

EFFECT OF L-TYROSINE DURING EARLY POSTPARTUM PERIODS ON MILK YIELD AND REPRODUCTIVE PERFORMANCE OF FRIESIAN COWS

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ABSTRACT

A total of 24 Friesian cows between the 1st and 3rd parity and average body weight (LBW) of 512.6 ±15.5 kg were divided into three similar groups (n=8 each) based on their BW, parity and milk production of the previous season. Cows of the 1st group (G1) were fed concentrate feed mixture (CFM) (control group). Cows of the 2nd group were received oral dose L-tyrosine 50 g/cow at 21 day (G2) while those of the 3rd group (G3) were received the same dose of G2 but on day 40. Throughout the experimental period, cows were machine milked and daily milk yield was individually recorded for the 1st four months. Milk composition and somatic cell count were determined. Estrus was detection and cows in heat were inseminated. Also, number and length of estrous cycles from calving up to conception were recorded. Postpartum 1st ovulation (PPOI), 1st estrus (PPEI) and 1st service (PPSI) intervals, number of services per conception (NSC), days open (DO) and conception rate (CR%) were calculated. Pregnancy was diagnosed by rectal palpation on day 60 post-insemination.

Results revealed that L-tyrosine treatment improved (P<0.05) daily milk production of G2 and G3 by 15.6 and 16.3% compared to G1. G3 had higher (P<0.05) percentages of fat, protein and lactose as compared to G1 (3.64, 3.07 and 4.16 vs. 3.54, 2.75 and 4.00%), respectively. G2 had higher (P<0.05) percentages of protein and lactose (2.98 and 4.28%, respectively) compared to G1, while fat percentage was similar to G1. Treated cows with L-tyrosine showed lower (P<0.05) somatic cell count in milk as compared to G1.

Postpartum estrous interval was shorter (P<0.05), by 11.5 days in G2 than G1, While, those of G3 showed longer period (+ 8.13 day) than G1. Days open in G2 and G3 cows was shorter (P<0.05) by 21 or 13.2 day, respectively, than G1. Number of services per conception was less (P<0.05) in G2 (1.63) and G3 (2.0) than in G1 (2.6). Conception rate increased (P<0.05) in G2 and G3 compared with those of control (50 vs. 75 and 100%).

Keywords: *Friesian, lactation, L-tyrosine, milk yield, reproduction.*

INTRODUCTION

Use of organic substances is believed having positive effect on animal productivity and reproductive performance through enhancing the release of sex hormones (Gabr, 2009). One of these substances is L-tyrosine, which involves in the catecholamine and thyroxin formation (Hammel and Russe, 1987). In addition it serves as a precursor for the synthesis of dopamine, norepinephrine, and epinephrine and is a specific brain neurotransmitter implicated in the control of GnRH and LH (Ramirez *et al.*, 1984).

Tyrosine may be involved in stimulating GnRH *via* influencing synthesis of norepinephrine (Gibson and Wurtman, 1986 and Acworth *et al.*, 1988), a neurotransmitter that stimulates GnRH release (Ramirez *et al.*, 1984 and Terasawa *et al.*, 1988).

The relationship between tyrosine and reproduction has been reported previously (Gabr, 2009). In dairy cows, tyrosine treatment resulted in expressing estrus within several days in more than 85% of the cows followed by normal estrous cycles (Munsterer, 1987).

In sows, exogenous tyrosine increased LH pulse frequency in growth-restricted lambs (Hall *et al.*, 1992), induced follicular growth, estrus and ovulation in anovulatory dairy cows (Hammerl, 1986 and Munsterer, 1987) and improved expression of estrus (Hammerl and Russe, 1987).

The aim of the present work was to study the effect of post-partum L-tyrosine treatment on milk yield and reproductive performance of Friesian cows during the first four months postpartum.

MATERIALS AND METHODS

The present study was carried out at Sakha Animal Production Research Station, belonging to the Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture and Land Reclamation, Egypt during the period from July to November 2009.

Animals and management:

A total of 24 health Friesian cows with an average of 512.6 ± 15.5 kg body weight (BW), between 28 and 56 months of age and 1-3 parities was used in this study. All cows were chosen at early postpartum period (10 days post calving). At the beginning of the experimental period, the experimental cows were divided into three similar groups, 8 in each. Multiparous cows (n=5 in each group) were divided according to their BW, parity and milk production of the previous season, while primiparous cows (n=3 in each group) were allotted based only on their BW.

Experimental cows were fed according to their BW and milk production. The 1st group (G1) was served as a control, while cows in 2nd (G2) and 3rd (G3) groups were received an oral dose of L-tyrosine (50 g/cow) at day 21 and 40 of postpartum period, respectively. All cows were housed in separately semi-open yards.

Feeding system:

Experimental cows were fed a diet containing concentrate feed mixture, rice straw and corn silage according to the recommendation of NRC (2001) for dairy cows based on their live body weight and milk yield.

Experimental procedures:

Milk yield and composition:

Cows were machine milked twice daily at 6:00 and 17:00 h. Daily milk yield (morning and evening) was individually recorded for the 1st four months of lactation. Milk samples were monthly collected to determine milk composition using Milko-Scan (Model 133B) and somatic cell count (Foss Electronic 360, Slangerupgade, Denmark).

Detection of estrus and insemination:

Beginning of day 10 postpartum, an infertile bull was introduced to cows of each group for 20 minutes three times daily at 6, 12 and 15 h to recognize the onset of the 1st estrus. Estrus was identified when cows showed complete receptivity to the teaser and stood quietly to be mounted. Cows those be recognized to be on heat were artificially inseminated.

Number and length of estrous cycles from calving up to conception were recorded. Postpartum 1st ovulation (PPOI), 1st estrus (PPEI) and 1st service (PPSI) intervals, number of services per conception (NSC), days open (DO) and conception rate (CR%) were calculated. Conception rate was calculated as the proportion of Conceived cows relative to inseminated cows multipliable by 100.

Pregnancy was diagnose by rectal palpation which taken place on day 60 post-insemination.

Statistical analysis:

The obtained data were statistically analyzed using SAS (1990). The significant differences among treatment groups were tested using Duncan's Multiple Range Test (Duncan, 1955). The statistical model was

$$Y_{ij} = U + A_i + e_{ij}$$

Where:

Y_{ij} = Observed traits

U = Overall mean

A_i = Experimental group 1-3 (1= G1, 2= G2 and 3=G3)

e_{ij} = Random error

Conception rate values were statically analyzed using Chi square test.

RESULTS AND DISCUSSION

Milk yield:

L-tyrosine treatment in G2 and G3 increased ($P < 0.05$) daily milk production during the 1st four months of lactation, compared to G1 (Table 1). It is of interest to note that treatment of L-tyrosine on 21 (G2) or 40 (G3) day-postpartum improved ($P < 0.05$) protein and lactose percentages as compared to G1. This however, treatment on day 40 postpartum (G3) affected fat percentage compared to G1. This indicates that L-tyrosine treatment has a positive reflection on the yield of fat and protein (Table 1). Meanwhile it reduces ($P < 0.05$) the somatic cell count.

The present results come in agreement with the findings of Rae and Ingalls (1984) reporting an increase in milk production as a result of tyrosine treatment. This is mostly attributed to the increase in blood supply (Mephram, 1982) and the energy intake of mammary gland cells (Anderson, 1979 and Wurtman, 1982), in addition to its effect on increasing growth hormone via its effect on brain catecholamine's (Martin, 1980). This explanation is supported by the previous findings of Machlin (1973) and Peel *et al.* (1981) who found that administration of exogenous growth hormone increases milk production.

The observed increase in milk protein yield in treated groups may be attributed to elevation in the supply of tyrosine to the mammary gland, to from milk protein (Mephram, 1982).

Table (1): Yield and composition of milk (Mean ± MSE) as affected by time of L-tyrosine treatment as calculated throughout the first 120 day post-partum.

Item	Experimental groups (n=8)			±MSE
	G1	G2	G3	
Average daily milk yield (kg/day):				
Actual milk yield	13.5 ^b	15.6 ^a	15.7 ^a	0.25
4% fat corrected milk	12.6 ^b	14.3 ^a	14.9 ^a	0.22
Milk composition (%):				
Fat	3.54 ^{ab}	3.46 ^b	3.64 ^a	0.038
Protein	2.75 ^b	2.98 ^a	3.07 ^a	0.045
Lactose	4.0 ^b	4.23 ^a	4.16 ^a	0.039
Component yields (g/day):				
Fat	47.8 ^b	54.0 ^{ab}	57.1 ^a	2.94
Protein	37.1 ^b	46.5 ^a	48.2 ^a	4.34
Lactose	54.0 ^b	66.0 ^a	65.3 ^a	3.21
Somatic cell count (10³/ml):	374.56 ^a	296.12 ^b	275.43 ^b	20.4

^a and ^b: Means within the same row with different superscripts are significantly different (P<0.05).

G1= Control, G2= Cows received oral dose of L-tyrosine (50 g/cow) at day 21 of postpartum period and G3= Cows received oral dose of L-tyrosine (50 g/cow) at day 40 of postpartum period.

Reproductive traits:

Data in Table (2) indicated that G2 showed the significantly shorter PPEI and DO, in addition lower NS/C and the highest CR compared to G1 and G3. Except PPEI, which was the longest in G3, the other reproductive traits of G3 came between G1 and G2.

Table (2): Reproductive traits (Mean ± MSE) as affected by time of L-tyrosine treatment throughout the first 120 days post-partum

Item	Experimental groups (n=8)			±MSE
	G1	G2	G3	
Postpartum 1 st estrus interval (day)	38.0 ^b	26.5 ^c	46.13 ^a	1.60
Number of services per conception	2.60 ^a	1.60 ^b	2.00 ^{ab}	0.30
Days open (day)	81.0 ^a	60.0 ^b	67.8 ^{ab}	6.10
Conception rate (%)	50 ^c	100 ^a	75 ^b	-

^a and ^b: Means within the same row with different superscripts are significantly different (P<0.05).

Such trend is in agreement with the results of Hammerl (1986) in which reported higher conception rate (69 %) after treating anestrus cows with L-tyrosine compared to 26% in the control group. This may be due to the involvement of tyrosine in stimulating GnRH release via stimulating synthesis of norepinephrine (Wurtman et al., 1981; Gibson and Wurtman, 1986 and Acworth et al., 1988), and /or neurotransmitter that stimulates GnRH release (Ramirez et al., 1984 and Terasawa et al., 1988).

Ovarian activity:

Results in Table (3) showed that L-tyrosine treatment in G2 and G3 decreased ($P < 0.05$) average number of estrus cases and ovulatory cycles per cow during the ovulatory cycles compared with the control group. On the other hand, the no statistical differences in average number of total ovulations, silent ovulations per cow, ovulatory cycle length during the ovulatory cycles were observed among experimental groups.

The low number of estrus per cow was associated with that exogenous tyrosine treatment induced follicular growth and ovulation in anovulatory dairy cows (Wetzel, 1985; Hammerl, 1986 and Munsterer, 1987).

Table (3): Postpartum ovarian activity and progesterone (P4) concentration of cows in different experimental groups.

Item	Experimental group (n=8)			±MSE
	G1	G2	G3	
Total number of ovulations/cow	4.00	3.00	3.25	0.43
Number of silent ovulations/cow	0.75	0.00	1.00	0.36
Total number of estrus cases	3.50 ^a	2.50 ^b	2.25 ^b	0.29
Number of ovulatory cycles/cow	3.50 ^a	2.25 ^b	2.50 ^b	0.24
Ovulatory cycle length (day)	20.64	21.25	22.67	3.61

L-tyrosine may involve stimulation of GnRH release because availability of tyrosine influences synthesis of norrepenephrine (Wurtman *et al.*, 1981), a neurotransmitter that stimulates hypothalamic GnRH release and pulsatile and preovulatory release of LH from pituitary gland (Ramiez *et al.*, 1984 and Terasawa *et al.*, 1988). The catecholamines may mediate effects of other neurotransmitters and gonadal steroids on release of GnRH (Kalra and Kalra, 1983; Ramirez *et al.*, 1984 and Yen and Vale, 1990).

In conclusion, the present study indicated the beneficial effects of L-tyrosine treatment on day 21 post-partum on milk yield and reproductive performance of Friesian cows during the first four months of lactation.

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تأثير التيروزين على إنتاج اللبن والصفات التناسلية أثناء فترة بعد الولادة المبكرة في الأبقار الفريزيان

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أستخدم في هذه الدراسة 24 بقرة فريزيان متوسط أوزانها 15.5 ± 512.6 كجم وفي الموسم من 1-3. وقسمت إلى ثلاث مجموعات متماثلة (ن=8) كل الأبقار كانت في الفترة المبكرة بعد الولادة. قسمت الأبقار إلى ثلاث مجموعات متماثلة في الوزن وموسم الحليب وإنتاج اللبن للموسم السابق كانت الأبقار في المجموعة الأولى (G1) بدون معاملة (كنترول) وأبقار المجموعة الثانية تم تجريعها عن طريق الفم 50 جم تيروزين لكل بقرة عند اليوم 21 بعد الولادة (G2) في حين أن المجموعة الثالثة (G3) أخذت الجرعة نفسها ولكن عند اليوم 40 بعد الولادة. خلال الفترة التجريبية كانت الأبقار تحلب آليا يوميا وإنتاج اللبن يتم تسجيله علي حدة خلال الأشهر الأربعة الأولى من الحليب. وتم تقدير مكونات اللبن وعدد الخلايا الجسدية. وكذلك كان يتم كشف الشياخ وتلقيح الأبقار الشائعة صناعيا. كذلك تم تسجيل عدد وطول دورات الشياخ من الولادة حتى الحمل بعد الولادة. وفي فترة ما بعد الولادة تم حساب كل من الفترة الفاصلة من الولادة وحتى أول تبويض (PPOI) وأول شياخ (PPEI) وأول تلقيح (PPSI) وعدد التلقيحات اللازمة للإخصاب والأيام المفتوحة (DO) وتم تشخيص الحمل عن طريق المستقيم عند اليوم 60 بعد التلقيح وحساب معدل الحمل. ويمكن تلخيص النتائج المتحصل عليها فيما يلي:

المعاملة بالتيروزين حسنت إنتاج اللبن اليومي للمجموعتين الثانية والثالثة بنسبه 15.6 و 16.3% مقارنة بالكنترول. وارتفعت نسبة كل من البروتين والدهن واللاكتوز في المجموعة الثالثة مقارنة بالكنترول (3.64، 3.07 و 4.16 مقابل 3.54، 2.75 و 4.0%) علي التوالي. وكانت المجموعة الثانية أعلي في نسبة البروتين واللاكتوز (2.98 و 4.28% علي التوالي) بالمقارنة بالمجموعة الأولى، في كانت نسبة الدهن مماثلة للمجموعة الأولى. وأظهرت الأبقار المعاملة بالتيروسين أقل ($P < 0.05$) عدد للخلايا الجسدية في اللبن مقارنة مع الكنترول.

وقصرت الفترة الفاصلة من الولادة وحتى الشياخ في المجموعة الثانية بنسبة 11.5 يوم عن الكنترول، في حين أن المجموعة الثالثة أظهرت فترة أطول (8.13 يوما) عن المجموعة الأولى. وكذلك قصرت فترة الأيام المفتوحة في المجموعتين الثانية والثالثة بنسبة 21 و 13.2 يوم علي التوالي عن المجموعة الأولى. عدد التلقيحات كان أقل معنويا في المجموعة الثانية (1.63) والمجموعة الثالثة (2.0) مقارنة بالكنترول (2.6). وزاد معدل الحمل في المجموعتين الثانية والثالثة بالمقارنة بالكنترول (50 مقابل 75 و 100%).

استنتجت هذه الدراسة أن المعاملة بالتيروزين 50 جم لكل بقرة في اليوم 21 بعد الولادة حسنت إنتاج اللبن والأداء التناسلي للأبقار الفريزيان خلال الأشهر الأربعة الأولى من إنتاج اللبن.

قام بتحكيم البحث

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