CONDICIÓN CORPORAL (CC) Y DESEMPEÑO REPRODUCTIVO EN VACAS LECHERAS DE LA REGIÓN ORIENTAL DEL PARAGUAY

BODY CONDITION SCORE AND REPRODUCTIVE PERFORMANCE OF DAIRY COWS IN EASTERN REGION OF PARAGUAY

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RESUMEN. El objetivo del presente trabajo de investigación fue evaluar la condición corporal (CC) de vacas en lactación y comparar la CC de vacas con buen desempeño reproductivo (alta tasa de preñez) con vacas que tuvieron menor tasa de preñez en la Región Oriental del Paraguay. Fueron evaluadas 116 vacas de 13 diferentes establecimientos. Los datos obtenidos fueron analizados usando el programa SAS Enterprise Guide versión 4.3. A pesar de la gran variación en la CC durante el periodo evaluado, la CC fue menor en la fase temprana y media de la lactación que en la fase tardía ($p < 0,05$). La producción de leche fue mayor en vacas de fenotipos lecheros y otros fenotipos ($p<0,01$); sin embargo los cambios en la CC observados en las cruzas Holando y en las razas híbridas durante el presente trabajo fueron casi similares. Las vacas con mayor calificación de la CC tuvieron mejor desempeño reproductivo (intervalo entre partos y días abiertos más cortos) ($p<0,0001$), y la producción diaria de leche fue menor en vacas con mejor CC de otros tambos. Durante el periodo de lactación, la CC de vacas con buen desempeño reproductivo fue mayor que aquellas con baja CC. Además, la CC de vacas con buen desempeño reproductivo no se redujo después del parto, mientras la CC de vacas con menor desempeño reproductivo se redujo durante la fase temprana y el pico de lactación, comparado con el periodo seco ($p<0,05$). No se han observado diferencias en la CC entre vacas con mayor o menor producción de leche. Los resultados obtenidos bajo las condiciones experimentales, sugieren que la condición corporal afecta el desempeño reproductivo en vacas de fenotipos lecheros y de otros fenotipos, controlando la disminución de la CC en el periodo post-parto debido al efecto de la lactación se puede mejorar el desempeño reproductivo en vacas lecheras.

Palabras clave: Condición corporal, desempeño reproductivo, región este del Paraguay, vacas lecheras.

ABSTRACT. The objective of the current investigation work was to compare body condition score (BCS) to reproductive performance in milking dairy cows in Paraguay. We used 1169 dairy cows of 13 farms from October 2013 to August 2015. Data were analyzed using SAS Enterprise Guide version 4.3. BCS in early and mid lactation period were lower than in the late period ($p < 0.05$), although it had large variation. In addition, daily milk yields of Holstein cows were higher than cows mixed with various breed ($p < 0.01$); however, BCS between two breeds was mostly similar. In addition, we compared BCS between cows on farm with the calving interval less than 365 days ($n = 243$, good reproduction) and other cows ($n = 710$) except 6 farms without reproductive record. In cows with good reproductive performance, calving interval ($p < 0.0001$) and days open ($p < 0.0001$) were shorter and daily milk yield was lower ($p < 0.0001$) than cow of other farms. During the all lactation period, BCS of cows with good reproductive performance were higher than others ($p < 0.05$). In addition, BCS of cows with good reproductive performance did not decrease after calving, whereas BCS of cows on other farms decreased during early and peak lactation period compared with dry period ($p < 0.05$). Moreover, BCS did not differ between cows with higher and lower milk yield. In conclusion, the results under the running conditions of the experiment indicate that BCS affect reproductive performance of Holstein and crossbreed milking cows in eastern region of Paraguay. Our data suggests that controlling the decrease of BCS after calving for milk production may improve the reproductive performance.

Keywords: Body condition score, dairy cow, eastern region of Paraguay, reproductive performance.

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INTRODUCTION

In Paraguay, dairy sector has grown in recent years owing to genetic improvement of dairy cattle and enhanced infrastructure, and milk production has steadily increased from 122 million of liters in 1996 to 450 million of liters in 2010 (1). However, optimal nutritional management of dairy cattle has not yet been well established in Paraguay, especially in the east region of the country. Some of the reasons are that the amount and kind of feed is not stable throughout the year and grazing method is different from farm to farm despite dairy farm production depended on forage. In addition, there is little data for the chemical composition in grass varieties, silage and prepared concentrates of each farm. Therefore, although feed management depending on the policy in each farm, it is important to manage while understanding the nutritional status of cow in order to keep a certain level of milk production and reproductive performance.

Measurement of feed intake is one of the most suitable variables to reflect nutritional status; however, monitoring of feed intake in individual cows is impractical for most commercial dairy farms. Evaluation of energy and metabolic status based on metabolic hormones and metabolites in the blood is suitable and useful, but blood sampling and laboratory analyses are limited because of higher technology and cost. On the other hand, body condition score (BCS) is one of the useful tool that is feasible for commercial dairy farms. BCS is the assessment of body fat store and related to feed intake and milk production (2). However, information of BCS in Paraguay is little, so suitable score for management leading to good reproductive performance is not clear. Therefore, the present study examined the BCS of dairy cows and compared the BCS between cows on farm with higher reproductive performance and cows on farm with lower reproductive performance in the eastern region of Paraguay.

MATERIALS AND METHODS

One thousand one hundred sixty-nine dairy cows from 13 dairy farms in the eastern region of Paraguay (Alto Paraná Department and Itapúa Department) were used for this study. Two types of dairy cattle breed are mainly found in Paraguay. One type of breed with strong Holstein characteristics and the other type include cattle of mixed breed including beef cattle. BCS of former is assessed using a 1 to 5 scale with 0.25 intervals according to Ferguson et al. (1994). However, it is difficult to evaluate in the same way for cattle of mixed breeds, because the skeleton related to BCS measurement such as the transverse processes is different between Holstein and mixed breed. Therefore, we modified the method of BCS measurement for Holstein (Figure 1-1 and 1-2 A), which has been shown by Ferguson et al. 1994 (2), in order to applicate for cattle of mixed breeds (Figure 1-1 and 1-2 B). Based on these methods of BCS measurement, BCS were assessed 1 to 8 times for each herd between October 2013 and August 2015 (Table 1).

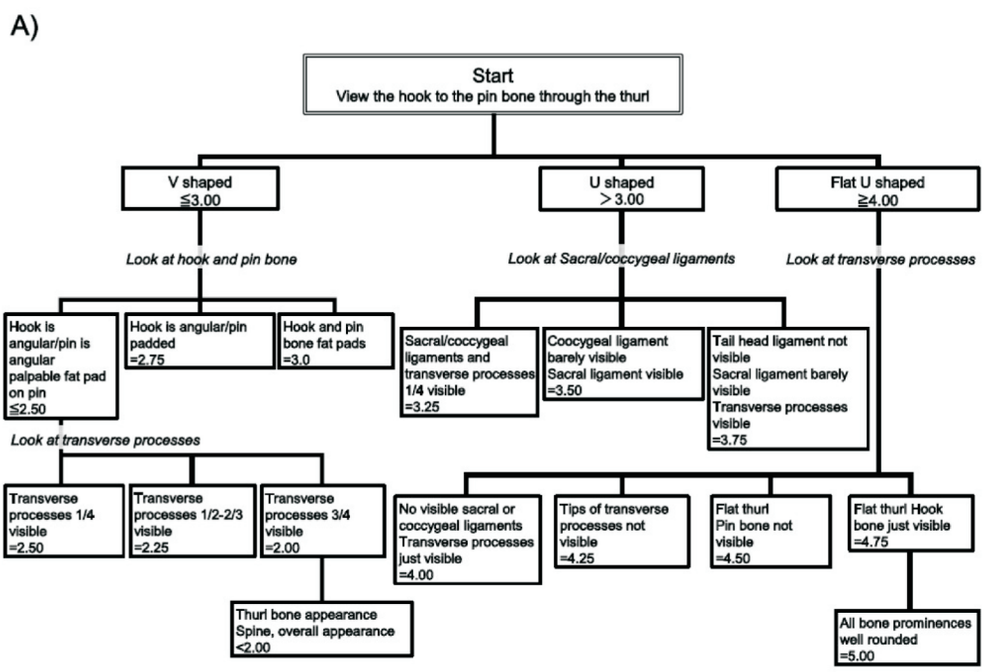

Figure 1-1. Method of BCS measurement for Holstein (A) and mixed breed (B) in English.

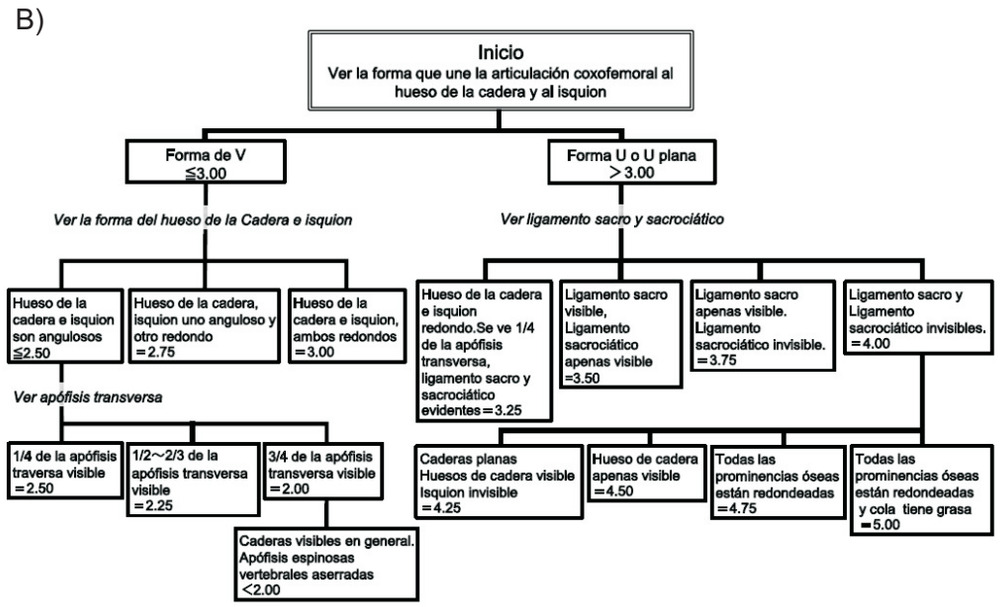

Figure 1-2. Method of BCS measurement for Holstein (A) and mixed breed (B) in Spanish.

Table 1. Herd size, BCS, milk yield and reproductive performance in each herd

Farm	Number of milking cow	Number of BCS measurement	Postpartum days at BCS measurement	BCS	Daily milk yield	Calving interval	Days open
A	35	2	163.4 ± 16.7	3.20 ± 0.05	*No data*	407.2 ± 19.9	117.8 ± 18.8
B	15	3	148.6 ± 17.3	3.46 ± 0.05	9.2 ± 0.5	360.9 ± 5.4	75.6 ± 3.9
C	100	2	167.3 ± 14.5	3.44 ± 0.04	*No data*	414.9 ± 19.9	142.6 ± 20.5
D	30	1	185.9 ± 35.3	3.38 ± 0.08	19.4 ± 1.4	448.8 ± 36.5	168.8 ± 36.5
E	15	2	98.8 ± 31.0	3.03 ± 0.11	*No data*	374.1 ± 6.9	95.2 ± 7.6
F	54	3	144.5 ± 9.4	3.54 ± 0.03	*No data*	332.0 ± 4.3	61.2 ± 5.2
G	12	4	201.7 ± 23.8	3.81 ± 0.05	10.4 ± 0.4	344.0 ± 22.3	71.0 ± 28.5
H	18	4	153.5 ± 13.8	3.66 ± 0.05	15.8 ± 0.7	359.6 ± 6.8	73.9 ± 5.7
I	22	8	173.4 ± 10.3	3.41 ± 0.04	12.2 ± 0.4	383.7 ± 11.3	124.5 ± 10.8
J	30	8	106.3 ± 13.3	3.50 ± 0.03	*No data*	368.5 ± 28.2	72.2 ± 13.1
K	100	5	215.9 ± 9.2	3.24 ± 0.02	18.1 ± 0.5	426.5 ± 11.3	146.5 ± 11.3
L	100	3	212.0 ± 10.0	3.53 ± 0.03	*No data*	427.5 ± 7.7	155.4 ± 8.5
M	15	8	185.2 ± 13.9	3.16 ± 0.03	14.0 ± 0.5	446.4 ± 30.3	173.4 ± 23.7

Values are the mean ± SEM.

Data of daily milk yield at the month when BCS was measured were collected from 7 farms except 6 farms without record, and reproductive records such as calving date and insemination date in each cow were collected from all farms (Table 1).

In addition, we regarded cows on farm with the calving interval less than 365 days as good reproductive performance, and compared BCS in each lactation period between cows on farm with higher reproductive performance and cows on other farms with lower reproductive performance. Postpartum days of each lactation period were regarded as 0 to 50 days in early, 51 to 110 days in peak, 111 to 220 days in mid and 221 to 300 days in late lactation period, respectively. In addition, dry period was regarded as 60 days before calving. Data were analyzed by the Student's t-test, Wilcoxon signed-rank test or Bonferroni correction after statistical testing of normality using the Kolmogorov-Smirnov test (SAS Enterprise Guide version 4.3, SAS Institute Inc.; Cary, NC, USA). Results are reported as mean ± standard error of the mean (SEM); differences with $p < 0.05$ were considered significant.

RESULTS AND DISCUSSION

Figure 2 shows the distribution of BCS (n = 1169) and daily milk yield (n = 389) in all cows. Daily milk yield was declined over time after calving, although its variation was large. Averages of daily milk yields in each lactation period, expressed in liters, were 17.3 in early, 15.5 in peak, 14.2 in mid and 11.5 in late lactation period, respectively. Daily milk yield in early was higher than in mid ($p < 0.05$) and late ($p < 0.05$), and it in peak was greater than in late ($p < 0.05$). On the other hand, BCS had large variation, and the average of BCS in each period was 3.48 in dry, 3.22 in early, 3.24 in peak, 3.40 in mid and 3.45 in late, respectively. Although BCS in early and mid lactation period were lower than other period ($p < 0.05$), the change of BCS after calving was smaller compared with previous reports (3,4,5). It is considered that one of the reasons is lower milk yield in cows of the present study than in cows of the previous studies mentioned recently. Moreover, distribution of BCS and daily milk yield of Holstein cows (BCS, n = 995; daily milk yield, n = 348) and mixed breed cows (BCS, n = 144; daily milk yield, n = 38) are shown in Figure 3 and 4, respectively. Daily milk yields of Holstein cows were higher in early (18.1 L vs. 13.1 L, $p < 0.01$), peak (16.1 L vs. 11.7 L, $p < 0.0001$) and mid (14.6 L vs. 9.8 L, $p < 0.001$) than cows mixed with various breed; however, BCS between two breeds differed only in peak lactation period (Holstein; 3.21, mixed breed; 3.26, $P<0.05$) and BCS of other lactation period did not differ between the two types of breed.

Table 2 shows the average of BCS, daily milk yield and reproductive performance in cows on farm with good reproductive performance and cows on other farms with low reproductive performance. There was no difference of breed between the two farms. It was reasonable that calving interval ($p < 0.0001$) and days open ($p < 0.0001$) were shorter in cows with good reproductive performance than cow of farms with lower reproductive performance. However, BCS was higher ($p < 0.0001$) and daily milk yield was lower ($p < 0.0001$) in cows with good reproductive performance than cow of other farms, although postpartum days at BCS measurement were similar between two farms. Figure 5 shows the comparison of BCS in each lactation period and dry period between cows on farm with good reproductive performance and cows on other farms. During the all lactation period, BCS of cows with good reproductive performance were higher than cows of other farms ($p < 0.05$ in early, $p < 0.01$ in peak and late, and $p < 0.001$ in mid). In addition, BCS of cows with good reproductive performance did not decrease after calving, whereas BCS of cows on other farms decreased during early and peak lactation period compared with dry period ($p < 0.05$).

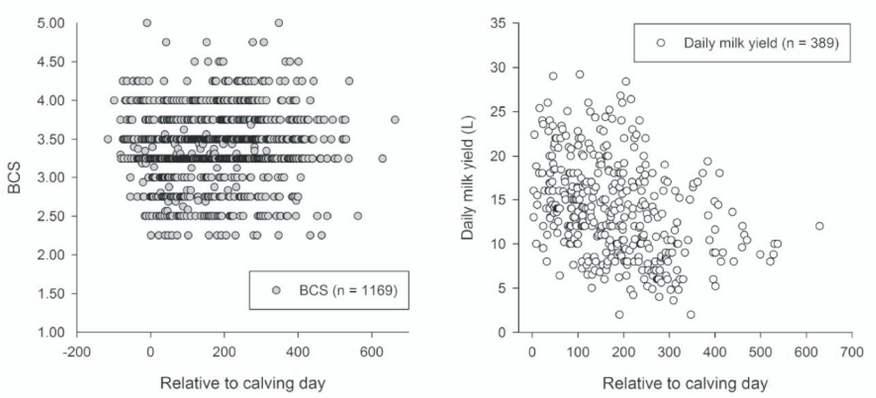

Figure 2. Distribution of BCS (n = 1169) and daily milk yield (n = 389) in cows with a strong Holstein breed.

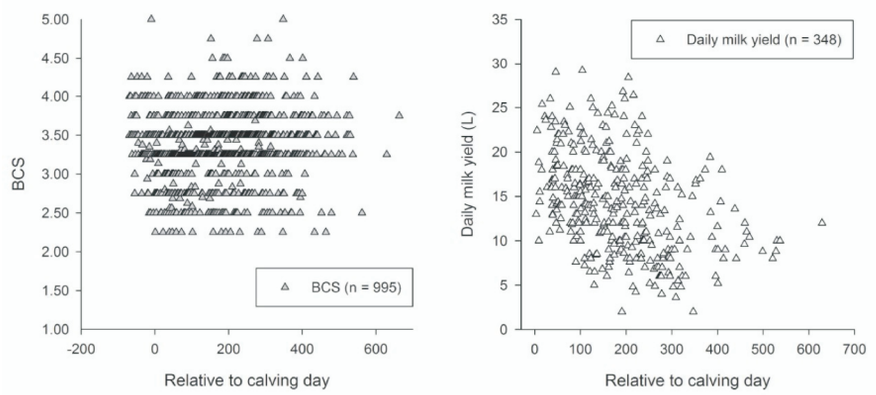

Figure 3. Distribution of BCS (n = 995) and daily milk yield (n = 348) in cows with a strong Holstein breed.

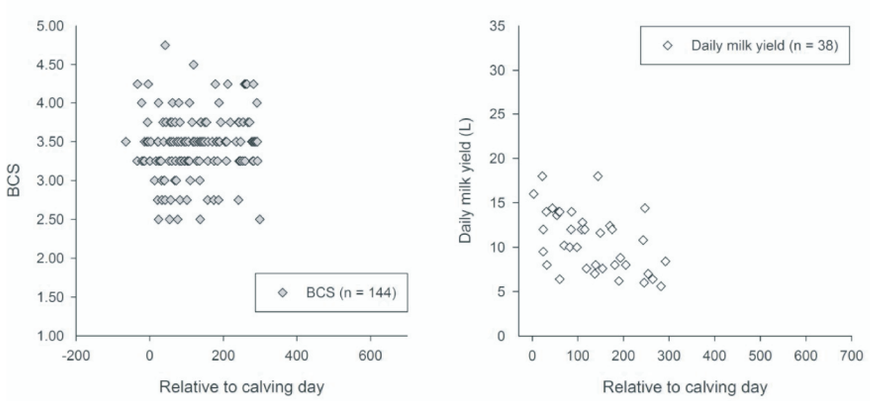

Figure 4. Distribution of BCS (n = 144) and daily milk yield (n = 38) in cows mixed with various breed.

Table 2. BCS, milk yield and reproductive performance in each group

	Good reproductive performance (4 herd, n = 243)			Others (9 herd, n = 710)			p-value
Postpartum days at BCS measurement (days)	162.1	±	13.3	167.6	±	13.7	0.3469
BCS	3.62	±	0.08	3.32	±	0.06	< 0.0001
Daily milk yield (L)	11.8	±	2.1	15.9	±	1.7	< 0.0001
Calving interval (days)	349.1	±	6.9	410.8	±	10	< 0.0001
Days open (days)	70.4	±	3.2	132.9	±	11.3	< 0.0001

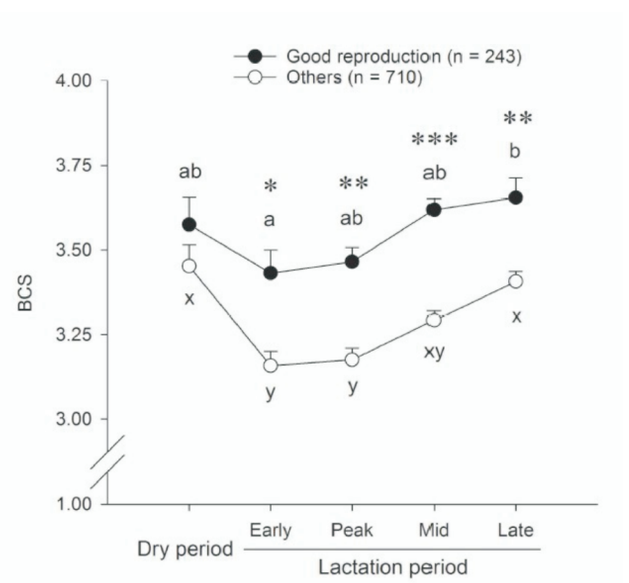

Figure 5. BCS of cows with good reproductive performance and cows of other farms with low reproductive performance during the dry period, early, peak, mid and late period of lactation. Values are mean ± SEM. *indicates differences of $p < 0.05$, **indicates differences of $p < 0.01$ and ***indicates differences of $p < 0.001$ between cows of farms with good reproductive performance and cows of other farms with lower reproductive performance (a and b indicate differences of $p < 0.05$ among cows on farm with good reproductive performance and other farms), x and y indicate differences of $p < 0.05$ among cows of other farms with lower reproductive performance.

Almost dairy cows undergo a period of negative energy balance (NEB) during the early postpartum period, because the energy required for milk production and maintenance of tissue function exceeds the energy uptake during this period (6,7). Although dairy cows in Paraguay may not have severe NEB because of lower milk production, the energy intake for milk production and maintenance of tissue function might be insufficient in cows on other farms. In addition, the result of comparing BCS between cows with the average of daily milk yield during the lactation period more than 15 L (n = 232) and less than 15 L (n = 286) was that BCS did not differ between cows with higher milk yield and lower milk yield in this study (3.16 vs. 3.15 in early, 3.14 vs. 3.28 in peak, 3.32 vs. 3.40 in mid, 3.36 vs. 3.42 in late and 3.37 vs. 3.59 in dry period). Hence, it is considered that the reason of good reproductive performance in the present study was the maintained BCS from dry period to early and peak lactation rather than lower milk yield. Butler & Smith, 1989 observed that the levels of NEB were directly related to the postpartum interval to first ovulation (8). The resumption of ovarian activity plays a crucial role in subsequent fertility, in which earlier resumption of ovarian function is related to higher fertility (9,10,11,12). Therefore, keeping BCS after calving like the cows on the farm with good reproductive performance may lead to enhancement of reproductive performance.

Overall, the present study provided the date of BCS and daily milk yield of dairy cows in eastern region of Paraguay. In addition, our data indicates that BCS affect reproductive performance of Holstein and crossbreed milking cows in Eastern region of Paraguay, and we suggests that controlling the decrease of BCS after calving for milk production may improve the reproductive performance, because cows with good reproductive performance maintained BCS after calving though milk yield was not high. Thus, the present results should prove valuable for determining feed management strategies to improve reproductive performance of dairy cows in Paraguay.

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REFERENCES

1.Servin B, Vásquez F. Study on inclusive development in Paraguay. Santiago de Chile: United Nations. Chapter ; 2013. 170-174.

2.Ferguson JD, Galligan DT, Thomsen N. Principal descriptors of body condition score in Holstein cows. J Dairy Sci. 1994; 77: 2695-2703

3.Gallo L, Carnier P, Cassandro M, Mantovani R, Bailoni L, Contiero B, Bittante G. Change in body condition score of Holstein cows as affected by parity and mature equivalent milk yield. J Dairy Sci. 1996; 79: 1009-1015.

4.Aeberhard K, Bruckmaier RM, Kuepfer U, Blum JW. Milk yield and composition, nutrition, body conformation traits, body condition scores, fertility and diseases in high-yielding dairy cows--Part 1. J Vet Med A Physiol Pathol Clin Med. 2001; 48: 97-110.

5.Brun-Lafleur L, Cutullic E, Faverdin P, Delaby L, Disenhaus C. An individual reproduction model sensitive to milk yield and body condition in Holstein dairy cows. Animal: an international Journal of Animal Bioscience. 2013; 7: 1332-1343.

6.Beam SW, Butler WR. Effects of energy balance on follicular development and first ovulation in postpartum dairy cows. J Reprod Fertil Suppl. 1999; 54: 411-424.

7.Lucy MC. Reproductive loss in high-producing dairy cattle: where will it end? J Dairy Sci. 2001; 84: 1277-1293.

8.Butler WR, Smith RD. Interrelationships between energy balance and postpartum reproductive function in dairy cattle. J Dairy Sci. 1989; 72: 767-783.

9.Staples CR, Thatcher WW, Clark JH. Relationship between ovarian activity and energy status during the early postpartum period of high producing dairy cows. J Dairy Sci. 1990; 73: 938-947.

10.Senatore EM, Butler WR, Oltenacu PA. Relationship between energy balance and postpartum ovarian activity and fertility in first lactation dairy cows. J. Anim Sci. 1996: 62; 17-23.

11.Darwash AO, Lamming GE, Woolliams JA. The phenotypic association between the interval to post-partum ovulation and traditional measures of fertility in dairy cattle. Anim Sci, 1997; 65: 9-16.

12.Kawashima C, Kaneko E, Amaya Montoya C, Matsui M, Yamagishi N, Matsunaga N, Ishii M, Kida K, Miyake Y-I, Miyamoto A. Relationship between the first ovulation within three weeks postpartum and subsequent ovarian cycles and fertility in high producing dairy cows. J Reprod Dev. 2006; 52: 479-486.