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SOME FACTORS AFFECTING FIRST SERVICE CONCEPTION RATE IN HOLSTEIN DAIRY COWS UNDER EGYPTIAN CONDITIONS

By

A.S. MOSTAFA*

*Department of Hygiene, Management and Zoonoses, Faculty of Veterinary Medicine, Beni-Suef University

SUMMARY

The objective of this study was to investigate the effect of some factors on first service conception rate in Holstein dairy cows under Egyptian conditions. These factors are parity, days to first insemination, body condition score at calving and at first insemination time and its changes from calving to first insemination, peak and 305-d milk yield, season of insemination, temperature humidity index and progesterone level at the time of insemination. The study was carried out on 670 dairy cows and 190 heifers which were loosely housed in fenced partially shaded yards and milked three times daily in a milking parlour. Cows were fed on a total mixed ration (TMR) based on corn silage, yellow corn, soya bean and cotton seed meal. Estrus was detected by the use of electronic activity tag and cows were inseminated artificially. First service conception rate was significantly affected by body condition score at insemination time and its changes from parturition till insemination, 305-d milk yield, season of insemination, temperature humidity index and progesterone level at the time of insemination, while there was no significant effect for parity, days to first insemination, body condition score at calving and peak milk yield.

Key words: Dairy cow- First service conception- Parity- Body condition score- Season- Temperature humidity index- Progesterone.

Abbreviation key: **FSCR**= first service conception rate, **BCS**= body condition score, **THI**= temperature humidity index.

INTRODUCTION

Conception rate to first service is the combined consequences of fertilization, early embryonic, late embryonic and foetal development, and each of these steps in establishing pregnancy may be affected (**Grimard et al., 2006**).

First service conception rate in dairy cattle appears to be declining in several countries (**Royal et al., 2000 and Lucy, 2001**). This will have an economic impact due to the use of more insemination doses per conception that will be reflected on more costs per cow and consequently decreased profit of the herd.

Numerous epidemiological studies have suggested that individual cow, environmental and management factors influence FSCR (**Coleman et al., 1985; Kinsel and Etherington, 1998; Gröhn and Rajala-Schultz, 2000; Buckley et al., 2003a and Rajala-Schultz and Frazer, 2003**).

Higher parity cows had a significantly higher FSCR than first parity (**Shah et al., 1989 and Kinsel and Etherington, 1998**). On the contrary (**Taylor et al., 1985; Eicker et al., 1996; Gröhn and Rajala-Schultz, 2000; Buckley et al., 2003a and Grimard et al., 2006**) found that FSCR was declined as parity number increased especially when the number of lactation was ≥ 4

Conception rate at first service was increased with advancement in stage of lactation (**Britt, 1975**). With the increase of calving to first service interval, the FSCRof low yielding cows increased steadily while there was a sudden stepwise increase in high yielding cows and the differences were highly significant for the cows served within 60 days of calving but were more consistent for the matings after 100 days (**Dhaliwal et al., 1996**). On the other hand, FSCR was increased significantly when the interval between calving to first insemination was longer than 90 days compared to less than 70 days (**Seegers et al., 2001; Bukley et al., 2003a and Grimard et al., 2006**). Moreover, (**Espinasse et al., 1998**) reported that FSCR was lower when insemination was earlier than 50 days postpartum and particularly so before 30 days postpartum. On the contrary, (**Stevenson et al., 1983**) found that there was no significant effect of calving to first service interval on FSCR.

Body condition score is used as a subjective method to determine the body reserves of dairy cattle (**Lowman et al., 1976**). BCS at calving was significantly related to FSCR (**Gearhart et al., 1990; Whitaker et al., 1993; Domecq et al., 1997; Markusfeld et al., 1997; Suriyasathaporn et al., 1998; Heuer et al., 1999; Pryce et al., 2001; Berry et al., 2003**).Thin cows had a higher FSCR than moderate and fatty cows (**Houghton et al., 1990**). **Buckley et al. (2003b)** reported a negative effect of low BCS at insemination time on FSCR, but a non significant effect of high BCS ($\geq$ 3.5) was found, while others found no relation between BCS at calving (**Gransworthy, 1988; Holter et al., 1990; Pedron et al., 1993 and Waltener et al., 1993**) or at insemination time (**Lopez-Gatius et al., 2003 and Grimard et al., 2006**) and FSCR.

Dairy cattle in common with most lactating mammals, are usually in negative energy balance in the first few weeks of lactation (**Berglund and Danell, 1987 and Nielsen, 1999**). Furthermore, energy intake of high yielding Holstein cows during this period is less than half the energy requirements for production **(Veerkamp et al., 1995).** The shortfall of energy must be met through mobilization of body tissues; thus appreciable live weight loss during this time is common **(Komaragiri and Erdman, 1997).** The changes in BCS over the first few weeks of lactation may indicate the extent of metabolic load as the shortfall of energy to fuel production is thought to be met through mobilizing body reserves **(Pryce and Lovendahl, 1999)**. BCS changes had a significant negative effect on FSCR **(Gransworthy, 1988; Butler and Smith, 1989; Gearhart et al., 1990; Ferguson, 1992; Osoro and Wright, 1992; Nebel and McGilliard, 1993; Whitaker et al., 1993; Domecq et al.,1997; Suriyasathaporn et al.,1998; Butler, 2000; Gillund et al., 2001 and Pryce et al., 2001)**, but this was not the case with **(Ruegg et al., 1992; Waltener et al., 1993; Markusfeld et al., 1997 and Corro et al., 1999).**

Selection for milk production has led to a decline in fertility, and the genetic correlation estimates between milk yield and fertility are unfavourable **(Hoekstra et al., 1994 and Pryce et al., 1998)**. On the other side, high peak milk yield was associated with low FSCR **(Lean et al., 1989 and Buckley et al., 2003b)**. Furthermore, FSCR was declined as peak milk yield increased above 39 kg/day versus ≤ 39 kg/day **(Stevenson et al., 1983; Kinsel and Etherington, 1998 and Grimard et al., 2006).** High producing dairy cows had a lower FSCR **(Bagnato and Oltenacu, 1993; Carroll et al., 1994; Hodel et al., 1995; Ouweltjes et al al., 1996; Pryce et al., 1998; Heuer et al., 1999; Roman et al., 1999; Butler, 2000 and Tekerli, 2000)**. Moreover, low yielding cows had a higher FSCR than high yielders **(Dhaliwal et al., 1996).** On the contrary, **(Erb et al., 1981; Fonseca et al., 1983; Bertrand et al., 1985; Raheja et al., 1989; McGowan et al., 1996; Domecq et al., 1997; Rajala-Shultz and Frazer, 2003 and**

Santos et al., 2004) found no significant effect of milk yield on FSCR.

FSCR was reduced greatly in summer due to the effect of heat stress (**Ingraham et al., 1976; Gwazdauskas et al.,1981; Turner,1982; Putney et al., 1989; Badinga et al., 1993; Ouweltjes et al., 1996; Hansen, 1997; Al-Katanani et al., 1999; Wolfenson et al., 2000 and Cartmill et al., 2001**). A decline in FSCR was more marked between spring and summer (**Francos and Mayer, 1983**). On the other hand, lower FSCR was reported during autumn as compared to spring **(Gillund et al., 2001)**, while **(Taylor et al., 1985**) found that FSCR was superior in fall months than winter months. Moreover, **(Shah et al.,1989)** reported that summer and autumn calvers (i.e. will be inseminated during autumn and winter) showed a significantly higher FSCR than those calved in winter and spring (i.e. will be inseminated during spring and summer).**Stevenson et al.(1983)** found a reduction in FSCR of cows when the maximum temperature on the day of insemination was below 10°C. Contrarily, **(Salah and Mogawer, 1990 and Grimard et al., 2006)** found no relation between season of insemination and FSCR in dairy cows.

THI at the time of insemination had the greatest significant effect on FSCR in dairy cows where higher values were associated with low FSCR and vice versa (**Ingraham et al., 1976; Armstrong, 1994; Al-Katanani et al., 1999 and Mayer et al., 1999**).

Cows that inseminated when the plasma progesterone level was >3 ng/ ml were less likely to conceive at first service (insemination occurs in the luteal phase) than those inseminated at levels $\leq$ 3 ng/ml **(Lamming and**

Darwash, 1998 and Grimard et al., 2006).

The objective of this study was to investigate some factors that affecting first service conception rate including parity, days to first insemination, body condition score and its changes during early lactation, milk yield, season of insemination, temperature humidity index and progesterone level at the time of insemination.

MATERIALS AND METHODS

1- Animal and management:

This study was conducted in a private farm (TEC-DAP) in El-Fayum Governorate in the period from December 2004 to February 2006 on 670 Holstein dairy cows and 190 heifers which are loosely housed in a partially shaded and fenced yards and milked three times daily in a milking parlour. Cows were fed on a total mixed ration (TMR) based on corn silage, yellow corn, soya bean, cotton seed meal and hay. Estrus was detected by the use of electronic activity tag fixed around the pastern which record the increased activity of the cow during estrus and these cows were inseminated artificially. Cows were diagnosed for pregnancy at 35 days after insemination by rectal palpation.

2- Data collection:

a- Data about all cows in the herd (including parity, milk yield, and days to first insemination, number of insemination per conception and confirmed pregnancy by rectal palpation) were collected and retrieved from a computerized data base.

b- First service conception rate was calculated as follow:

FSCR (%) = No. of cows conceived to first service / No. of all first inseminated cows x 100.

3- Determination of body condition score:

Cows were condition scored according to (**Edmonson et al., 1989 and Howard, 1996**) on a scale ranged from (1= very thin, 2= thin, 3= moderate, 4= fat and 5= very fat) to the nearest quarter point(depending on the amount of fat deposition on the ribs, vertebral column, hip bone, and around the root of the tail) within 24 hours after calving as it is less affected by production pressure and at the time of first insemination (**McGowan et al., 1996 and Corro et al., 1999**). BCS changes were calculated by subtraction of BCS at the time of insemination from that at calving (BCS changes = BCS at insemination - BCS at calving).

4- Season classification:

The year was classified to summer (July to September), autumn (October to December), winter (January to March) and spring (April to June) according to (**Tekerli et al., 2000**).

5- Calculation of temperature humidity index:

Daily minimum and maximum temperature and relative humidity were recorded during the study by the use of minimum and maximum thermometer and hair hygrometer respectively then the average of daily temperature and relative humidity was calculated from the average of the daily minimum and maximum recordings (**Al-Katanani et al., 1999, and Tekerli et al., 2000**). Temperature humidity index was calculated by combining environmental temperature (°c) and relative humidity (%) into one value as described by (**Ravagnolo et al., 2000 and Bohmanova et al., 2005**) as follow:

THI = {1.8 (temp. °c) + 32} - {0.55 - 0.0055 (relative humidity %)} {1.8 (temp. °c) -26}

6- Blood sampling and assays:

About 5 ml of blood sample was collected from the jugular vein of a cow (80 cows in summer and 75 cows in winter) at the time of first insemination postpartum into a clean tube containing sodium fluoride as anticoagulant for plasma separation. After collection samples were cooled at 4°C for 4-6 hours in refrigerator. Plasma was separated by centrifugation of the sample for 15 minutes at 4000 r.p.m. then pipetted and kept in clean eppendorf tubes which are frozen at -20°c in deep freezer till analysis. Progesterone levels were determined by using of progesterone ELISA technique(CALBIOTECH, INC.) for the quantitative measurement of progesterone in serum and plasma according to (**Radwanska et al., 1978; Van de Wiel and Koops, 1986 and Tietz, 1995**).

7- Statistical analysis:

Results were statistically analyzed by the use of one way ANOVA according to (**Snedecor and Cochran, 1989**). For the effect of parity cows were classified into heifers, first, second, third, fourth, fifth and sixth or more; for the effect of days to first insemination cows were classified into those inseminated at 40-49, 50-59, 60-69, 70-79 and ≥ 80 days postpartum; for the effect of BCS cows were classified into those having a BCS <3 , 3- <4 and ≥ 4; for the effect of BCS changes cows were classified to those gaining a 0.25 point, no loss (zero), and losing of 0.25, 0.5, ≥ 0.75 points; for the effect of peak milk yield cows were classified into those producing 20 - < 30, 30 - < 40, 40 - <50 , 50 - < 60 and ≥ 60 kg according to thir peak milk yield; for the effect of 305-d milk yield cows were classified into those producing 5000 -< 6000, 6000 - < 7000, 7000 - < 8000, 8000 - < 9000, 9000 - < 10000 and ≥ 10000 kg; for the effect of THI cows were classified to those insemi-

Table (7): Effect of 305-day milk yield on first service conception rate in Holstein dairy cows

305-day milk yield (kg)	(5000 -< 6000)	(6000 - < 7000)	(7000 - < 8000)	(8000 - < 9000)	(9000 - < 1000)	(1000)
FSCR (%)	**51.28^{a}** ± 8.10	**22.80^{b}** ± 5.60	**17.50^{b}** ± 4.27	**20.51^{b}** ± 4.60	**22.22^{b}** ± 5.71	**13.79^{b}** ± 2.51

Results are expressed as means ± SE.

Table (8): Effect of season of insemination on first service conception rate in Holstein dairy cows

Season	Summer	Autumn	Winter	(Spring
FSCR (%)	**3.70^{b}** ± 0.59	**17.03^{a}** ± 3.24	**21.33^{a}** ± 3.35	**14.43^{a}** ± 1.58

Results are expressed as means ± SE.
a, b superscripts indicate significant difference at $p < 0.05$.

Table (9): Effect of temperature humidity index on first service conception rate in Holstein dairy cows

THI (units)	(> 20)	(20 -< 40)	(40 -< 60)	(60-< 80)	(≥80)
FSCR (%)	**21.33^{a}** ± 3.35	**22.22^{a}** ± 4.64	**20.00^{ab}** ± 3.20	**7.46^{b}** ± 0.23	**4.87^{b}** ± 0.40

Results are expressed as means ± SE.
a, b superscripts indicate significant difference at $p < 0.05$.

Table (10): Effect of plasma progesterone level at insemination time on first service conception rate in Holstein dairy cows

Progesterone level (ng/ml)	($\leq$ 20)	(>2 - $\leq$ 3)	(> 3)
FSC rate (%)	$42.50^{a} \pm 6.91$	$34.28^{a} \pm 5.14$	$2.69^{b} \pm 0.09$

Results are expressed as means ± SE.
a, b superscripts indicate significant difference at $p < 0.05$.

DISCUSSION

Table (1) showed that first bred heifers had a significantly higher FSCR (48.66%) than first (21.42%), second (23.86%), third (22.80%), fourth (24.39%), fifth (24.48%) and sixth or more (23.07) parity cows, while there was no significant difference between first, second, third, fourth, fifth and sixth or more parity cows. This may be attributed to that heifers are non lactating so that not subjected to the stress of milk production and high prolactin which antagonize fertility and also the uterine environment is still aseptic. The lack of difference between different parity cows may be related to the high milk yield of Holstein cows especially during the first, second, third and fourth lactations and to the very low number of cows lie under the category of fifth and more parity. These results disagree with **(Eicker et al., 1996; Gröhn and Rajala-Schultz, 2000; Buckley et al., 2003a and Grimard et al., 2006)**.

It was observed from Table (2) that days to first insemination had no significant effect on FSCR. Cows inseminated at 50-59, 60-69 and 70-79 days postpartum had a higher FSCR (27.90%), (28.57%) and (25.80%) respectively than those inseminated at 40-49 and ≥ 80 days postpartum which had a FSCR of (18.64%) and (16.50%) respectively. The low FSCR in cows inseminated before 50 days postpartum may be attributed to the stress of high milk yield or incomplete uterine involution, while those inseminated at 80 days or more may be related to the continued stress of high milk yield or these cows may suffer from fertility problems. These results are in agreement with **(Espinasse et al., 1998)** but are not like the reports obtained by **(Britt, 1975; Dhaliwal et al., 1996; Seegers et al., 2001 and Grimard et al., 2006).**

BCS at calving had no significant effect on FSCR as shown in Table (3), but in general, thin cows (< 3) had a lower FSCR (22.58%) than moderate (3- <4) or fat cows (≥4) which their rate was (26%) and (38.46%) respectively. These may be related to the mobilization of fat and protein from body tissues is mainly directed for the milk yield leaving insufficient portion for reproduction. These results are in the same concert with **(Domecq et al., 1997; Markusfeld et al., 1997); Suriyasathaporn et al., 1998; Pryce et al., 2001 and Berry et al., 2003)** and disagree with **(Gransworthy, 1988; Holter et al., 1990; Pedron et al., 1993 and Waltener et al., 1993)**. On the other hand, Table (4) demonstrated that BCS at first insemination had significantly affected FSCR than BCS at calving. FSCR was significantly lower (15.06%) and (29.33%) in thin (< 3) and moderate cows (3 - < 4) respectively than fat cows (≥ 4) whigh was (56.66%). The high FSCR in fat cows may be attributed to the small BCS loss that when occurs the cows reached to the reccmmended moderate level in the contrary to moderate and thin cows and to the small namber of cows lie under the category of ≥4 BCS. These results are like to that obtained by **(Buckley et al., 2003b)** but disagree with **(Lopez-Gatius et al., 2003 and Grimard et al., 2006)**. With regard to BCS changes from parturition till first insemination, it has the greatest significant effect on FSCR than the effect of BCS alone as shown in Table, (5). Cows that lose (0.25), (0.5) and (≥ 0.75) points of BCS (negative energy balance) from parturition till first insemination had a significantly lower FSCR (20.47%), (12.96 %) and (9.52%) respectively than those which gain BCS (36.11%) or with no loss (26.88%). With the increase in the magnitude of BCS loss within cows that lost BCS, there is a corresponding decrease in FSCR. Similar findings have been reported previously by **(Nebel and McGilliard, 1993; Domecq et al., 1997; Suriyasathaporn et al., 1998; Butler, 2000 and Gillund et al., 2001),** while others **(Ruegg et al., 1992; Waltener et al., 1993; Markusfeld et al., 1997 and Corro et al., 1999)** do not support that.

It was declared from Table (6) that FSCR was decreased with increased peak milk yield but the effect is not significant. Cows with a peak milk yield (≥ 60) kg had a lower FSCR (18.18%) than those with a peak of (20-< 30) kg which their FSCR was (28.57%). This agrees with **(Lean et al., 1989 and Grimard et al., 2006)**. Additionally, selection for high milk yield was associated negatively with FSCR as appears in Table (7) which demonstrated that cows with a 305-d milk yield of (5000-<6000) kg had a significantly higher FSCR (51.28%) than those with a 305-d yield of (6000-<7000), (7000-<8000), (8000 - < 9000), (9000 - < 10000) and (≥ 10000) kg which their FSCR was (22.80), (17.50), (20.51), (22.22) and (13.79)% respectively. This may be attributed to the negative genetic correlation between milk production and FSCR and to the negative energy balance in high producing cows. This was similar to that reported by **(Dhaliwal et al., 1996; Pryce et al., 1998; Heuer et al., 1999; Roman et al., 1999; Butler, 2000 and Tekerli, 2000)** but this was not the case in studies of **(McGowan et al., 1996; Domecq et al., 1997; Rajala-Schultz and Frazer, 2003 and Santos et al., 2004).**

Table (8) declared that FSCR was significantly reduced in cows inseminated during summer season (3.70%) than cows inseminated during autumn (17.03%), winter (21.33%) and spring (14.43%). This may be related to el-

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بعض العوامل المؤثرة على معدل الحمل عند التلقيحة الأولى فى الأبقار الهولستين تحت الظروف المصرية

أحمد سعد مصطفى

قسم الصحة والرعاية والأمراض المشتركة - كلية الطب البيطرى - جامعة بنى سويف

تمت هذه الدراسة لاستبيان تأثير بعض العوامل على معدل الحمل عند التلقيحة الأولى فى أبقار الهولشتين المرباة تحت الظروف المصرية. إشتملت هذه العوامل على عدد الولادات، الفترة من الولادة وحتى أول تلقيح، درجة الإكتناز عند الولادة وعند أول تلقيح والتغيرات فى درجة الإكتناز فى الفترة من الولادة وحتى أول تلقيح، إنتاج اللبن عند القمة وعند ٣٠٥ يوم، موسم التلقيح، مؤشر الحرارة والرطوبة ومستوى البروجستيرون فى الدم عند أول تلقيح .أجريت الدراسة على عدد ٦٧٠ بقرة حلابة و ١٩٠ عجلة والتى كانت تسكن بالنظام الحر فى أحواش مظللة جزئياً وتحلب ثلاث مرات فى اليوم فى محلب ملحق بهذه الأحواش. كانت الأبقار تغذى على عليقة كاملة التخليط مكونة أساساً من سيلاج الذرة الصفراء، كسب فول الصويا، كسب بذرة القطن، والدريس. إكتشاف الشبق كان يتم عن طريق إستخدام مسجل الحركة الألكترونى وكانت الأبقار تلقح صناعياً. ولقد إستنتج من هذه الدراسة أن هناك تأثيراً معنوياً لكل من درجة الإكتناز عند أول تلقيح، التغيرات فى درجة الإكتناز فى الفترة من الولادة وحتى أول تلقيح، إنتاج اللبن لموسم ٣٠٥ يوم، موسم التلقيح، مؤشر الحرارة والرطوبة ومستوى البروجستيرون فى الدم عند أول تلقيح على معدل الحمل عند أول تلقيح. يجب تعويض الفقد فى درجة الإكتناز وتوازن الطاقة السلبى فى المراحل الأولى من موسم الحلب بالتغذية الجيدة لتقليل التأثير السلبى على معدل الحمل عند أول تلقيح. لتقليل تأثير الإجهاد الحرارى على الحيوانات يجب إستخدام نظم التبريد المناسبة. يفضل قياس مستوى البروجستيرون عند التلقيح حتى يتم إستثناء الأبقار ذات المستويات الأعلى من ٣ نانوجرام/مل والتى من الممكن أن تكون قد إجتازت مرحلة التبويض.