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Twinning in dairy cattle and its effect on milk yield, lactation length, dry period length and calf performance

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The twinning rate in a herd of Holstein dairy cattle and its effect on lactation and calf performance was investigated by using records of 5815 calving events. Data from twin calving Holstein cows in (TEC-DAP) farm in Al-Fayum Governorate between January 1997 and April 2008 were compared to those giving singles to study the differences in subsequent milk yield, previous and subsequent lactation and dry period length, as well as calf performance. The obtained average twinning rate was 1.4% during the period of the study. Cows giving twins had a significantly ($p<0.01$) lower daily, peak and 305-d milk yields than those with singles. There was no significant difference ($p>0.05$) in previous and subsequent lactation and dry period length between cows calving twins or singles. Calves born as twins were significantly ($p<0.005$) lighter at birth and weaning time than single calves, whereas total birth weight and total weaning weight were significantly ($p<0.005$) increased for twins than singles. Daily body weight gain from birth to weaning was significantly lower ($p<0.005$) for twin than single calves. Twinning in dairy cattle has a negative depressive effect on subsequent milk yield. Calf weight produced at weaning per cow calving can be increased in cows producing twins relative to cows producing singles. Alleviation of twinning constraints including dystocia, reduced calf survival and low reproductive performance requires improved management practices and early diagnosis of cows gestating twins in order to provide higher nutritive requirements in the last trimester of gestation and proper timing of drying off, and for higher assistance requirements at parturition. Thus, due to the increased disadvantages which did not offset the additional returns earned by calves, twinning in dairy cattle via selection or artificial induction appears not to be desirable.

The twinning rate in dairy cattle seems to have increased recently, and this may have important practical implications (Kinsel *et al.,* 1998). The regulation of ovulation rate appears to be the primary mechanism for regulating litter size (Wiltbank *et al.,* 2000). A number of factors were identified as possible regulators of twinning rates including age of dam (Jones and Rouse, 1920; Fricke and Wiltbank, 1999; Wiltbank *et al.,* 2000), season (Cole and Rodolf, 1924) and genetics (Lush, 1925). Other factors have been found to be associated with twinning, including use of antibiotics or reproductive hormones, ovarian cysts, days open, and peak milk production (Pfau *et al.,* 1948; Johansson *et al.,* 1974; Nielen *et al.,* 1989; Ryan and Boland, 1991; Lopez-Gatius *et al.,* 1996; Kinsel *et al.,* 1998; Wiltbank *et al.,* 2000).Studies of the effects of twin births on milk production in the subsequent lactation are contradictory. Cows with twins had greater milk production than cows with singletons (Auran, 1974; Syrstad, 1974; Wood, 1975; Kay, 1978; Wood, 1984; Eddy *et al.,* 1991) while in others lower milk yields were recorded (Bar-Anan and Bowman, 1974; Suchanek, 1977; Syrstad, 1977; Chapin and Van Vleck, 1980). Effect of twinning on birth weight, weaning weight and growth of calves has been investigated in several studies (Bellows *et al.,* 1971; Turman *et al.,* 1971; Bellows *et al.,* 1974; Johansson *et al.,* 1974; Davis *et al.,* 1989; Gregory *et al.,* 1990, 1996; Echternkamp and Gregory, 2002; Bell and Roberts, 2007). The aim of this study included the determination of twinning rate in a Holstein dairy cattle herd and investigation of its effect on milk yield, lactation length, dry period length and calf performance.

Materials and Methods

Management. Holstein dairy cattle were housed and milked three times daily in a milking parlour system provided with a sheltered and fenced

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yards. Total mixed ration (TMR) according to (NRC 2001) was available all the day round based on corn silage, yellow corn, soya bean meal, cotton seed meal, hay, dicalcium phosphate in addition to mineral and vitamin premix. Estrus was detected by the use of electronic pedometer and cows that confirmed in estrus were artificially inseminated. Pregnancy diagnosis was done by rectal palpation at 35-48 days after insemination. Cows were dried off at an average of two months according to milk yield, conception time, and gestation length which control the length of this period. At the time of drying the teats were dipped in iodophor antiseptic solution and long acting antibiotic was infused intramammary. Pregnant cows were isolated in collective calving area at 7-10 days before expected calving date. After parturition live calves were left to be licked and dried by their mothers and the umbilical cord was cut, ligated and disinfected by iodophor solution. After that calves were separated from their mothers, transferred to calf hutch, identified by a metal ear tag and given colostrums by use of a nipple-bottle which was repeated every six hours and continued for four days. Calves were fed on whole milk at a rate of 10% of body weight by use of nipple-bottles. Calf starter, straw and water were available all the day to claves after one week of age till weaning. Claves were dehorned at an age of two months by electric dehorner. Weaning of calves was done at an average of 85 days.

Data collection. Data of 5815 calving events in (TEC-DAP) farm in Al-Fayum Governorate were extracted from the farm computer records in the period from January 1997 to April 2008 and used for statistical analysis. These data include cow identification, insemination date, calving date, milk yield (daily yield, peak yield and 305 day yield) subsequent to twin and single calvings, lactation length and dry period length prior and subsequent to twin and single calvings, number of calves born alive or dead (single or twin), calf birth weight, total calf birth weight per cow calving (calculated for those calves born alive), weaning weight, total calf weaning weight per cow calving (calculated as the number of live calves weaned at weaning time after subtracting of dead calves) and daily gain in body weight (weaning weight-birth weight in kg/weaning period in days).

Statistical analysis. Twinning rate was calculated as the number of twins born per cow calvings. For comparing the effect of twin and single calvings on milk yield, lactation length, dry period length, calf birth weight, total calf birth weight, calf weaning weight, total calf weaning weight and daily gain in body weight, data were analyzed by *t*-test using SPSS 13.0 according to (Norusis, 2004).

Results and Discussion

Twinning rate in Holstein dairy cows in the period from 1997 to 2007 is shown in Table1. The twinning rate in this period is ranged from 1.0 to 2.3 % with an average of 1.4 %. The obtained average twinning rate in the present study is lower than the range (2.2 to 6.9 %) reported in previous studies (Meadows and Lush, 1957; Erb and Morrison, 1959; Cady and Van Vleck, 1978; Nielen *et al.,* 1989; Markusfeld, 1990; Eddy *et al.,* 1991; Esslemont and Spincer, 1993; Peeler *et al.,* 1994; Day *et al.,* 1995; Kinsel *et al.,* 1998; Bell and Roberts, 2007; Silva del Río *et al.,* 2007; Al-Samarai, 2009), but within the range reported by Sreenan and Diskin (1989). This result suggests that the incidence of twinning is not a biologically fixed rate and that differences in herd management may allow some control of the incidence of twin birth. The difference in twinning rate may be related to multiple factors, including multiple ovulation rate, breed, parity, milk production, season and year of conception (Syrstad, 1974; Rutledge, 1975; Cady and Van Vleck, 1978; Ben-David, 1982; Bendixen *et al.,* 1989; Nielen *et al.,* 1989; Kinsel *et al.,* 1998; Fricke, 2001). Wiltbank *et al.,* (2000) proposed that high milk production increases steroid metabolism as a result of an increased blood flow to the digestive tract and the liver. The subsequent metabolism of the steroid oestradiol slows down the natural decline in follicle stimulating hormone, which means that follicles have more time to undergo physiological changes before they ovulate. Table 2 highlights the difference in milk yield of Holstein dairy cows following twin and single calvings expressed in daily yield, peak yield and 305-d yield. Milk yield subsequent to twin calving was lower ($p<0.01$) in terms of daily yield(23.27 kg), peak yield(41.92 kg) and 305-d yield(7097.79 kg) than that following single birth with corresponding values of (24.87kg kg), (46.31 kg) and (7585.35 kg) respectively. The total loss in 305-d milk yield caused by twinning amounts to 487.5 kg. So economic losses can result due to the negative effect of twin birth on subsequent milk yield. These findings are in accordance with that obtained by (Bowman and Hendy, 1970; Hendy and Bowman, 1970; Bar-

Table (1): Twinning rate in Holstein dairy cows in the period from 1997 to 2007.

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Average
No.	6/575	9/582	8/593	9/605	6/580	7/600	6/587	7/561	12/518	4/283	6/331	80/5815
Twinning rate (%)	1.0	1.5	1.3	1.5	1.0	1.2	1.0	1.2	2.3	1.4	1.8	1.4

Table (2): Effect of twinning on subsequent milk yield in Holstein dairy cows.

Milk yield (Kg)	Twin			Single		
	No.	Mean	SE	No.	Mean	SE
Daily yield	37	23.27	0.21	1230	24.87*	0.28
Peak yield	37	41.92	0.97	1230	46.31*	1.09
305-d yield	37	7097.79	129.35	1230	7585.35*	141.56

*superscript within rows indicate significant difference at $p<0.01$

Table (3): Effect of twinning on lactation and dry period length in Holstein dairy cows.

Parameters in relation to calving (days)	Twin			Single		
	No.	Mean	SE	No.	Mean	SE
Previous lactation	80	324.09	9.82	1230	338.43	4.52
Subsequent lactation	37	328.44	12.98	1230	339.13	6.38
Previous dry period	80	65.64	1.85	1230	62.74	1.39
Subsequent dry period	37	61.80	2.26	1230	62.47	1.22

Table (4): Effect of twining on calf birth weight, weaning weight and body gain.

Parameter (kg)	Twin			Single		
	No.	Mean	SE	No.	Mean	SE
Calf birth weight	134	27.64	1.56	1740	38.12*	0.62
Total calf birth weight per cow calving	134	46.29*	3.78	1740	36.84	1.01
Calf weaning weight	126	70.16	4.01	1625	87.44*	3.75
Total calf weaning weight per cow calving	126	110.50*	6.23	1625	78.93	2.12
Daily body weight gain	125	0.498	0.02	1625	0.584*	0.01

*superscript within rows indicate significant difference at $p<0.005$.

Anan and Bowman, 1974 ; Suchanek, 1977 ; Syrstad, 1977; Chapin and Van Vleck, 1980) but do not support results of (Auran, 1974; Syrstad , 1974; Wood, 1975; Kay, 1978; Wood, 1984; Eddy *et al.,* 1991). In other studies reported by (Nielen *et al.,* 1989; Bell and Roberts, 2007) there was no significant difference in 305-d milk yield between twin and single calvers. The low milk yield following twin birth may be related to the depressive effect of twin pregnancy on the concurrent lactation (Syrstad, 1977; Bareille *et al.,* 2003). There is some thought that lobuloalveolar duct development in twin calvers is not as extensive as it may be in the single calvers due to shortened gestation period (Skjervold, 1977; Cady and VanVleck, 1978). Moreover, most of twin calving cows have a low body condition at parturition time which can

negatively affect subsequent milk yield. The high energy demand of twin pregnancy at late gestation cannot be compensated due to short gestation length and consequently inadequate dry period for maintaining these demands (Bell and Roberts, 2007).

Means of lactation and dry period length prior and subsequent to twin and single calvings in Holstein dairy cows are given in Table 3. It can be recognized from these results that there is no significant difference ($p>0.05$) in length of previous lactation for twin (324.09 days) and single (338.43 days) producing cows. On the other hand, no significant difference was found for subsequent lactation in twin (328.44 days) and single (339.13 days) calvers. Although not significant, cows giving singletons had a longer previous and subsequent lactation than those giving twins by (14.3) and (10.6) days respectively. With regard to dry period length, there is no significant difference in length of previous (65.64 and 62.74 days) and subsequent (61.80 and 62.47 days) dry period in cows giving twins or singletons respectively. The lengths of lactation and dry period are mainly affected and controlled by gestation length, level of milk yield, reproductive success, management decisions and economic reasons. Twin pregnant cows should be dried off at least a week earlier than single pregnant cows due to shorter gestation length and high nutritive requirement during the last trimester, so that they have more than 60 days to get in suitable body condition for calving. Twin pregnant cows need a sufficient energy intake from their diet during the last 2 months of their lactation to ensure they have a body condition score as near to three as possible at the time of drying off, which can then be maintained to calving time. Similar results are also presented by (Bell and Roberts, 2007).

From Table 4 it can be recognized that calves born as twins were lighter (27.64 kg) at birth ($p<0.005$)than singles (38.12 kg) by 10.4 kg and this may be attributed to the nutrient supply from the dam directed into two fetuses rather than a single as well as the more roomy space inside the uterus for singles in comparison with twins. On the other hand, total calf birth weight per cow calving measured by those calves born alive was significantly increased ($p<0.005$) for twin calves(46.29 kg) as compared with singles (36.84 kg). Thus total birth weight of twin exceeded that of single claves by 25.6%. Regarding weaning weight, twin calves had a lower ($p<0.005$) weaning weight (70.16 kg) than singletons (87.44 kg) by 17.2 kg and this may be related to the difference in birth weight and body weight gain between twins and singles. Total weaning weight was increased ($p<0.005$) for twin calves (110.50 kg) than for singles (78.93 kg) by 31.5 kg (39.9%). The increased total birth weight and weaning weight in twin calves as compared with singles are mainly attributed to the increased number of calves born and weaned per cows giving twins than singles. With regard to daily body weight gain, single calves gained 86 g more ($p<0.005$) per day than twins from birth to weaning at about 85 days of age. The present results confirmed other findings obtained by (Bellows *et al.,* 1971; Turman *et al.,* 1971; Vincent and Mills, 1972; Bellows *et al.,* 1974; Johansson, 1974; Kay *et al.,* 1976; Anderson *et al.,* 1978; Cady and VanVleck, 1978; Anderson *et al.,* 1979; Anderson *et al.,* 1982; Davis *et al.,* 1989; Gregory *et al.,* 1990, 1996; Echternkamp and Gregory, 2002; Bell and Roberts, 2007).

Conclusion

The reported twinning rate is lower than that obtained in other studies. Twinning in dairy cattle has a negative depressive effect on subsequent milk yield whereas lactation and dry period length are not affected. Calves born as singles are heavier at birth and weaning time than those born as twins. Calf weight produced at weaning per cow calving can be increased in cows producing twins relative to cows producing singles. However, the increased incidence of dystocia and low calf survival in twin calvings must be considered. Alleviation of twinning constraints including dystocia, reduced calf survival and low reproductive performance will require improved management practices and early diagnosis of cows gestating twins in order to provide for their higher nutritive requirements in the last trimester of gestation and proper timing of drying off, and for their higher assistance requirements at parturition. With palpation per rectum, pregnancy diagnosis between 30 and 60 days post breeding does not detect all twin pregnancies. Only those with ovulations from both ovaries and/or an amniotic sac in each horn can be detected by this way. So ultrasound holds promise for determining number of embryos or fetuses between day 30 and day 75 of gestation. Thus, due to the increased disadvantages which did not offset the additional returns earned by calves, twinning in dairy cattle via selection or artificial induction appears not to be desirable.

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معدل التوائم فى الأبقار الحلابة وتأثيره على إنتاج اللبن وطول فترة الحليب و طول فترة الجفاف وأداء العجول

كان الهدف من هذه الدراسة هو تقدير معدل التوائم فى أبقار الهولشتين الحلابة وتأثيره على إنتاج اللبن وطول فترة الحليب و طول فترة الجفاف وأداء العجول باستخدام 5815 سجلا للولادة فى مزرعة (تيك-داب) بالفيوم وتم مقارنة بيانات الأبقار التى أعطت توائم بتلك التى أعطت فرادى لاستبيان مدى معنوية هذه الفروق. وكان معدل ولادة التوائم فى هذه الأبقار 1.4 %. وقد أظهرت النتائج وجود نقص معنوى فى معدل إنتاج اللبن اليومى وقمة إنتاج اللبن وإنتاج موسم 305 يوم التالى للولادة للأبقار التى أعطت توائم عن تلك التى أعطت فرادى. لم يكن هناك فروق معنوية فى طول فترتى الحليب والجفاف السابقة واللاحقة لولادة العجول التوائم والفرادى. كانت هناك زيادة معنوية فى أوزان العجول الفرادى عند الميلاد والفطام عنها فى العجول التوائم بينما كانت هناك زيادة معنوية فى الوزن الكلي للعجول التوائم عند الميلاد والفطام بالنسبة لعدد الولادات عنها فى العجول الفرادى. أيضا كانت هناك زيادة معنوية فى معدل النمو اليومى للجسم فى العجول الفرادى عنها فى التوائم. وقد استنتج من هذه الدراسة أن ولادة لتوائم لها تأثيرا سلبيا مثبطا لإنتاج اللبن. وبالرغم من زيادة الوزن الكلى للعجول التوائم عند الميلاد والفطام إلا انه يجب الأخذ فى الاعتبار المعوقات الأخرى لولادة التوائم مثل زيادة معدلات حدوث عسر الولادة وزيادة معدلات النفوق فى العجول عند الولادة ونقص معدلات الأداء التناسلى. ومن اجل الحد من هذه المعوقات يجب تشخيص حمل التوائم مبكرا باستخدام الموجات الفوق صوتية حتى يمكن الاستعداد باتخاذ أساليب الرعاية الجيدة قبل الولادة عن طريق التغذية الجيدة وإعطاء فترة الجفاف المناسبة وعند الولادة للتقليل من مشاكل عسر الولادة ومعدلات نفوق العجول. ومن كل ما سبق يتضح أن حدوث التوائم فى الأبقار الحلابة غير مرغوب نظرا لان زيادة العائدات الناتجة عن زيادة الأوزان الكلية للعجول المباعة لا تقابل الخسائر الناتجة عن نقص إنتاج اللبن وزيادة معدلات عسر الولادة ونفوق العجول والأبقار عند الولادة وقلة معدلات الخصوبة لهذه الأبقار.