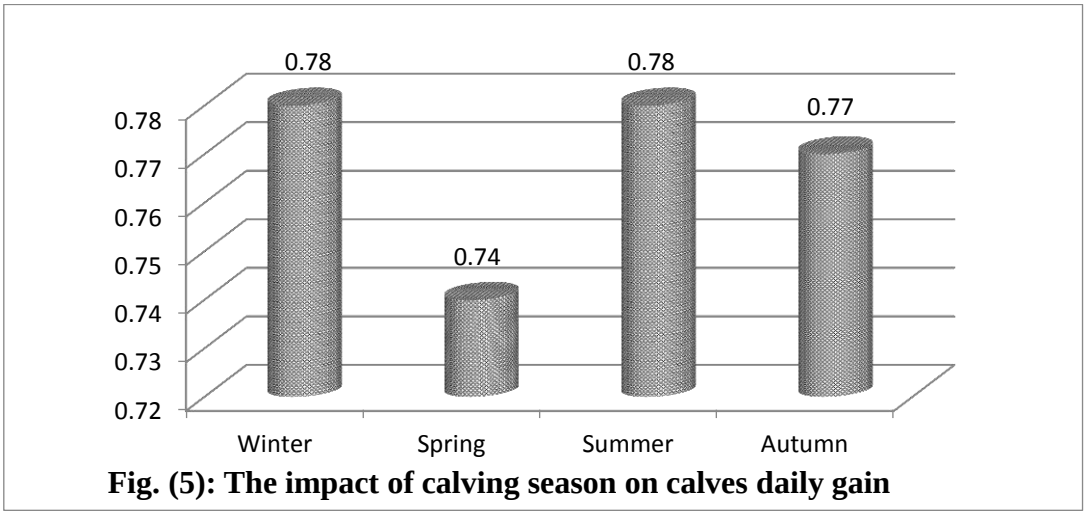

Fig. (5): The impact of calving season on calves daily gain

These results were in agreement with that observed by (Yaylak *et al*., 2015) who mentioned that, lower weaning weights in spring were expected because of increasing disease-causing microorganisms and disease carrying flies together with increasing temperatures. Thusly, diseases are mostly observed in spring months. Mpofu *et al*. (2017) and Bahashwan (2016) said that season had a significant (P<0.05) effect on birth weight (BW), pre-weaning average daily gain and weaning weight.

On the other hand, these results were in agreement with findings of Thevarnanoharan *et al*., (2001)who noted that birth weights of calves born during winter was the least (29. 661 kg) while those of calves born in summer was (30.939 kg) followed by the birth weight of the calves born during spring.

Managing calves' gender

It was clearly appearing (Table 5) that the greatest birth weight was been 32.93±4.04 kg in male while the lowest one was been for female (31.63±3.81 kg). Furthermore, weaning age was been 81.31±10.39 days and 79.14±10.71 days in female and male respectively. Weaning weight and daily gain were been almost equal (92.36±7.28 kg/day and 0.78±0.09 kg/day) in female and male respectively.

These results were in agreement with that observed by (Ugurlu*et al*., 2016) and Abera *et al*. (2012) who stated that birth weight and weaning weight was significantly influenced by sex of calf (P<0.05). This was attributed to the longer gestation period of male calves or higher concentration of growth hormone in male, however Bayrıl and Yılmaz (2010) was not able to identify any significant differences in weaning weights of genders.

The effects of interactions among some criteria studied

Table 6 shows the interaction among some criteria of calves performance on one hand and some management criteria on the other hand. The interaction between housing systems and calves' gender was highly significant (P< 0.01) on birth weight but only significant (P< 0.05) on weaning age and daily gain and non-significant on weaning weight.

On the other hand, the interaction within management criteria and calves performance (housing x season), (gender x suckling) and (season x suckling) were highly significant on birth weight,

weaning weight, weaning age and daily gain.

Table (5): Means ± standard deviation (X̄±SD) for calves' performance in different gender

Gender	№	calves' performance			
		Birth weight(kg)	Weaning weight(kg)	Weaning age(day)	Daily gain (kg/day)
		$\bar{X}$ ±SD	$\bar{X}$ ±SD	$\bar{X}$ ±SD	$\bar{X}$ ±SD
Female	1845	31.63[g] ±3.81	92.05 ±6.83	81.31[g] ±10.39	0.78 ±0.09
Male	1846	32.93[f] ±4.04	92.67 ±7.71	79.14[f] ±10.71	0.77 ±0.10
Overall means	3691	32.28 ±3.98	92.36 ±7.28	80.23 ±10.61	0.78 ±0.09

[f, g,] within each column means differ highly significant (P<0.01).

Table (6): Interaction among calves' management criteria in different calves' performance

Interactions criteria	calves' performance			
	Birth weight (kg)	Weaning weight (kg)	Weaning age(day)	Daily gain (kg/day)
Housing x Gender	**	NS	*	*
Housing x Season	**	**	**	**
Gender x Season	NS	**	**	NS
Gender x Suckling	**	**	**	**
Season x Suckling	**	**	**	**

- P>0.05 non-significant (NS), P<0.01 highly significant and P<0.05 significant.

CONCLUSION

According to the present study, determining the impact of management on calves' performance from birth to weaning is a very difficult task. There are so many different variables that can take place during the time of raising a calf. This has been achieved through various approaches and the main conclusions and implications are as follows:

- Housing calves in outdoor systems (hutches) seems to be preferable in terms of weaning weight, weaning age and daily gain.
- Managing adequate suckling practices can contribute positively to calves performance, also to control the suckled consumed quantity of milk, however it can also have negative effects.
- The lowest birth weight was found in winter, while it was almost equal in others seasons, however, the highest weaning weight was in winter.
- There was highly significant effect of gender on birth weight and weaning age. The highest birth weight was reported in male with shorter weaning age.
- The remarkable interaction between management systems and calves' performance proves the extent of the management's influence and its

interference in the different production elements of the farm.

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تأثير إدارة تربية العجول على أدائها فى مزرعة تجارية للهولستين فريزيان

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الملخص العربي

أجريت هذه الدراسة في مزرعة تجارية لانتاج الألبان في جمصة محافظة الدقهلية – مصر (تسمي مزرعة البيومي) لدراسة تأثير نظم الإدارة علي أداء العجول .إستخدمت في هذه الدراسة عدد ٣٦٩١ سجل لعجول هولستين فريزيان (فى الفترة من ٢٠١٣-٢٠١٩)، تشمل هذه الدراسة تأثيرعوامل الادارة من ناحية تأثير الأم مثل (فترة الجفاف السابقه- ترتيب الموسم – الفتره بين آخر ولادتين وانتاج اللبن الموسمى فى الموسم السابق) وكذا دراسة تأثير بعض العوامل من ناحية نظم الرعاية المتبعة لتنشأة العجول مثل (نظم الإيواء – نظم الرضاعة- فصل الولادة- جنس المولود) وتأثير كل هذه العوامل علي أداء العجول (وزن الميلاد (كجم)-وزن الفطام(كجم) -عمر الفطام (يوم)-معدل النمو(كجم/يوم)). كان تأثير نظام الإيواء -نظام الرضاعة-فصل الميلاد معنوي علي عمر الفطام،معدل النمولعجول. كانت العجول المولوده في فصل الشتاء الأقل وزنا (٣١,٣٤ كجم) ومع ذلك كانت الأثقل وزنا عند الفطام (٩٣,٨٨كجم). كان وزن الميلاد للذكور ٣٢.٩٣ كجم بينما كان ٣١.٦٣ كجم فقط في الاناث. من الناحية الأخري كان عمر الفطام ٨١.٣١ يوم – ٧٩.١٤ يوم في الاناث والذكور علي التوالي. كان تأثيرطول فترة الجفاف- ترتيب الموسم – الفتره بين آخر ولادتين وانتاج اللبن الموسمى فى الموسم السابق غير معنوي علي أداء العجول.حيث كان أقل وزن ميلاد للعجول في ابقار الموسم الأول ٣١,٦٣ كجم ، بينما الأثقل وزنا كان في أبقار الموسم الثالث ٣٣ كجم.

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