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PRODUCTIVE PERFORMANCE OF TWIN FRIESIAN CALVES IN EGYPT

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ABSTRACT

The data from records of 1185 single and 58 twins of male and female Friesian calves were collected during the consecutive 8 years (1997-2004) at the Sakha Animal Production Research Station. The animals were used to study the effect of twinning on the live body weight, body weight gain, feed intake, feed conversion and economic efficiency.

Results revealed that the twining rate in dairy Friesian cows was 4.67% and the percentage of freemartins was 0.64%. The average live body weight and daily weight gain were significantly higher ($P<0.05$) for single compared to twin claves (430, 0.54 vs. 384, 0.49 kg, respectively). However, the sum of body weight and weight gain were significantly higher ($P<0.05$) for twins compared to single calves (768, 0.99 vs. 430, 0.54 kg, respectively).

Feed conversion rate was significantly higher ($P<0.05$) for twin calves compared with single calves. The cost of daily feed intake, price of daily weight gain and cost/kg gain were significantly lower ($P<0.05$), while economic efficiency was significantly higher ($P<0.05$) for twins compared to single calves. The sum body weight and economic efficiency of twin calves increased by 79 and 25%, respectively, compared to single calves.

The results show that twin calves have higher total body weight, total body weight gain, feed conversion rate and economic efficiency, whilst lower feed intake and feed cost compared with single calves. This is very important for increasing beef production in Egypt.

Key words: Friesian calves; twins; body weight gain; feed intake; feed conversion; economic efficiency

INTRODUCTION

Ron et al. (1990) reported the twinning rate in Israeli Holsteins to be 4.8 and 6.9% for second and third parity cows, respectively. They estimated heritability to be 0.10 using a threshold model (TM), but only 0.02 using a linear model (LM). The heritability of twinning rate in Friesian cows in Egypt using a linear model was 0.028 (Shamiah et al 2007).

Twinning might be reasonable to emphasize if the economic benefits from such research, if successful, might be very great. For example, Turman et al (1971) reported that cows producing twin weaned an additional 171 kg of calf as compared to those weaning singles. Although twinning reduced calf survival, dams producing twin at birth weaned 70.8% more calves than dams with a single birth, which resulted in a 48.1% increase (336 vs. 227 kg) in total weaning weight (Echternkamp and Gregory 2002). Gregory at al (1996) compared growth traits of single and twin born calves and reported that twin calves were about 20% easier at birth and about 10% easier at weaning. They also pointed out that twin calves were easier at slaughter, even though they were 3-weaks older than single-born calves. Single born calves also had greater average daily gain during suckling period compared to twin (1.1 vs. 1.0 kg/d). They postulated that the greater ADG reflects both pre- and post-natal maternal effects on calf growth.

The objective of this study was to investigate the effect of twining on live body weight, body weight gain, feed intake, feed conversion and economic efficiency of Friesian calves.

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MATERIAL AND METHODS

Experimental animals

The data for this study were obtained at the Sakha Animal Production Research Station belonging to Animal Production Research Institute, Agriculture Research Centre, the Ministry of Agriculture. The data from records of 1185 single (597 male + 588 female) and 58 twin (30 male + 28 female) Friesian calves were collected during consecutive 8 years (1997-2004) and were used to study the effect of twinning on the live body weight, body weight gain, feed intake, feed conversion and economic efficiency.

Feeding and management

For suckling period (3.5 month), the calves were housed in semi-open pens at daytime and individually in carts nightly during the first 6 weeks of age. While, during the period from 7 weeks to weaning, they were housed in semi-open pens at daytime and closed pens nightly. Calves were allowed to suckle colostrums from their dams throughout the first three days postpartum, thereafter they were fed whole milk, calf starter with fresh berseem in winter feeding (from December to May) or berseem hay in summer feeding (from June to November) through the suckling period. Calves were given the whole milk in plastic buckets twice daily at 7 a.m. and 5 p.m. during winter season or 7 a.m. and 7 p.m. during summer season. Calf starter was provided once daily at 9 a.m., while fresh berseem or berseem hay was given once daily at 11 a.m. Water was available in a built basin for calves all the day round. The calves were weighed weekly to nearest one kg before the morning suckling and feeding. The calves were fed according to the Animal Production Research Institute Recommendation (1997) as shown in Tables (1).

After weaning, the calves were fed calf starter until 6 month of age and then replaced by a concentrate feed mixture and rice straw with fresh berseem (winter ration) or berseem hay (summer ration) according to the Animal Production Research Institute Recommendation (1997) as shown in Tables (2). The calves were fed in a group feeding and when reached 6 month of age, male calves were separated from female calves. Calf starter or concentrate feed mixture fed in two equal meals daily at 8 a.m. and 3 p.m., rice straw two times daily at 9 a.m. and 4 p.m., while fresh berseem or berseem hay once daily at 11 a.m. Water was available for calves in a built basin all the day round.

Table 1: Daily allowance of feedstuffs (kg / head) for suckling Friesian calves

Age	Whole milk	Calf starter	Fresh berseem	Berseem hay
1-3 days		Suckling their dams colostrum		
4-7 days	3.15	-	-	-
Week 2	3.15	-	-	-
Week 3	3.60	0.25	1.00	0.10
Week 4	4.05	0.25	1.00	0.10
Week 5	4.50	0.50	1.50	0.20
Week 6	4.50	0.50	1.50	0.20
Week 7	4.05	0.75	2.00	0.30
Week 8	4.05	0.75	2.00	0.30
Week 9	3.60	1.00	2.50	0.40
Week 10	3.15	1.00	2.50	0.40
Week 11	2.70	1.25	3.00	0.50
Week 12	2.25	1.25	3.00	0.50
Week 13	1.80	1.50	3.50	0.60
Week 14	1.35	1.50	3.50	0.60
Week 15	0.90	1.75	4.00	0.70
Total consumed	**318**	**85.8**	**217**	**34.3**

* Calf 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 allowance of summer and winter feedstuffs (kg / head) for growing Friesian calves

Body weight	Winter ration				Summer ration			
	CS	CFM	FB	RS	CS	CFM	BH	RS
100 kg	1.5	-	10	1.0	2	-	1	1
200 kg	-	2.5	15	1.5	-	3.0	1.5	2
300 kg	-	3.0	20	2.0	-	3.5	2.0	3
400 kg	-	3.5	25	2.5	-	4.0	2.0	4

* CFM consisted of 30% cotton seed cake, 10% linseed meal, 27% yellow corn, 17% wheat bran, 10% rice bran, 3% molasses, 2% limestone and 1% common salt.
** CS= calf starter, CFM= concentrate feed mixture, FB= fresh berseem, BH= berseem hay, RS= rice straw.

Feed conversion rate

Feed conversion rate was calculated as the amount of tested feedstuffs required per one kg of live body weight gain for single and twin calves during different age periods.

Economic efficiency

Economic efficiency was calculated as the cost of daily feedstuffs consumed, feed cost per 1 kg live body weight gain, price of daily weight gain and economic efficiency for single and twin calves during different age periods. The prices were 2.5 LE / kg for whole milk, 2200 LE / ton for calf starter, 2000 LE / ton for concentrate feed mixture, 120 LE / ton for fresh berseem, 850 LE / ton for berseem hay, 100 LE / ton for rice straw and 24 LE / kg for live body weight gain according to prices of 2010.

Statistical analysis

Heritability was determined according to Harvey (1990). The obtained data were statistically analyzed using general linear model procedure adapted by SPSS (2008) for user's guide. To determine the degree of significance between means t-test using SPSS program was done.

RESULTS AND DISCUSSION

Twining rate

Results in Table (3) demonstrate that the average twinning rate in dairy Friesian cows was 4.67% and the percentage of freemartin was 0.64%. The heritability of twinning rate in Friesian cows, estimated in the present study, was 0.028, which is within the values obtained by Gregory et al. (1990), who found that heritability of twinning rate in cows was 0.02 ± 0.07. These results are within the values obtained by Ron et al. (1990), who stated that twinning rate of Israeli Holsteins has increased from 4.5 to 5.6% during the last 20 year. Gregory et al. (1996) found that cows producing twin had 65.2% more ($P<0.01$) live calves than cows producing singles.

Mortality rate

The mortality rate of single calves was significantly ($P<0.05$) lower than that of twin calves (Table 3). The most mortality occurred during the first weeks after birth. The higher mortality rate in twin calves may be attributed to their lower birth weight compared to single calves. These results are in agreement with the results obtained by Echternkamp and Gregory (2002) and Mostafa (2009), who found that mortality rate was higher in twin than single birth.

Table 3: Mortality rate (%) of single and twining Friesian calves

Item	Single calves	Twin calves	Percentage (twin x 100/single)
Number	1185	58	
At birth	2.03[b]	7.76[a]	382
At weaning (3.5 month)	3.38[b]	11.2[a]	331
At 6 month	3.97[b]	12.9[a]	325
At 12 month	4.64[b]	14.7[a]	317
At 18 month	5.56[b]	16.4[a]	295
At 24 month	6.16[b]	17.2[a]	279

[a, b] Means in the same row with different superscripts differ significantly ($P<0.05$).

Average live body weight and daily weight gain

The average body weight and daily weight gain of single and twin Friesian calves during the different age periods are shown in Table 4. The average live body weight as well as average daily weight gain at birth, weaning, 6, 12, 18 and 24 month of age were significantly higher (P<0.05) for single calves compared to twin calves. The body weight of twin calves was 67.0 - 89.3% of single calves. Moreover, the average daily body weight gain of twin calves was 87.9 - 93.8% of single calves. These results might be due to that daily weight gain increased with increasing birth weight. These results are in agreement with those obtained by Davis et al. (1989), who reported that singles were heavier at birth and weaning than twins. Suzuki et al. (1998) reported that daily gain (DG) of twin calves from birth to 90 days of age was significantly lower than that of single calves. At weaning after 180 days of age, body measurements of twin calves were 92-97% of those of single calves except for the body weight, which was 82% of that of single calves.

Table 4: Body weight and weight gain of single and twining Friesian calves

Item	Single calves	Twin calves	Percentage (twin x 100/single)
Number	1185	58	
Body weight (kg)			
At birth	34.5[a]	24.1[b]	69.9
At weaning (3.5 month)	101[a]	87[b]	86.1
At 6 month	145[a]	126[b]	86.9
At 12 month	243[a]	213[b]	87.7
At 18 month	339[a]	300[b]	88.5
At 24 month	430[a]	384[b]	89.3
Weight gain (kg/day)			
From birth to weaning	0.64[a]	0.60[b]	93.8
From weaning to 6 month	0.58[a]	0.51[b]	87.9
From 6 to 12 month	0.55[a]	0.49[b]	89.1
From 12 to 18 month	0.53[a]	0.48[b]	90.6
From 18 to 24 month	0.51[a]	0.47[b]	92.2
From birth to 24 month	0.54[a]	0.49[b]	90.7

[a, b] Means in the same row with different superscripts differ significantly (P<0.05).

Twinning reduced birth weight by 13% and weaning weight by 17% (Guerra-Martinez et al. 1990). Gregory at al (1996) compared growth traits of single and twin born calves and reported than calves born as singles were 8.8 kg heavier (P<0.01) at birth and 28 kg heavier (P<0.01) at 200 d than calves born and reared as twins. Single male calves gained 74 g more per day than twin males from birth to 200 d, 45 g more (P<0.01) per day from 200 d to slaughter and 57 g more (P<0.01) per day from birth to slaughter. Morris et al. (1986) and Gaertnr et al. (1992) found that birth weight was significant factor affecting weaning weight and body weight gain. Aksakal and Bayram (2009) stated that the mean birth weight of single calves was 6.26 kg (17%) higher than that of twin calves.

The sum of body weight and weight gain per cow

The sum of body weight and weight gain of single and twin calves per cow during different age periods were significantly higher (P<0.05) for twin calves compared to single calves (Table 5). Moreover, the sum of body weight of twin calves was 140-179% of single calves. Moreover, the sum of weight gain of twin calves was 178-188% of single calves. Twinning might be reasonable to emphasize if the economic benefits from such research, if successful, might be very great. For example, Turman et al. (1971) indicated that cows producing twins weaned an additional 171 kg of calf when compared to those weaning singles. Dams producing twins at birth weaned 70.8% more calves than dams with a single birth, which resulted in a 48.1% increase (335.7 vs. 226.6 kg) in total weaning weight (Echternkamp and Gregory 2002). Davis et al. (1989) reported that cows raising twin produced 108 kg (51%) more total weaning weight than did cows raising singles. Gregory at al (1996) found that calf weight produced per cow calving was 53.1%, 54.7%, and 58.4% greater (P<0.01) at birth, 150 d, and

200 d, respectively, in cows producing twins than in cows producing singles. Cows producing twins had 65.2% more (P<0.01) live calves at 200 d than cows producing singles. Echternkamp and Gregory (2002) reported that birth weight was lower (37.2 vs. 47.2 kg; P<0.01) for twins vs. single calves, respectively, but total birth weight (live) was increased 53.1% for twins. Respective weaning weights (200-d weight) were 232 vs. 259 kg (P<0.01). Twinning increased productivity at weaning by 54.2 kg (or 28.3%) per cow exposed at breeding.

Table 5: Sum body weight and weight gain of single and twining Friesian calves per cow

Item	Single calves	Twin calves	Percentage (twin x 100/single)
Body weight (kg)			
At birth	34.5[b]	48.3[a]	140
At weaning (3.5 month)	101[b]	174[a]	172
At 6 month	145[b]	251[a]	173
At 12 month	243[b]	427[a]	176
At 18 month	339[b]	599[a]	177
At 24 month	430[b]	768[a]	179
Body weight gain (kg/day)			
From birth to weaning	0.64[b]	1.20[a]	188
From weaning to 6 month	0.58[b]	1.03[a]	178
From 6 to 12 month	0.55[b]	0.98[a]	178
From 12 to 18 month	0.53[b]	0.96[a]	181
From 18 to 24 month	0.51[b]	0.94[a]	184
From birth to 24 month	0.54[b]	0.99[a]	183

[a, b] Means in the same row with different superscripts differ significantly (P<0.05).

Average daily feed intake

Average daily feed intake by Friesian calves during different periods is presented in Table 6. The intake of milk, calf starter, concentrate feed mixture, fresh berseem, berseem hay, rice straw and total DM by twin calves was significantly lower (P<0.05) compared to single calves. These results attributed to lower live body weight (Table 3) of twin calves. The intake by twin calves was 69.9, 76.8-78.2, 77.4-79.5, 56.9-64.8, 57.1-61.3, 74.9-76.8 and 70.5-74.3% of the intake by single calves, respectively. These results agreed with those obtained by Guerra-Martinez et al. (1990,) who stated that twins showed lower feed intake when crowding limited voluntary feed intake was 60% of single calves. De Rose and Wilton (1991) reported that feedlot feed intake of twins was 85% of that for singletons.

Feed conversion rate

Twin calves showed significantly (P<0.05) better feed conversion rate during different age periods compared with single calves, as shown in Table 7. The mean amounts of feedstuffs required per kg body weight gain of twin calves were 74.5, 82.0-88.9, 85.5-89.2, 60.8-72.7, 59.1-66.2, 81.1-87.0 and 75.1-84.6% of those for single calves, respectively. These results might be due to lower feed intake by twin than single calves, as stated in Table 5. These results are in accordance with those obtained by De Rose and Wilton (1991), who found less feed required per kg gain for twin calves, than for singles in the feedlot. Although twins were smaller throughout their lifetime, they grew more rapidly relatively to their initial size and consumed less feed.

Economic efficiency

The results in Table 8 demonstrate that the cost of daily feed intake, the price of daily weight gain and feed cost per 1 kg gain were significantly lower (P<0.05), whilst economic efficiency was significantly higher (P<0.05) for twins compared to single calves during different age periods. The feed cost, price of daily weight gain and feed cost / kg gain of twin calves were 72.6, 90.8, 83.2 and 125% of those for single calves. These results might be due to lower feed intake by twin than single calves, as stated in Table 5. The results from experimentation and simulation of production systems suggest a potential increase in efficiency of producing beef by twinning (Guerra-Martinez et al. 1990).

Table 6: Feed intake (kg/head/day) by single and twining Friesian calves

Item	Single calves	Twin calves	Percentage (twin x 100/single)
Suckling period (3.5 month)			
Milk	2.99[a]	2.09[b]	69.9
Calf starter	0.82[a]	0.63[b]	76.8
Fresh berseem	1.16[a]	0.66[b]	56.9
Berseem hay	0.14[a]	0.08[b]	57.1
Total DM	1.39[a]	0.98[b]	70.5
From weaning to 6 month			
Calf starter	2.52[a]	1.97[b]	78.2
Fresh berseem	3.39[a]	2.13[b]	62.8
Berseem hay	0.38[a]	0.22[b]	57.9
Rice straw	1.25[a]	0.96[b]	76.8
Total DM	4.28	3.18	74.3
From 6 to 12 month			
Concentrate feed mixture	3.37[a]	2.68[b]	79.5
Fresh berseem	5.45[a]	3.53[b]	64.8
Berseem hay	0.55[a]	0.32[b]	58.2
Rice straw	1.39[a]	1.04[b]	74.8
Total DM	5.65	4.20	74.3
From 12 to 18 month			
Concentrate feed mixture	3.94[a]	3.05[b]	77.4
Fresh berseem	7.09[a]	4.59[b]	64.7
Berseem hay	0.66[a]	0.39[b]	59.1
Rice straw	1.81[a]	1.35[b]	74.6
Total DM	6.90	5.05	73.2
From 18 to 24 month			
Concentrate feed mixture	4.56[a]	3.62[b]	79.4
Fresh berseem	9.21[a]	5.97[b]	64.8
Berseem hay	0.80[a]	0.49[b]	61.3
Rice straw	2.35[a]	1.76[b]	74.9
Total DM	8.41	6.24	74.2

[a, b] Means in the same row with different superscripts differ significantly ($P<0.05$).

CONCLUSION

Twin calves showed higher total body weight, total body weight gain, feed conversion rate and economic efficiency, whilst lower feed intake and feed cost compared to single calves. This is very important for increasing beef production in Egypt.

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Table 7: Feed conversion rate (kg/ kg gain) of single and twining Friesian calves

Item	Single calves	Twin calves	Percentage (twin x 100/single)
Suckling period (3.5 month)			
Milk	4.67[a]	3.48[b]	74.5
Calf starter	1.28[a]	1.05[b]	82.0
Fresh berseem	1.81[a]	1.10[b]	60.8
Berseem hay	0.22[a]	0.13[b]	59.1
Total DM	2.17	1.63	75.1
From weaning to 6 month			
Calf starter	4.34[a]	3.86[b]	88.9
Fresh berseem	5.84[a]	4.18[b]	71.6
Berseem hay	0.66[a]	0.43[b]	65.2
Rice straw	2.16[a]	1.88[b]	87.0
Total DM	7.38	6.24	84.6
From 6 to 12 month			
Concentrate feed mixture	6.13[a]	5.47[b]	89.2
Fresh berseem	9.91[a]	7.20[b]	72.7
Berseem hay	1.00[a]	0.65[b]	65.0
Rice straw	2.53[a]	2.12[b]	83.8
Total DM	10.3	8.57	83.2
From 12 to 18 month			
Concentrate feed mixture	7.43[a]	6.35[b]	85.5
Fresh berseem	13.4[a]	9.56[b]	71.5
Berseem hay	1.25[a]	0.81[b]	64.8
Rice straw	3.42[a]	2.81[b]	82.2
Total DM	13.0	10.5	80.8
From 18 to 24 month			
Concentrate feed mixture	8.94[a]	7.70[b]	86.1
Fresh berseem	18.1[a]	12.7[b]	70.3
Berseem hay	1.57[a]	1.04[b]	66.2
Rice straw	4.61[a]	3.74[b]	81.1
Total DM	16.5	13.3	80.6

[a, b] Means in the same row with different superscripts differ significantly ($P<0.05$).

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Table 8: Economic efficiency of single and twining Friesian calves

Item	Single calves	Twin calves	Percentage (twin x 100/single)
Suckling period (3.5 month)			
Feed cost (LE)	9.54[a]	6.76[b]	70.9
Price of weight gain (LE)	15.4	14.4	93.5
Feed cost (LE)/ kg gain	14.9[a]	11.3[b]	75.8
Economic efficiency	1.61[b]	2.13[a]	132
From weaning to 6 month			
Feed cost (LE)	6.39[a]	4.87[b]	76.2
Price of weight gain (LE)	13.9[a]	12.2[b]	87.8
Feed cost (LE)/ kg gain	11.0[a]	9.55[b]	86.8
Economic efficiency	2.18[b]	2.51[a]	115
From 6 to 12 month			
Feed cost (LE)	8.00[a]	6.16[b]	77.0
Price of weight gain (LE)	13.2[a]	11.8[b]	89.4
Feed cost (LE)/ kg gain	14.6[a]	12.6[b]	86.3
Economic efficiency	1.65[b]	2.05[a]	124
From 12 to 18 month			
Feed cost (LE)	9.47[a]	7.12[b]	75.2
Price of weight gain (LE)	12.7[a]	11.5[b]	90.6
Feed cost (LE)/ kg gain	17.9[a]	14.8[b]	82.7
Economic efficiency	1.34[b]	1.62[a]	121
From 18 to 24 month			
Feed cost (LE)	11.1[a]	8.55[b]	77.0
Price of weight gain (LE)	12.2[a]	11.3[b]	92.6
Feed cost (LE)/ kg gain	21.8[a]	18.2[b]	83.5
Economic efficiency	1.10[b]	1.32[a]	120
From birth to 24 month			
Feed cost (LE)	9.57[a]	6.95[b]	72.6
Price of weight gain (LE)	13.0[a]	11.8[b]	90.8
Feed cost (LE)/ kg gain	17.7[a]	14.2[b]	83.2
Economic efficiency	1.36[b]	1.70[a]	125

[a, b] Means in the same row with different superscripts differ significantly ($P<0.05$).

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