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Effects of dry period length and parity on milk production and blood metabolites of Holstein Friesian dairy cows

Tamer M. M. Hassan* and Ragab A. Abou-Saleh

Animal Production Department, Faculty of Agriculture, Benha University, 13736, Qalyubia, Egypt.

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ABSTRACT

The aim of this study was to investigate effects of dry period length (<45, 45-60, 61-90, 91-120 and >120 days) and parity (second, third, fourth and fifth^{+}) on milk production, composition and some blood metabolites using 620 Holstein-Friesian cows during the subsequent 305 days of lactation. Milk production was recorded during the following 305 days of lactation. Milk and blood samples were taken from 6 cows of each dry period group after first 100 days of lactation to analyze some milk composition and blood metabolites. Results showed that the differences between means of cow's milk production due to dry period length and parity number effects were highly significant (P<0.001). Cows which dried at 45-60 days before calving had the highest daily and total milk production followed by cows which dried at 91-120 days, cows which dried at 61-90 days, cows which dried at >120 days then, cows that dried at <45 days. Fourth parity cows had the greater daily and total milk production. Milk composition and blood metabolites means were greatly in cows dried at 45-60 days and with third and fourth parity number cows. It could be concluded that the optimal dry period length when cows dried at 45-60 days to produce more milk production without negative results on milk composition and blood metabolites in the subsequent lactation.

Keywords: Non-lactation period, milk production, milk composition, blood analysis, dairy cows.

*****Corresponding author: Tamer.mohamed@fagr.bu.edu.eg.

INTRODUCTION

The dry period is a crucial phase in the lactation of the dairy cow (Useni et al., 2014). Length of dry period has become a topic of renewed interest, as evidenced by numerous popular press articles (Kuhn et al., 2006a). During recent years there has been a renewed interest in dry period length, perhaps partly because of an ever increasing need for dairy farmers to maximize their income on investment. During the production cycle before the expected calving a period of rest is needed and in that time milking is ceased and thus the production of milk in the udder stops (Zadeh and Mohit, 2013). Increased potential for milk yield may have made cows more tolerant of shorter dry periods. Conversely, higher production may also result in a demand for a longer rest period in order to maintain production, health and fertility in the subsequent lactation. But, the effect of variation in dry period length on subsequent lactation performance, for modern day dairy cattle, is largely unknown and warrants re-evaluation (Kuhn et al., 2006b). As well as, few controlled studies have been conducted to directly evaluate the effect of dry period length. Results from these studies demonstrated that production losses of 18 to 29% occurred in the lactation following an omitted dry period (Annen et al., 2004). Other studies demonstrate that a dry period less than 40 days reduces milk yield in the subsequent lactation, and an 8-wk dry period is optimal. Shortening or omitting the dry period of cows can improve the energy balance of dairy cows in early lactation through a decrease in milk yield after calving (Kok et al., 2017).

The aim of this study was to investigate effects of dry period length and parity number on milk production of subsequent 305 days of lactation, milk composition and some blood metabolites.

MATERIALS AND METHODS

The experimental work of this study was carried out at the International Company for Animal Wealth dairy cattle farm from July 2019 to June 2020 under the supervision of Animal Husbandry Professors, Faculty of Agriculture, Benha University, Egypt.

The aim of this study is to investigate the effect of different dry period length and parity number on milk yield, its composition as well as blood metabolites of imported Holstein Friesian cows in the Nile delta of Egypt to decide the optimal dry period length.

Management of experimental animals

In this study 620 Holstein-Friesian cows of the herd (at 3 to 8 years of age with average body weight 759.65 kg) were allowed to feed on Egyptian clover (*Trifolium alexandriunm)*, corn silage and rice straw during autumn (21 September to 20 December) and winter (21 December to 20 March) months. However, in spring (21 March to 20 June) and summer (21 June to 20 September) months, cows were allowed to feed on Alfalfa hay, corn silage and rice straw. Temperature of air in autumn and winter months was 10 to 25°C while, in spring and summer months were 26 to 39°C.

All cows were supplied with concentrate feed mixture (CFM) by using total mix ration (TMR) technology as presented in Table 1. The amount of concentrate mixture offered to early dry period cows at different parities was 5.5 kg CFM, 14 kg corn silage and barley straw *ad libitum*; while, for close up period cows (21 days before calving) it was 7 kg CFM, 11 kg corn silage and 1.5 kg alfalfa hay; for 10-14 kg milk production cows it was 8 kg CFM, 16.5 kg corn silage and 3.5 kg alfalfa hay and barley straw *ad libitum*; for 15-24 kg milk production cows they were supplied with 11.25 kg CFM, 16.5 kg corn silage and 3.5 kg alfalfa hay and barley straw *ad libitum*; for fresh cows (60 days after calving) and 25-30 kg milk production cows they offered 13.5 kg CFM, 16.75 kg corn silage and 3.5 Kg alfalfa hay; finally for over 30 Kg milk production cows they allowed to consume 15 Kg CFM, 18.5 kg corn silage and 4 kg alfalfa hay according to NRC (2001) recommendations. Feed ingredients and chemical composition of dairy cow's diets was presented in Table 2.

All cows were subjected to the routine vaccination program against infectious diseases and also were injected or drenched against internal parasites. At the same time, the experimental cows were sprayed by the suitable pesticides when needed. All experimental cows were milked three times per day (at 5:00 am, 1:00 pm and 9:00 pm) by automatic milking machine system; after milking they were allowed to feed its concentrate feed mixture and roughages.

Table 1. Feed total mixed ration (TMR) of cows' diets.

Item	Concentrate feed mixture (kg)				Corn silage (kg)	Alfalfa hay (kg)	Barley straw
Early dry period cows	5.50	-	-	-	14.00	-	*ad libitum*
Clos up dry period cows	-	7.00	-	-	11.00	1.50	-
Fresh and 25-30 kg milk production cows	-	-	-	13.50	16.75	3.50	-
High milk production cows (<30 kg)	-	-	-	15.00	18.50	4.00	-
Mediate milk production cows (15-24 kg)	-	-	11.25	-	16.50	3.50	*ad libitum*
Low milk production cows (10-14 kg)	-	-	8.00	-	16.50	3.50	*ad libitum*

Table 2. Feed ingredients and chemical composition of dairy cows' diets.

Item	Early dry period cows	Close up dry period cows	Mediate and low production cows[1]	Fresh and high production cows[2]
Ingredients%				
Corn grain dent yellow	43.50	43.40	47.60	42.00
Wheat bran	26.70	19.50	21.50	18.30
Soybean meal 44%	25.80	25.00	20.50	28.10
Limestone ground	2.00	2.3.00	1.20	1.17
Molasses cane	-	3.00	6.50	3.60
Protected fat	-	0.60	-	3.50
Sodium chloride	0.90	0.27	0.70	0.60
Vitamins AD3E	0.17	0.20	0.15	0.15
Sodium bicarbonate	-	-	1.22	1.50
Magnesium oxide	-	-	0.25	0.45
Micro minerals (Zn-Cu-Selenium)	-	0.10	-	0.05
Di-calcium phosphate	0.22	0.35	-	0.20
Antitoxins	0.35	0.12	0.07	0.07
Dried yeasts	-	0.01	-	0.01
Minerals	0.35	0.40	0.30	0.30
Acid buffer	-	0.54	-	-

Table 2. Continues.

Calcium chloride	-	1.40	-	-
Magnesium sulfate	-	2.80	-	-
Total	100	100	100	100
Chemical composition%				
Dry matter	92.00	90.00	90.00	92.00
Crude protein	18.60	17.40	16.20	18.50
Crude fiber	4.00	3.00	3.50	3.00
Nitrogen free extract	73.00	70.70	76.20	73.60
Ether extract	0.40	0.70	0.30	0.50
Ash	4.00	8.50	3.80	4.40

[1] below 25 kg milk production cows; [2] over 25 kg milk production cows.

Milk production of experimental cows

The experiment was designed to study the effect of both dry period length (<45 days, 46-60, 61-120 and >120 days) and parity number (second, third, fourth and fifth or more parity) on herd cows (N = 620) milk yield recorded by summing of daily milk yield of each cow during the subsequent days of lactation.

Milk sampling and analysis

Milk samples were taken from 6 cows from each dry period group during first 100 days of subsequent lactation. Milk samples (10 ml of morning milking from each cow) stored at 5°C for subsequent analysis of milk components (total solids, fat, solids not fat, protein, lactose and ash %) according to IDF (1991a), IDF (1991b), IDF (1993) and AOAC (1995).

Blood sampling and analysis

Blood samples were collected individually during first 100 days of the subsequent lactation from 6 cows of each dry period group. Blood sample was taken at morning before feeding and drinking by addition of EDTA into dry clean tubes. The blood plasma was obtained by centrifuging the blood samples soon after collection at 3000 rpm for 15 min. Blood plasma was transferred into vials and stored in deep freezer at -20°C for subsequent specific chemical analysis. Total protein, albumin, globulin, A/G ratio, triglyceride, total cholesterol, calcium, potassium and magnesium concentration were determined according to Henry (1964), Doums et al. (1971), Frings et al. (1972) and American Association for Clinical Chemistry (1977).

The concentration of total globulin in each sample was obtained by subtracting albumin concentration from the total protein concentration and albumin globulin (A/G) ratio was calculated by total albumin by total globulin.

Statistical analysis

Statistical analysis was carried out using the least squares procedure with unequal subclass number of SAS software (2004). The statistical model for analyzing the data was used as follows:

$$Y_{ijk} = \mu + D_i + P_j + (DP)_{ij} + e_{ijk}$$

Where: Y_{ijk} = the observation of milk production, milk composition, and blood plasma parameters for the ij cows; μ= general mean, common element to all observations; D_i= the fixed effect due to the i^{th} dry period length (i=1, 2, 3, 4, 5 while, 1 ≥ 45, 2= 46-60, 3= 61-90, 4= 91-120 and 5 ≤ 120 days); P_j = the fixed effect due to the j^{th} parity number (j=1, 2, 3, 4 while, 1=2^{nd}, 2=3^{rd}, 3=4^{th}, 4=5^{th} or more parity); $(DP)_{ij}$= the fixed effect of the interaction between the i^{th} dry period length and the j^{th} parity number; e_{ijk}= random error associated with the individual observation and assumed to be (N, IND) and (0, Ϭ2e). Tests of significance for differences between means were carried out according to Duncan (1955).

RESULTS

Milk production

The differences between Least Squares Means (LSM) of cow's milk production due to dry period length and parity number effects were significant (P < 0.001). Cows which dried at 45-60 days before calving had the highest daily and total milk production (29.0 and 8846.2 kg) followed by cows which dried at 91-120 days (28.65 and 8739.7 kg), cows which dried at 61-90 days (28.21 and 8606.0 kg), cows which dried at >120 days (25.78 and 7865.7 kg) then, cows that dried at <45 days (25.36 and 7735.9 kg). Fourth parity cows had the greater daily and total milk production (29.80 and 9089.5 kg) followed by cows at third (27.15 and 8282.4 kg), fifth or more parity (26.19 and 7989.5 kg) then, cows at second (23.40 and 7138.2 kg). The differences between LSM of experimental cow's daily and total milk yield, due to the interaction between dry period length and parity number, were not significant as presented in Table 3.

Milk composition

The differences between LSM of experimental cow's milk composition due to dry period length and parity number effects were significant (*P-value* ranged between 0.05 and 0.001). Milk composition (total solids, fat, protein, lactose and ash) LSM were significantly higher (P < 0.01)

Table 3. Effects of dry period length and parity number on milk production (kg) of the experimental cows during 305 days of lactation.

Items	Dry period length (DP)					Parity number (P)				P-value		
	>45	45-60	61-90	91-120	<120	Second	Third	Fourth	Fifth +	DP	P	DP×P
Number of cows	39	271	107	34	169	287	169	79	85			
Daily milk yield	25.36 ± 1.38^{b}	29.00 ± 2.93^{a}	28.21 ± 2.25^{a}	28.65 ± 1.06^{a}	25.78± 2.47^{b}	23.40 ± 2.35^{b}	27.15 ± 1.69^{ab}	29.80 ± 2.01^{a}	26.19 ± 2.28^{ab}	0.04	0.01	0.08
Total milk yield	7735.90 ± 393.74^{b}	8846.20 ± 135.84^{a}	8606.00 ± 186.08^{a}	8739.70 ± 331.78^{a}	7865.70 ± 142.47^{b}	7138.20 ± 137.34^{c}	8282.40 ± 228.03^{b}	9089.50 ± 303.38^{a}	7989.50 ± 231.80^{b}	< 0.01	<.0.01	0.22

$^{a, b, c}$ Within rows means bearing different superscripts differ significantly at P < 0.05.

in cows dried at 45-60 days and with third and fourth parity number cows. The differences between LSM of experimental cow's milk composition, due to the interaction between dry period length and parity number, were not significant as shown in Table 4.

Blood metabolites

The differences between LSM of experimental cow's blood metabolites (protein fraction, A/G ratio and triglyceride) due to dry period length and parity number effects were significant (P-value ranged between 0.02 and 0.001) except for cholesterol, calcium, potassium and magnesium levels. Experimental cow's blood plasma parameters means was the highest level in cows dried at 45 to 60 days with third and fourth parity number cows. The differences between LSM of experimental cow's blood plasma parameters, due to the interaction between dry period length and parity number, were not significant as obtained in Table 5.

Table 4. Effects of dry period length and parity number on milk composition of the experimental cows.

Items	Dry period length (DP)							Parity number (P)						DP×P
	>45	45-60	61-90	91-120	<120	SEM*	*P-value*	Second	Third	Fourth	Fifth +	SEM*	*P-value*	*P-value*
Total solids, %	11.54^{c}	12.43^{a}	11.85^{b}	12.06^{b}	12.06^{b}	0.12	<.0.01	11.54^{c}	12.24^{a}	12.06^{ab}	11.85^{b}	0.08	0.01	0.08
Fat, %	3.19^{c}	3.51^{a}	3.34^{b}	3.39^{ab}	3.38^{ab}	0.05	<.0.01	3.19^{b}	3.44^{a}	3.39^{a}	3.34^{a}	0.03	0.03	0.23
Fat, kg	123.30^{c}	232.80^{a}	201.20^{b}	222.20^{b}	141.50^{c}	0.14	< 0.01	178.40^{b}	199.43^{ab}	236.03^{a}	166.88^{b}	0.16	0.05	0.35
Protein, %	3.04^{bc}	3.26^{a}	2.94^{c}	3.04^{bc}	3.16^{ab}	0.06	< 0.01	3.04^{b}	3.21^{a}	3.04^{b}	2.94^{b}	0.04	< 0.01	0.06
Protein, kg	117.58^{c}	216.28^{a}	177.11^{b}	199.26^{b}	132.35^{bc}	0.20	0.01	170.01^{b}	186.10^{b}	211.66^{a}	146.90^{c}	0.15	< 0.01	0.09
Lactose, %	4.56^{b}	4.78^{a}	4.72^{a}	4.78^{a}	4.75^{a}	0.03	<.0.01	4.56^{b}	4.75^{a}	4.78^{a}	4.72^{a}	0.02	0.05	0.26
Lactose, kg	176.37^{c}	317.13^{a}	284.34^{b}	313.31^{a}	198.94^{c}	0.16	0.02	255.02^{b}	275.38^{b}	332.81^{a}	235.84^{b}	0.18	0.03	0.55
Ash, %	0.74^{d}	0.86^{a}	0.83^{b}	0.85^{ab}	0.79^{c}	0.01	<.0.01	0.74^{c}	0.82^{b}	0.86^{a}	0.83^{b}	0.01	0.01	0.07

a, b, c, d Within rows means bearing different superscripts differ significantly at P < 0.05.
*SEM - Standard error of mean.

Table 5. Effects of dry period length and parity number on blood metabolites of the experimental cows.

Items	Dry period length (DP)							Parity number (P)						DP×P
	>45	46-60	61-90	91-120	<120	SEM*	*P-value*	Second	Third	Fourth	Fifth +	SEM*	*P-value*	*P-value*
Total protein, g/dl	65.56^{b}	66.70^{a}	66.45^{ab}	66.37^{ab}	65.62^{b}	0.25	<0.01	65.56^{b}	65.99^{ab}	66.70^{a}	66.45^{a}	0.25	0.01	0.54
Albumin, g/dl	31.61^{bc}	32.12^{a}	32.00^{ab}	31.91^{abc}	31.50^{c}	0.13	0.02	30.60^{b}	31.70^{b}	32.12^{a}	32.00^{ab}	0.13	0.02	0.08
Globulin, g/dl	33.95^{c}	34.59^{a}	34.46^{ab}	34.47^{ab}	34.08^{bc}	0.12	<0.01	33.75^{b}	34.27^{ab}	34.59^{a}	34.46^{a}	0.12	<0.01	0.06
A/G ratio	0.93^{a}	0.92^{abc}	0.93^{ab}	0.92^{bc}	0.92^{c}	0.01	0.02	0.93^{a}	0.92^{b}	0.92^{b}	0.93^{a}	<0.01	0.01	0.14
Triglyceride, mg/100 ml	28.57^{b}	28.12^{c}	29.06^{a}	28.94^{ab}	28.72^{ab}	0.11	<.0.01	28.37^{b}	28.83^{ab}	28.12^{c}	29.06^{a}	0.11	<0.01	0.07
Cholesterol, mg/100 ml	158.41	157.95	156.69	153.83	157.81	1.66	0.56	158.22	155.82	157.95	156.69	1.56	0.67	0.12
Calcium, mg/dl	8.86	8.88	8.83	8.88	8.84	0.02	0.74	8.84	8.86	8.88	8.83	0.03	0.68	0.25
Potassium, mg/dl	5.85	5.88	5.79	5.86	5.83	0.03	0.31	5.81	8.85	5.88	5.75	0.04	0.21	0.11
Magnesium, mg/dl	2.49	2.48	2.43	2.56	2.51	0.02	0.12	2.43	2.54	2.48	2.43	0.02	0.08	0.09

a, b, c Within rows means bearing different superscripts differ significantly at P< 0.05.
*SEM - Standard error of mean.

DISCUSSION

Milk production

Cows which dried at 45-60 days before calving had greater milk production during the subsequent 305 days of lactation. Similar results observed by Van Knegsel et al. (2014) who found that omitting or short dry period length (0 or 30 days) of Holstein-Friesian cows reduced milk production compared with a conventional dry period (60 days). Also, Useni et al. (2014) stated that dry period less than 60 days reduced milk yield, while an extended dry period more than 121 days may result in over conditioned dry cows and therefore be costly for the dairy farmer even although milk yield is higher in the next lactation. Steeneveld et al. (2014) showed that 305 days milk production of Holstein Friesian cows was 7685, 9101 and 9753 kg, for cows with 0, 30 and 60 days dry period, respectively, with significant differences (P < 0.05). Shoshani et al. (2014) reported that Israeli Holstein cow's milk yield was affected by dry period length (40 versus 60 days) significantly (P < 0.05); increasing of dry period length caused an increasing of milk yield. Köpf et al. (2014) with Simmental cows showed that milk losses were high (18.49 Euro/cow) in 56 days dry period cows compared with continuous milking and dried off spontaneously cows. Cielava et al. (2015) recorded that milk production of Holstein cows was higher (6801.2 kg/305 days) from cows with the average dry period length of 53.9 days than other cows (0-45 and >61 days). Also, Kok et al. (2017) found that standard dry period length (6-8 weeks) gained the highest milk production in Dutch dairy cows than no (0-2 weeks), short (3-5 weeks) and long (9-12 weeks) dry period length.

Parity number had a significant (P < 0.001) effect on cows´ milk production. Similar results obtained by Mellado et al. (2011) who reported that total milk yield of Holstein cows was 10071, 14470, 14588 and 14680 kg, for cows at <2, 2-4, 4-6 and >6 parity number, respectively and the differences between means of total milk yield due to parity number were significant (P < 0.05). M'hamdi et al. (2012) found that 305 days milk yield of Tunisian Holstein cows was 5412, 5721, 5614, 5417 and 5123 kg, for cows at first, second, third, fourth and fifth parity, respectively and that differences between means of milk production due to parity effect were significant (P < 0.05). Dawod (2012) included that Holstein cows at second-third parity recorded higher milk yield (P < 0.05) than cows at first parity. Atashi et al. (2013) recorded that 305 days milk yield was 8088, 9027, 9254, 9368, 9386, 9329 and 9312 kg, for Holstein cows at first, second, third, fourth, fifth, sixth and seventh parity, respectively and that differences were significant (P < 0.05). Results indicated that increasing of parity number caused an increasing in milk production till the fifth parity then it caused a decreasing in milk production. Shoshani et al. (2014) recorded that average daily milk yield of Israeli Holstein was 38.67 and 41.20 kg, for cows at first and second or parity more, respectively and that differences between average daily milk yield were significant (P < 0.05). Lehmann et al. (2016) found that multiple parity Holstein cows produced 1.6 kg/day more than first parity ones.

Milk composition

Cows which dried at 45-60 days before calving had a higher milk composition. These results agree with results showed by Kuhn et al. (2006) recording that milk fat and protein yields are maximized in the subsequent lactation with a 60 days dry period compared with dry periods of 20 days or less. Kuhn et al. (2007) recorded that milk fat and protein production was maximized in the subsequent lactation with 61 to 65 days dry period length cows. Also, Watters et al. (2008) estimated that fat (3.52 versus 3.45%) and protein (2.83 versus 2.68%) percentages in Holstein cow's milk at traditional 55 days or shortened 34 days dry periods. Madsen et al. (2008) showed that milk protein, fat and lactose percentage of Holstein dairy cows were 3.02, 3.88 and 4.82%, for cows with 60 days dry period; 3.42, 4.01 and 4.90%, for cows without dry period, respectively. As well as, Węglarzy (2009) with <30, 31-60, 61-90 and >90 days dry period, stated that differences in milk protein production between studied groups were statistically significant ($P \leq 0.01$) and fat production in group <30 days dry period was lower by 6.06%, in group >90 days dry period lower by 5.37% , in group 31-60 days dry period lower by 1.01%, protein production in group<30 days dry period was lower by 14.12%, while, in group >90 days dry period and 31-60 days dry period lower by12.84 and 9.78%, respectively. Pytlewski et al. (2009) found that the length of the dry period has a highly significant effect on yields of fat and protein content in Polish Holstein Friesian and jersey cows. Sawa et al. (2012) recorded that Holstein cows dry period of 40-60 days would be the most favorable in terms of milk fat and protein yield, in the next lactation, when compared with cows that had been dry less than 40-60 days, the cows whose calving was not preceded by a dry period had lower lactation yield by (24% for fat and 20% for protein). While, Zadeh and Mohit (2013) reported that Holstein cows within the dry period of 51-60 and 61-70 days had the greater adjusted fat and protein yields ($P < 0.05$). Atashi et al. (2013) found that Holstein cows with the standard dry period length (51 to 60 days) produced more fat and protein percentages over the next lactation compared with those with shorter dry period (0 to 35 and 36 to 50 days). Useni et al. (2014) concluded that milk composition of Holstein cows was affected by dry period length, higher fat and protein percent in the milk from cows with a short dry period (<60 days) than those cows with a long dry period(>120 days). Also, Kok et al. (2017) who concluded that standard dry period length (6-8 weeks) gained the highest milk composition (fat, protein and lactose) in Dutch dairy cows than no (0-2 weeks), short (3-5 weeks) and long (9 to 12 weeks) dry period length.

Third and fourth parity number cows had the greater milk composition than other parities. These results almost agree with those of Santschi et al. (2011) who showed that milk components of Holstein cow's milk were as follow: fat% 3.86 and 3.88%; protein% 3.31 and 3.31%; lactose 4.56% and 4.45%, for cows at second and third parity or more, respectively. The same authors reported that no significant differences between means of milk component, due to parity number of cows. Van Knegsel et al. (2014) noticed that Holstein Friesian cow's milk components (lactose, protein and fat percent) does not affected by parity number of cows except for lactose percent ($P < 0.05$).

Blood metabolites

Cows which dried at 45 to 60 days before calving had higher blood metabolites. Andersen et al. (2005) showed that there were no effects of experimental treatment (dry period length of 60 days versus continuous lactation) on plasma level of calcium ($P = 0.44$). Yamashina et al. (2012) found that Holstein cow's blood plasma total cholesterol and albumin were affected by dry period length ($P<0.01$), total cholesterol was 115.8 and 83.1 mg/dl; albumin was 3.73 and 3.43 g/dl, for cows dried at short (40 days) and traditional (60 days) length, respectively. The same authors observed that blood plasma total protein and calcium were not affected by cows dry period length, total protein was 8.02 and 7.72 g/dl; calcium was 9.5 and 9.5 mg/dl, for cows dried at short (40 days) and traditional (60 days) length, respectively.

Third and fourth parity number cows had higher blood plasma parameters than other parities. Brscic et al. (2015) using Holstein cows, found that blood serum total protein and globulins were 77.1 and 40.9 g/L, for cows at first parity, while, it were 81.3 and 44.3 g/L, for cows at second parity, respectively and differences between means of cows blood serum total protein and globulins due to parity effect were significant ($P < 0.05$). On contrary, Cozzi et al. (2011) found that serum total protein and globulin of Holstein dairy cows were 80 and 43 g/L, for cows at first parity, while it were 83 and 45 g/L, for cows at second parity or more, respectively; with no significant effect of parity on blood serum total protein and globulin of cows.

CONCLUSION

It could be concluded that the optimal dry period length when cows dried at 45 to 60 days to produce more milk production without negative results on milk composition and blood metabolites in the subsequent lactation. It is known that some weeks, before and after calving, are part of the transition period where intense changes in the physiology and metabolism of cows occur. It is a very important period, as it is when the animal gets ready for milk production. Thus, in order to obtain maximum profitability in dairy cattle farming, the animals' dry period

must be considered, as it represents an important success factor in commercial exploitation.

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Conflict of interest

The authors declare that no conflict of interests.

Ethical standards

Humane animal care and handling procedures were conducted in accordance with the Animal Care Committee of the Department of Animal Production, Faculty of Agriculture at Moshtohor, Benha University and with the instructions from the Ministry of Agriculture in Egypt.

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