Egypt. J. Anim. prod. Vol. 13, No, 2, pp. 123-134 (1973).

Effect of Farm, Parity and Season of Calving on The Shape of The Lactation Curve in Buffaloes

M.T. Ragab[1], **A.S. Abdel Aziz, and A. Kamal**

Department of Animal Production, College of Agriculture, Cairo University

Sets of monthly milk records of 2832 normal lactations of buffaloes collected from nine herds were used to study the effect of farm, parity and season of calving on monthly milk records. A least squares analysis of variance was carried out to calculate the constants needed for drawing lactation curves for each parity and for each season of calving. The results showed statistical evidence that all of the factors studied had influenced the monthly milk yield and consequently the shape of the lactation curve during the first 7 months of the 15-month lactation period. Most of the variability among the monthly milk records was due to farm. Monthly milk yield was stimulated during the autumn to an extent which was independent of the stage of lactation.

The rate of secretion of milk in dairy animals displays definite trends throughout the loctation period. The milk yield increases to a maximum in a few weeks following parturition and tends to decrease thereafter till the animal goes dry. This trend draws a certain curve, namely the lactation curve.

The mean monthly milk yield of the successive months of lactation represent a basic form of a lactation curve associated with a given breed under a specific set of environmental conditions. Many investigations were carried out to study the effect of nongenetic factors on the shape of the lactation curve in cows (Cersovsky 1957, Maymone and Mallossini 1960, Blau 1961, Asker and Bedeir 1961, Tapiay *et al.* 1964, Wood 1969). Parity and season of calving had perhaps the most pronounced effect on the lactation curve. Very few studies have been concerned with buffaloes in the same subject (Ragab 1945, Asker *et al.* 1961, Maymone and Mallossini 1962).

The purpose of this study is to study the effect of farm, parity, and season of calving on the lactation curve of buffaloes as defined by the loci of the means of the monthly milk yield.

(1) Chairman, Meat & Milk Organization, Cairo.

Data

The data used in this study included sets of monthly milk records of 2832 normal lactations of buffaloes with 150-day lactation period or more.

The records were obtained from the buffalo herds of the Meat & Milk Organization during the period from 1964 to 1969 (2130 records), and of the Faculty of Agriculture, University of Cario at Giza (702 records accumulated during the period from 1931 to 1969). The herds of the Meat and Milk Organization were kept in eight farms scattered all over the Delta and Upper Egypt. The data represented nine farms, five parities and four seasons of calving. Buffaloes were milked twice a day, and milk was recordedd daily in kilograms. Some buffaloes were left for suckling three to five months after parturition, and were milked thereafter.

Analysis procedure

A least squares analysis of variance was carried out according to Harvey (1960) to study the effect of farm, parity and season of calving on the monthly milk records up to the 15*th* month of lactation. The following fixed effects linear model was assumed to underly each monthly record.

$$X_{ijklm} = U_m + F_i + P_j + S_k + e_{ijklm}$$

Where,

X_{ijklm} is the m^{th} monthly milk record of the L^{th} buffalo calving in the k^{th} season of the j^{th} parity at the i^{th} farm,

U_m is the overall mean milk yield of the m^{th} month of lactation, and $m = 1,2,..., 15$,

f_i is an effect due to the i^{th} farm, and $i = 1,2,...,9$,

P_j is an effect due to the j^{th} parity, and $j = 1,2,...,5$,

S_k is an effect due to the k^{th} season of calving, and $k = 1,2,3,4$, where

1 = autumn season of calving; from September to Notember, inclusive,

2 = winter season of calving; from December to February, inclusive,

3 = spring season of calving; from March to May, inclusive, and

4 = summer season of calving; from June to August, inculsive,

and e_{ijklm} is a random effect associated with the $ijklm^{th}$ observation and assumed to be random, independent and normally distributed with mean zero and variance. σ_e^2

The overall least squares means and the least squares constants of the monthly milk yield up to the 15 *th* month of lactation were used in computing synthetic means for the monthly milk yield for each parity and for each season of calving, respectively (Abdel-Aziz et al, 1973). The means were utilized in the recent study in drawing respective lactation curves

Results and discussion

Effect of farm, parity and season of calving on monthly milk records

The least squares analysis of variance of the monthly milk records (Table 1) showed that, with few exceptions, farm parity and season of calving had highly significant effects, (P< 0.01) on the monthly milk records during the first 12

TABLE 1.—Effect of farm, parity and season of calving on the monthly milk records.

Month of lactation	Source of variation							
	Farm		Parity		Season of calving		Residual	
	df	Mean square	df	Mean square	df	Mean square	df	Mean square
1	8	438144++	4	36577++	3	19294++	1979	4541
2	8	217798++	4	118701++	3	25311++	1984	3845
3	8	189043++	4	49951++	3	19296++	2187	3420
4	8	87148++	4	31842++	3	10083++	1925	2969
5	8	111606++	4	51805++	3	17437++	2783	2377
6	8	47533++	4	39703++	3	20251++	2793	2279
7	8	25333++	4	20167++	3	23143++	2759	2389
8	8	12170++	4	3227	3	17214++	2696	2400
9	8	10060++	4	2050	3	12883++	2547	2389
10	8	16139++	4	6431	3	23378++	2289	3737
11	8	22957++	4	12974++	3	14689++	1909	2954
12	8	17581++	4	15247++	3	11440++	1483	2791
13	8	2666	4	8365+	3	9574++	466	3189
14	8	6572++	4	5154	3	2737	849	2242
15	8	7221	4	5395	3	5498	610	3819

\+ P < 0.05

++ P < 0.01

months of the 15-month lactation period. Yet, the duration and the trend of the effects were different. There was statistical evidence that the effects of farm and season of calving lasted for the first 12 and 13 months of lactation respectively. Parity exerted its effect only on the first seven months. The last two months of lactation were, in general, not affected by any of the factors studied.

An interesting feature of the analysis of variance was that variances of the milk yield (represented in Table 1 by the residual mean squares) were larger at both ends of the lactation period than they were at the middle in most cases. The proportions of the total variances contributed by the factors studied did not follow the same trend. Table 2 includes the percentages of the total variances of the monthly records which were due to farm, parity and season

TABLE 2.—**Percentages of the total variances of the monthly milk records attributed to farm, parity and season of calving.**

Month of lactation	Source of Variance		
	Farm	Parity	Season of calving
		%	
1	33.17	1.42	0.47
2	21.13	6.61	0.88
3	19.73	2.91	0.71
4	13.13	2.62	00.45
5	13.41	3.75	0.82
6	6.30	3.23	1.08
7	3.25	1.55	1.26
8	1.51	0.0	0.97
9	1.38	0.0	1.08
10	2.03	0.35	2.03
11	3.31	1.11	0.86
12	3.39	1.86	0.83
13	0.0	2.06	1.81
14	3.30	1.02	0.11
15	1.55	0.49	0.31

of calving. The percentages were based on the components of variance calculated from the analysis of variance given in Table 1. The contribution of the three factors studied to the total variance was relatively large in the early stage of the lactation period, and decreased gradually up to the 9 th month of lactation. During the following six months the components of variance were generally low and followed no specific trend. Among all the effects studied most of the variance was contributed by farm. The effect of parity was relatively large at the second of month of lacation where the maximum milk yield was attained.

These results might indicate that with the advance of lactation, milk records were increasingly influenced by factors other than those studied. For example, differences in persistency and changes in the reproductive satus would play a major role only in the later stages of the lactation period.

Least squares constants of the lactation curve

The overall least squares means of the monthly milk yield were used in locating the points of the overall curve of lactation free from the effects of farm, parity and season of calving (Fig. I). Synthetic least sqyares means for the monthly milk yield for each parity and each season of calving were calculated by Abdel-Aziz et al (1973) using the recent data. The synthetic means were then utilized in drawing respective lactation curves. The tangible effects which might influence the lactation curve in the different farms made it rather meaningless to draw a lactation curve for each farm. Furthermore, the effect of farm on the monthly milk yield was not consistent during the lactation period. Farms with greater-than-average means during the early stages of lactation had less-than- average means in the later stages. This could be partially explained by the negative association between maximum milk yield and persistency of lactation reported by Sikka (1950) and by Mahadevan (1951) in cows of different breeds.

Parity

Lactation curves for the first five lactations free of the effects of farm and season of calving are given in Fig.1. The curves became closer and even intercepted with each other at the middle of the lactation period. The sudden increase which occurred towards the tails of most curves could be due to that the buffaloes which contributed to the means of the last months of lactation were a selected group of higher persistency. Records of such animals were included only to allow for seasonal variations to be repeated within the same lactation.

The configuration of the curve of the first lactation was somewhat different from the curves of all other lactations : the peak was lower, the ascending phase was rather long, and the rate of decrease was slow. This could be partly explained by the longer service period of the first lactation (Ragab *et al.* 1956).

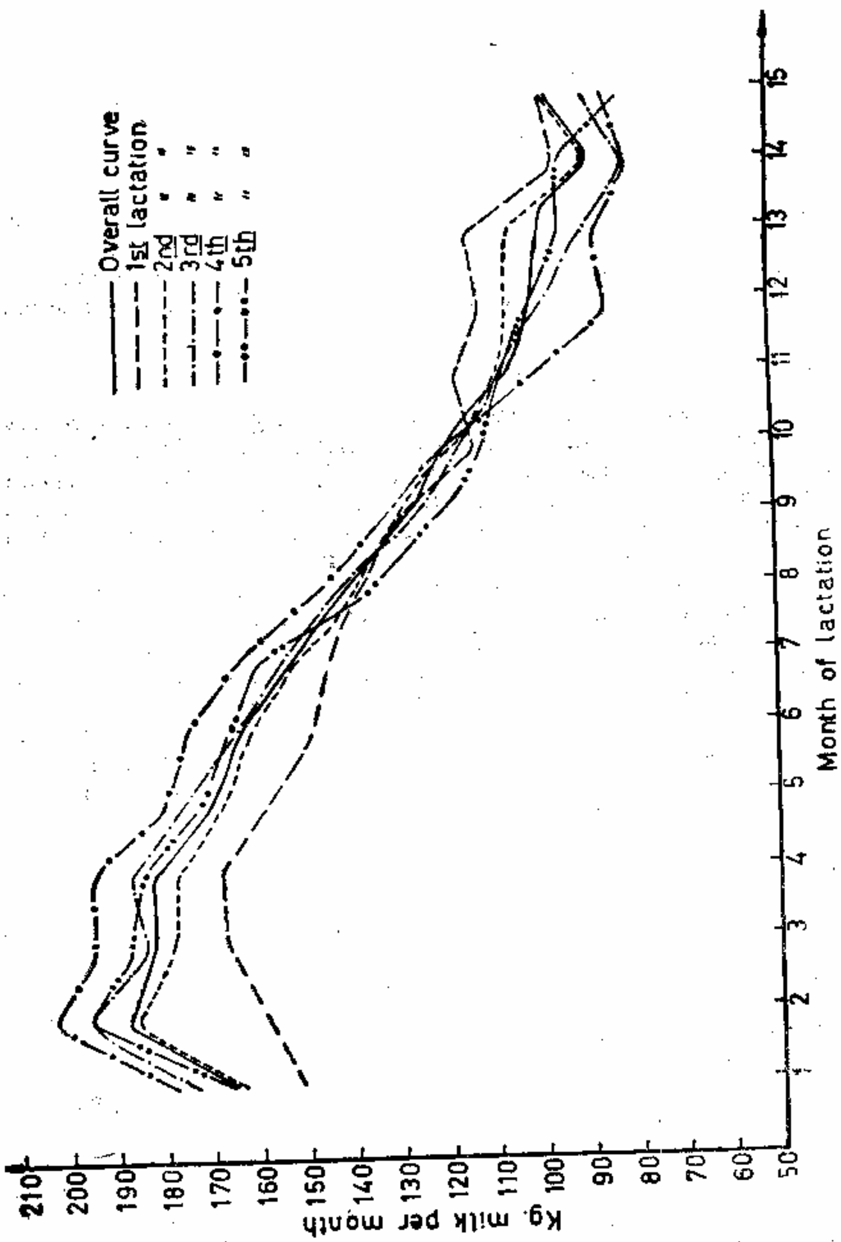

Fig. 1. Lactation curves for the first five lactations (Parities)

Seasonality

Basic forms of the lactation curves associated with each season of calving undisturbed by the effects of farm and parity were presented in (Fig. 2). The seasonality of production may take two forms. The first is the particular stimulus to milk production due to the net effect of the season of the year. This stimulus is a consequence of feeding, management and climate in a given season and shows its influence at any stage of the lactation. The second is that effect due to time of freshening. This effect is usually more pronounced at the early stages of lactation and fades out with the advance of lactation. The use of a 15-month lactation period helped in separa ting the effect due to each of these two forms.

The curve of the autumn calvers was characterized by a higher peak, smoother configuration and rapid decrease at the middle of the lactation period. The rate of decrease became rather slow in the later stages when the autumn stimulus to milk production repeated its effect. Buffaloes calving in autumn had their first and last stages of their lactations when favourable condition prevailed and the pasture was in lush. The lactation curve of the buffaloes calving in winter had a plateau which lasted for three months after the peak was reached. This plateau would occur as a result of the more or less stabilized conditions of feeding and weather. The lactation curves of the spring-and summer-calvers showed dips immediately following the peak of lactation and then tended to climb up to other peaks. This phenomenum could be explained by the stimulus to milk production associated with the autumn season of production.

It was interesting to observe that most of the upward flactuations in the lactation curves were associated with the autumn season of production, independent of the stage of lactation. These flactuations could be referred to as the autumn hump seasonality. Milk yield tended to increase or at least the rate of decrease tended to slow down whenever the autmumn was reached. Since the lactation period continued for 15 months, there was a chance for the autumn season to exert its influence twice in some cases as it was the case in the autmn calvers. A buffalo calving in autumn (September, 1 to November, 30) could reach the autumn months again in a period of nine to 12 months depending on the date of freshening. The duration of the autumn stimulus would last for a maxium period of three months for buffaloes freshening in september. Fig. 3 shows diagramatically the number of months needed to reach the autumn season of production by animals freshenining in different seasons. The month at which the autumn stimulus started was located for each curve by upward arrows in Fig.2 The autumn hump seasonality was more clearly observed in the early stages of lactation. Ali (1972) found that response to the autumn stimulus to milk production depended also on parity. Autumn hump seasonality was observed during the whole lactation in the first lactation, but was confined to the first six months in the second and third actations, and only to the first three months in the subsequent lactations.

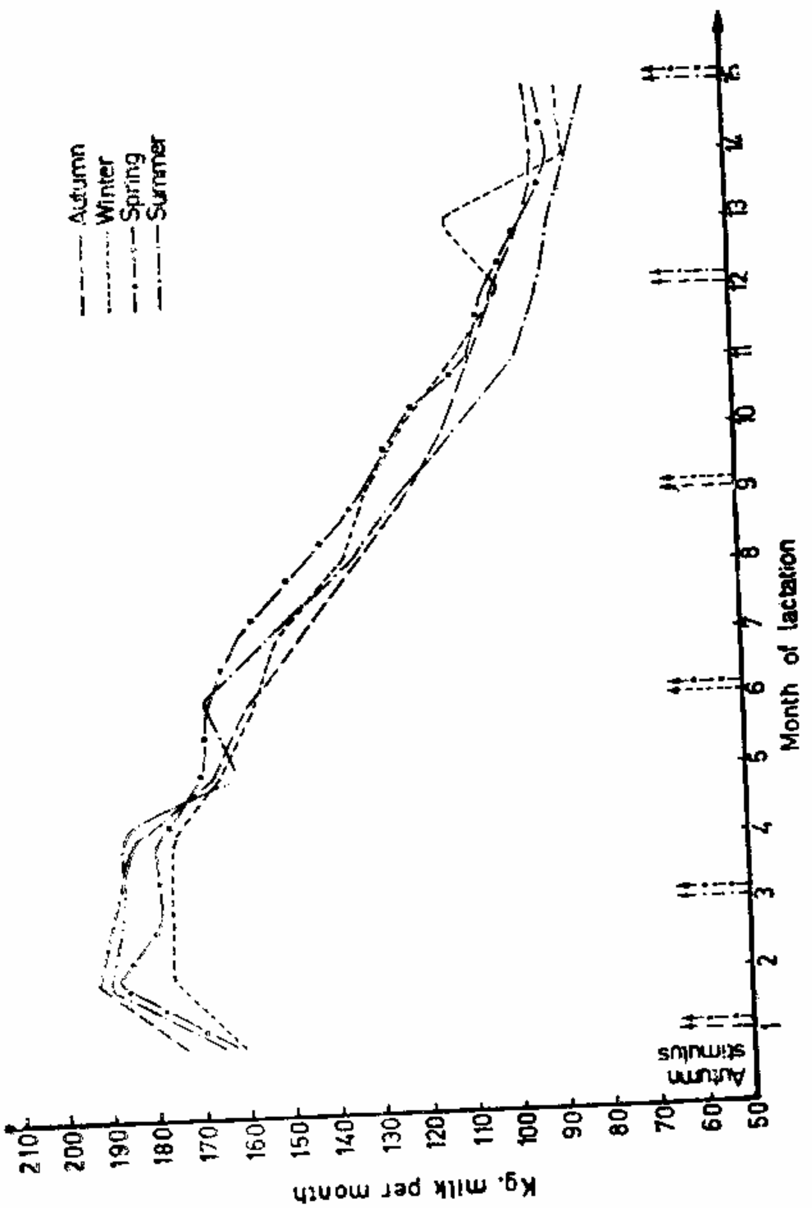

Fig 2. Lactation curves for the different seasons of calving.

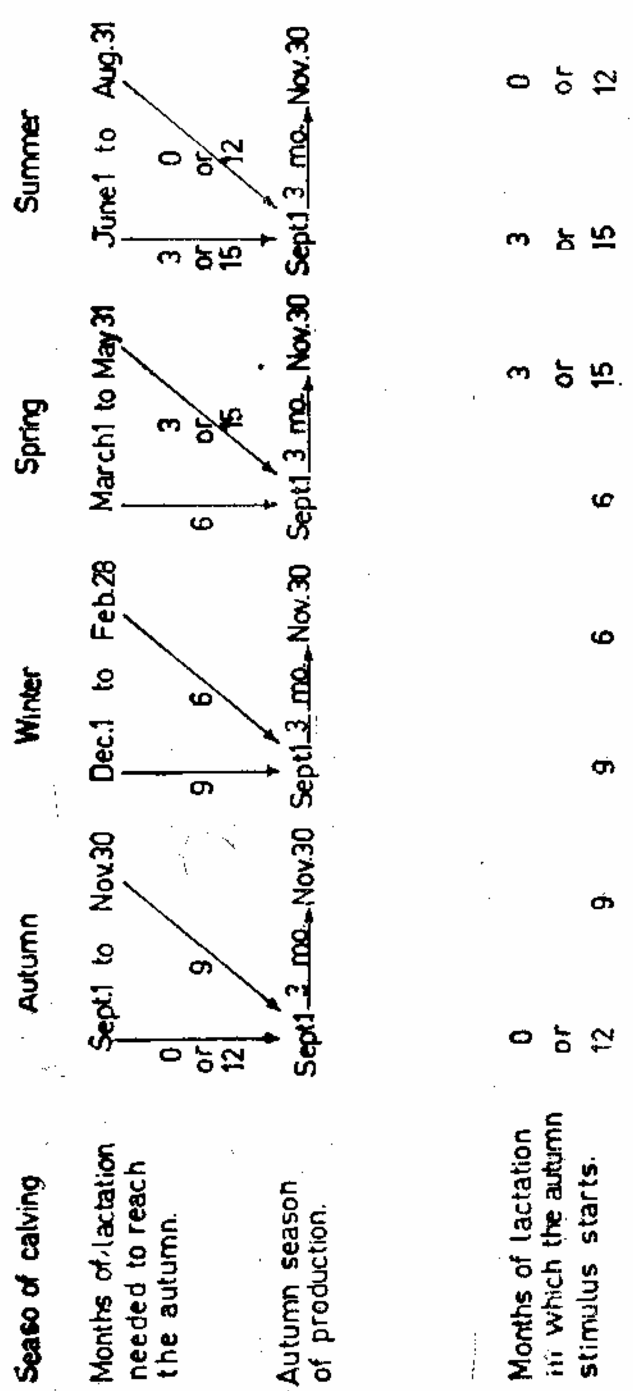

Fig. 3. Number of months needed to reach the autumn season of production by buffaloes freshening in the different seasons of calving.

References

Abdel-Aziz, A.S., Ragab., M.T., and **Kamal, A.** (1973). Regression model of the lactation curve in buffaloes. Proc. 9*th* Conf. of stat and comp. sci., Orman, Giza.

Ali, A.K.A., (1972) Some environmental factors affecting the lactation curve in buffaloes. *M.Sc. Thesis, Univ. of Cairo.*

Asker, A.A., and Miss Bedier, L.H., (1961). Evnironmental factors affecting persistency of lactation in Egytian buffaloes. *J. Agric. Sci.,* **26** : 1.

Blau, G., (1961). Investigations on the course of the lactation curve.

1. Influence of initial yield and lactation number on the shape of lactation cuve and lactation yield.

2. Relationships betw en persistency and lactation yield and the influence of length of lactation and month of calving on the shape of the lactation curve- *Zuchtungsh Unde.,* **33**, 161.

Cersovsky, H., (1957). The significance of the shape of lactation curve in cows. Tiersucht **11**, 185.

Harvey, W.H., (1960). Least squares analysis of data with unequal subclass numbers. ARS-20-8, ARS, USDA, Beltsville, Ma. U.S.A.,

Mahadevan, P., (1951). I. The effect of enveironment and heredity on lactation, II. Persistency of lactation *J. Agric. Sci.* **41**, 88.

Maymone, B., and Malossini, F., 1960). Influence exerted by some factors on the persistency of lactation in cattle. *Ann. Sper. Agr.* **14**, 695.

Maymone, B., and **Malossini, F.,** (1962). Lactation curve in water buffaloes. Abs. Z. *Tievz. Zuncht, Biels.,* **77**, 316.

Ragab, M.T., Asker, A.A., and **Ghazy, M.S.,** (1954). Effect of season of calving, dry period and calving interval on milk yield and lactation period of Egytian buffaloes *Indian. J. Dairy Sci.,* **7** : 8.

Ragab, M.T., Asker, A.A., and **Miss Hilmy. S.A.,** (1956). The relation between some fertility aspects and milk yield in Egyptian buffaloes. *Indian. J. Dairy Sci.,* **9**, 53.

Sikka, L.C., (1950). A study of the persistency in a herd of Ayrshire cows. *J. Dairy Res.,* **11**, 113.

Tapiay, J.E., Barriap., N., Bastidas, B.F., and **Rajas, U.L.,** (1964). Characterisitcs of the shape of the lactation curve in relation to lactation begun in different months of the year and to the ordinal number of lactation. *The ovee calorado* breed. *Boln. Bord. Anim.,* **2**, 121.

Wood, P.D.P., (1969). Factors affecting the shape of the lactation curve in cattle. *J. Animal production,* **11**, 307.

تاثير المزرعة وترتيب موسم الحليب وفصل الوضع على شكل منحنى الحليب فى الجاموس

تاثير المزرعة وموسم الولادة على منحنى الحليب فى الجاموس

محمد توفيق رجب و احمد سعيد عبد العزيز و احمد كمال

مؤسسة اللحوم وكلية الزراعة ــ جامعة لقاهرة

أجريت هذه الدراسة على ٢٨٣٢ سجل حليب موسمى طول كل منهـــا ١٥٠ يوما أو أكثر بعد استبعاد المواسم التى تأثرت باى ظروف غير طبيعية. وقد جمعت هذه السجلات من ٨ قطعان تابعة للمؤسسة العامة للحوم والاليان ومن قطيع كلية الزراعة • وتحتوى هذه السجلات على معلومات انتاج اللبن الشهرى فى الخمس مواسم الاولى من الحليب • حللت السجلات لتحديـــد تاثير المزرعة وترتيب موسم الحليب وفصل الوضع على ناتج اللبن الشهرى الذى قدرت متوسطاته من تحليل التباين بطريقة الحد الأدنى للمربعـــات ثم استعملت هذه المتوسطات فى رسم منحنيات للحليب من المتوسطات العامة ومن المتوسطات المحسوبة لكل موسم حليب وكل فصل للوضع •

وقد أظهر تحليل التباين أن تاثير المزرعة وفصل الوضع على كمية اللبن الشهرى كان معنويا حتى ١٢ ، ١٣ شـــهرا من بداية موســـم الحليب على التوالى بينما أقتصر تاثير ترتيب موسم الحليب على السبعة شهور الأولى من فترة الحليب فقط • وقد لوحظ من النسب المئوية لمكونات التباين أن ٣٥ر٠٦٪ من الاختلافات فى ناتج اللبن خلال الشهر الأول ترجع الى تاثير العوامل الثلاث التى شملتها الدراسة ثم اخذت مساهمة هذه العوامل فى الاختلافات بين الســجلات الشـــهرية للبن تتناقص تدريجيا حتى وصلت الى ٢ر٤٦٪ فى الشهر التاسع ثم لم تتبع نمطا معينا حتى نهاية فترة الحليب• وبين كل العوامل التى شملتها الدراسة ساهمت المزرعة فى الجزء الأكبر من الاختلافات فى ناتج اللبن فى معظم شهور الحليب • أما الاختلافات النـــاتجة عن اختلاف موسم الحليب فكانت أكثر وضوحا فى مراحل الحليب الأولى وخاصة فى الشهر الثانى عندما وصل ناتج اللبن فى معظم المواسم الى اقصاه• وقد كان لفصل الوضع تاثير مستقل عن تاثير آخر يتعلق بالفصـــل من

السنة فقط لوحظ أن الجاموس الذى وضع فى الخريف أعطى منحنى للحليب يتميز بإعلام قمة وبسلاسة الانحدار ، كما لوحظ فى جميع المنحنيات أنه كلما صادف موسم الحليب شهور الخريف (أول سبتمبر حتى آخر نوفمبر) فان المنحنى يبدأ فى الارتفاع أو يقل معدل الانحدار عما كان عليه ، وقد سميت هذه الظاهرة « بالتنبيه الخريفى لانتاج اللبن » كنتيجة لاعتدال الظروف الجوية والغذائية ـ كما سميت البروزات التى لوحظت فى منحنيات الحليب عند بداية فصل الخريف « بالحدبة الخريفية » . قد لوحظ أن معدل إستجابة حيوانات اللبن للتنبيه الخريفى يكون أكثر وضوحا فى المراحل المبكرة من موسم الحليب وفى مواسم الحليب الأولى .