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Evaluation of Milk Production and Litter Milk Efficiency in Two-and Three-Way Crosses of Three Breeds of Rabbits

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MILK yield , litter milk efficiency and lactation patterns for three pure breeds (New Zealand White , NZW ; Californian, Ca ; Chinchilla, Ch) , two breed crosses (NZW XCa & Ca-NZW) and three-breed crosses (Ch x (NZW- Ca) & (Ch x (Ca- NZW) rabbits were evaluated under the Middle Egypt condition . Data were available on rabbits of 410 litters kindled by 98 does during the period from september 1989 till July 1990 .

Breed group , parity and litter size at birth effects contributed significantly in the variation ($p< 0.01$) of milk yield and litter milk effeciency during the suckling period (36 days), while season of kindling or does within breed had non-sigificant effect . Among the purebred rabbits , NZW does produced the greatest amount of milk during the three periods studied (2997 ± 30 g from birth to 21 days , 1283 ± 17 g from 21 to 36 days and 4291 ± 45 from birth to 36 days), followed by Ca does , while Ch does were the lowest in milk production . The average milk yield of the cross does (Two - and three-breed crosses) during the three periods were greater than that of the average milk yield of purebreds . Milk yield of the first and fifth parities were significantly ($p< 0.05$) lower than those of the other parities . Milk yield and litter milk efficiency increased with the increased of litter size at kindling till sex or seven young and decreased thereafter .

Tow breed crosses showed positive individual heterosis for both milk yield from birth to 21 days (74.7g) and from birth to 36 days (118.5 g) . Also, three-breed crosses showed positive superiority for milk yield from birth up to weaning . The crossbred rabbits (Ch x (Ca-NZW) scored the highest superiority percentages for milk yield (12.66 % form birth to 21 days and 12.56 % from birth to weaning) .

Litter milk efficiency was higher in litters reared by NZW does than Ca or Ch does , although the differnce was not-significant. However , litter milk efficiency was significantly higher ($p < 0.05$) in litters reared by three-breed cross does than two-breed cross does . Litters kindling in the fourth parity gave significantly better milk efficiency than those of the other parities .

Milk yield reached its peak at 21, 18 and 15 days post partum for NZW,Ca and Ch does , respectively . The daily milk yield corresponding to the above days were 184 , 167 and 126 g/day , respectively . Milk yield of (Ca x NZW) and (NZW -Ca) does increased to a maximum of 186 and 180 g/day at approximately 21 and 18 days of age , respectively , followed by a sharp decline to the end of sckling period . Similar trend was observed with three-breed cross does.

Key words : Rabbits, Crosses , Milk production , Litter milk efficiency .

In rabbits , the main differences in litter growth and survival rate during the suckling period are partly due to the differences in milk yield produced by the doe . Lukefahr *et al* (1983) found a strong relation between milk production of the doe and both litter size and weight at 21 days of age . They found also that crossbred rabbits had the highest milk production and litter size and weight at 21 days than those rabbits of purebreds . Studies demonstrating the strong influence of milk yield of the doe on pre-weaning growth rate of the litter have been reported by Lebas (1969) and Niehaus and kocak (1973) .

The present study aimed to evaluate three foreign breeds of rabbits and their crosses in terms of production of milk and litter milk efficiency. Effects of parity, season of kindling and litter size at birth on milk production and litter milk efficincy were also studied.

Material and methods

The experimental work was carried out in a rabbit farm at Mansafies , El-Minia Governorate , Epypt , under the supervison of the Department of Animal production , Faculty of Agriclture , Minia University . Three pure breeds of rabbits (New Zealand White , NZW , Califorian , Ca and Chinchilla, Ch) and their crosses during the period from September 1989 till July 1990 were used in this study. During this year of production fourteen does and three bucks from each of the seven genetic groups {(NZW , Ca ,Ch , Ca x NZW, NZW x Ca , Ch x (Ca x NZW) and Ch (NZW x Ca)} were used . Details and description of the breeding plan , management and feeding practices , experimental work and data were reported by Sallam *et al* (1992) . A total of 410 litters kindled by 98 does were produced .

Milk yield of each doe was estimated at 3 days intervals from kindling up to 36 days of age (weaning) using the weight-suckle-weight method described by May and Simpson (1975) and used by Lukefahr *et al* (1983) . On the day before measuring milk yield , the young were separated from their mothers (usually at 9 a.m.) by closing the gate that separates the nest box from the doe compartment. After 24 hours from separation , each litter was weighed to the nearest gram , and the doe was allowed to suckle her litter by opening the gate . The litter was weighed again after suckling and the amount of milk consumed by the young was calculated as the difference between the weight before suckling and that after suckling . This 24 hours amount of milk per doe was multipied by 3 to give an estimate of 3 day milk yield .

Data were analysed using the least squares procedures and the mixed models as described by Harvey (1987) . Doe milk yield (from kindling to 21 days , from 21 to 36 days and from kindling to 36 days) and litter milk efficiency (gain in litter divided by litter milk intake) at the same intervals were analyzed separatly using the following mixed model

$$Y_{ijklmn} = U+B_i + D_{ij} + M_k + P_1 + L_m + (BM)_{ik} + e_{ijklmn} \quad \text{(Model 1)}$$

Where Y ijKlmn = the observation on the ijklmn*th* doe or litter , u = general mean , B_i = fixed effect of the *ith*-breed group, (i = 1,2....,7), Dij = random effect of *jth* doe nested within the *ith* breed group , M_k = fixed effect of the k*th* season of kindling (k= 1,2,3) , P_1= fixed effect of the l*th* parity (1 = 1,2,3,4,5) , L_m = fixed effect of the m*th* litter size at birth (m = 4,5,6,7,8) , (BM) i_k = fixed effect due to the interaction of breed group and season of kindling and e_{ijklmn} = random error particular to the ijklmn *th* lactation and assumed to be independently randomly distributed $(0, \delta^2 e)$.

Lactation patterns for each breed group were fitted using the following mixed model.

$$Z = U+D_j + M_k + P_l + S_n + e_{iklno} \quad \text{(Model 2)}.$$

where Z_{ijklno} = the observation on the jklno *th* litter , D j = random effect of the doe , Sn = fixed effect of the n*th* stage of lactation (each stage comprised three days from kindling up to weaning , *i .e* n = 1,2,3, ...,12) and e_{jklno} = random error particular to the jklno*th* record.The other symbols of the model were as mentioned previously in model 1.

Significant differences among sub-class means were detected using Duncan' s Multiple range test (1955) .

Heterosis and some selected orthogonal comparisons among the different breed groups were estimated .

Results and Discussion

Milk yield

Least squares means and tests of significance of factors affecting milk yield are presented in Table 1 . Breed group significantly ($p < 0.01$) affected mlik yield from birth to 21 days , from 21 to 36 days and total milk yield (from birth to 36 days) . Significant differences due to breed group for milk yield were also reported by Cowie (1969) , Lukefahr *et al* (1983) and Sallam (1990) on different breeds of rabbits .

Among the purebreeds , NZW does produced the greatest amount of milk during the three periods studied , followed by Ca does , while Ch does recorded the lowest milk one . In other words , differences in milk yield between Ch rabbits and either of the other two breeds were significant ($P < 0.05$) for the three periods studied , but the difference between NZW and Ca rabbits was not significant (Table 1) .

TABLE 1. Least squares means ± S.E and tests of significane of factors affecting milk yield.

Classification	Number of litters	Milk yield (g) from: Birth to 21 days L.S.M ± S.E	21-36 days L.S.M ± S.E	Total (0-36 days) L.S.M ± S.E
Overall mean	410	2817 ± 13	1265 ± 7	4073 ± 19
Breed group (B):		**	**	**
Pure breeds:				
Californian (Ca)	58	2846 ± 31 b	1247 ± 17 b	4076 ± 46 b
New Zealand White (NZW)	60	2997 ± 30 ab	1283 ± 17 ab	4291 ± 45 ab
Chinchilla (Ch)	54	2203 ± 31 c	1150 ± 18 c	3323 ± 47 c
Average		2682	1227	3896
Two-breed crosses:				
Ca x NZW	62	3063 ± 29 a	1351 ± 16 a	4383 ± 43 a
NZW x Ca	56	2929 ± 30 ab	1292 ± 17 ab	4221 ± 45 ab
Average		2996	1321	4302
Three-breed crosses:				
Ch x (NZW - Ca)	59	2796 ± 29 b	1252 ± 16 b	4047 ± 43 b
Ch x (Ca - NZW)	61	2887 ± 30 ab	1339 ± 17 ab	4224 ± 44 ab
Average		2842	1295	4136
Season of kindling (M):		NS	NS	NS
Autumn	162	2849 ± 47	1287 ± 26	4123 ± 70
Winter	135	2835 ± 30	1270 ± 17	4102 ± 45
Spring	113	2768 ± 52	1238 ± 29	3992 ± 77
Parity:		**	**	**
1 st	98	2720 ± 51 bc	1227 ± 28 b	3939 ± 75 bc
2 nd	96	2933 ± 41 a	1315 ± 23 a	4234 ± 60 a
3 rd	84	2922 ± 36 a	1314 ± 20 a	4218 ± 54 a
4 th	74	2813 ± 46 ab	1258 ± 26 b	4076 ± 68 b
5 th	58	2699 ± 61 c	1211 ± 34 b	3915 ± 9 c
Litter size at birth:		**	**	**
4 or less	33	2508 ± 44 d	1158 ± 24 c	2654 ± 65 d
5	86	2677 ± 29 c	1217 ± 16 b	3882 ± 42 c
6	173	2843 ± 22 b	1266 ± 13 ab	4100 ± 33 b
7	66	2959 ± 36 a	1319 ± 20 a	4275 ± 53 ab
8 or more	52	3100 ± 39 a	1366 ± 22 a	4453 ± 57 a
Doe within breed		NS	NS	NS
Interaction (B x M)		**	**	**

** = P<0.01 NS = Not significant

a,b,c,d = Means within the same classification followed by different letters differ significantly (P<0.05).

The average milk yield of the does produced crossbred litters (two - and three-breed crosses) during the three periods studied was greater than that of the average milk yield of pure breeds . This may be due to the hybrid vigor and/or the superior maternal ability of crossbred dams . Lukefahr *et al* (1983) with Ca and NZW Straightbred and Ca x NZW and NZW x Ca reciprocal crossbred does , reported that significant heterosis was detected for milk production . They added that maternal breed effects may exist for milk yield of does produced crossbred litters .

Milk yield of the three periods varied significantly ($p < 0.01$) with parity (Table 1). Milk yield of the first and fifth parities were significantly lower than other parities . Does in their second parity produced more milk than those in the other parities (Table 1) . Abo-El-Ezz *et al* (1981) working on Baladi rabbits and their crosses with Chinchilla and Bauscat , stated that the average daily milk yield and peak yield of the second parity were significantly greater than those of the first one . They added that no significant difference was found between milk yield in the second and third parities . The pattern of change in milk yield due to parity effect may be related to the changes in physiological efficiency of the doe which occur with advance in parity especially those related to the udder capacity and ability of the dam to nurse her young .

The effect of season of kindling on milk yield of the three periods studied was non-significant (Table 1) . Milk yield in the autumn was higher than those in the other two seasons (Table 1).

Litter size at birth had significant ($p < 0.01$) effects on milk yield at the three periods studied . Milk yield increased with increasing litter size at birth. Ibrahim (1985) found that litter size at birth in Giza rabbits had highly significant effect on milk yield during the first , second and third weeks of lactation . Also , Cowie (1969) reported that six young per litter were adequate to ensure regulary complete milking . Sallam (1990) reported that milk production in Ca, NZW and Ch rabbits increased with increasing of number of young per litter at brith till six young . Positive correlation between milk production and number of kits (or litter size) was reported by Venge (1963) . Also , Lukefahr *et al* (1983) reported a correlation coefficient of 0.78 between total 21-day lactational yield and litter size at 21 days . Torres *et al* (1979) obtained a correlation of 0.95 between the same two variables at 25 days .

The differences in milk yield at the three periods studied due to doe within breed effects were non-significant (Table 1) . Similar result was obtained by McNitt and Lukefahr . (1990) with Ca, NZW, Palomino and White Satin who reported that doe effect within breed was not important ($p > 0.05$) because the error test source (doe variation within breed) was based on mean lactation values of does for each available lactation record . Breed group x season of kindling interaction was significant ($p< 0.01$) for milk yield from birth to 36 days (Table 1) . Examination of the subclass means revealed that the interaction was due primarily to higher milk produced by " Ch x (NZW- Ca) & Ch x (Ca-NZW) " three breed cross rabbits during April , May and June compared with the other breed groups studied .

Heterosis for milk yield

Heterotic effects on milk yield are shown in Table 2 . Positive individual heterosis was observed for both milk yield from birth to 21 days (74 . 7 g) and from birth to 36 days (118 . 5 g) . Consistant with our results , Lukefahr *et al* (1983) with Ca, NZW and their crosses reported that the crossbred litters exhitied a poitive heterosis for milk yield from birth to 21 days , average heterosis percentage of F 1 does (NZW x Ca & Ca x NZW) being 9.2 % .

The existence of reciprocal differences between Ca x NZW and NZW x Ca crossbred doe groups would suggest differences in maternal characteristics between the NZW and Ca dams that reared the crossbred does , in favor of Ca-NZW does having been reared by NZW straightbred dams . One imprtant aspect of the maternal breed environment supplied by NZW Vs.Ca dams is the substantial difference in milking ability in favor of NZW does (4291 g for NZW vs . 4076 g for Ca) . Bartelli and Altomonte (1968) , using litter 21-day weight as a reflection of milk production , similarly reported NZW does to exceed Ca does in their milking ability. The selected contrasts between crossbred does { Ch x (Ca - NZW or Ch x (NZW-Ca) } and the average of Ch, Ca and NZW purebred does showed positive superiority in milk production at the two intervales studied (Table 2) .

TABLE 2. Estimates of heterosis as selected orthogonal comparisons for milk yield and milk efficiency of rabbits.

Selected orthogonal contrasts	Milk yield (g) from birth to 21 days	Total milk yield (g) from birth to 36 days
Individual heterosis contrast		
1/2[(Ca-NZW+NZW-Ca)-(Ca+NZW)]	74.7	118.5
(Heterosis percentage)	(2.56)	(2.84)
Maternal heterosis contrast		
[(ChxCa-NZW-(ChxNZW-Ca)]	90.6	177.4
orthogonal contrast		
[(ChxCa-NZW)-1/2Ch+1/4Ca+1/4NZW)]	324.4	471.4
(percentage)	(12.66)	(12.56)
\[(ChxNZW-Ca-(1/2Ch+ 1/4 Ca+1/4 NZW)]	233.8	293.6
(percentage)	(9.12)	(7.82)

Litter milk efficiency

Least squares means and tests of significance of factors affecting litter milk efficiency {gain in litter weight form birth to 21 days of age (g) / litter milk intake(g)] during this period are presented in Table 3 . Breed group significantly ($p < 0.01$) affected litter milk efficiency . These findings were similar to those obtained by Sallam (1990) with three purebreds of rabbits (Ca , NZW and Ch) .

Among pure breeds , litter milk efficiency was higher in litters reared by NZW does than those of Ca or Ch does , although the differences were not significant . Similarly , Lukefahr *et al* (1983) reported that litter milk efficiency value was slightly improved in litters reared by New Zealand White vs. Californian dam , although the difference was not significant .

Litter milk efficiency was significantly ($p < 0.05$) higher in litters of three-breed cross than litters of two-breed cross (Table 3). Litters of Ch x (Ca - NZW) and Ch x (NZW - Ca) three - breed cross gave the higher litter milk efficiency compared to that of (NZW x Ca) two-breed cross which was 0.46 (Table 3). Lukefahr *et al* (1983) reported that litter milk efficiency of NZW x Ca crossbreds were superior than either pure breeds (Ca & NZW) or F 1 litters produced by mating of Ca x NZW rabbits .

TABLE 3. Least squares means ± S.E and tests of significance of factors affecting litter milk efficiency in rabbits.

Classification	Number of litters	Litter milk efficiency from Birth to 21 days L.S.M ± S.E
Overall mean	410	0.48 ± 0.003
Breed group (B):		**
Pure breeds:		
Californian (Ca)	58	0.48 ± 0.007 ab
New Zealand White (NZW)	60	0.49 ± 0.007 a
Chinchilla (Ch)	54	0.48 ± 0.007 ab
Average		0.483
Two-breed crosses:		
Ca x NZW	62	0.47 ± 0.006 b
NZW x Ca	56	0.46 ± 0.006 b
Average		0.465
Three-breed crosses:		
Ch x (NZW - Ca)	59	0.49 ± 0.006 a
Ch x (Ca - NZW)	61	0.50 ± 0.006 a
Average		0.495
Season of kindling (M):		NS
Autumn	162	0.50 ± 0.009
Winter	135	0.48 ± 0.006
Spring	113	0.47 ± 0.010
Parity:		*
1 st	98	0.46 ± 0.010 d
2 nd	96	0.48 ± 0.008 cd
3 rd	84	0.49 ± 0.007 b
4 th	74	0.50 ± 0.009 a
5 th	58	0.49 ± 0.010 bc
Litter size at birth:		**
4 or less	33	0.47 ± 0.009 c
5	86	0.46 ± 0.006 c
6	173	0.49 ± 0.005 b
7	66	0.51 ± 0.007 a
8 or more	52	0.49 ± 0.008 b
Doe within breed		NS
Interaction (B x M)		NS

** = significant P<0.01 * = Significant P<0.05
NS = not significant
a,b,c,d = Means within the same classification followed by different letters differ significantly (P<0.05).

Litters kindled in the fourth parity gave better litter milk efficiency compared to those of the other parities . Means given in Table 3 showed a general trend indicating that litter milk efficiency increased ($p < 0.05$) with advancing of parity , attaining the maximum efficiency at the *4th* parity and decreased thereafter . Differences in litter milk efficiency due to parity effects were significant ($p < 0.05$) (Table 3) . Significant differences due to parity effect for litter milk efficiency was also reported by Sallam (1990) on Ch , Ca and NZW rabbits .

Results in Table 3 indicate that litter size at birth had a significant ($p < 0.01$) effect on litter milk efficiency . litter milk efficiency increased with increasing litter size at birth till seven young per litter and declined thereafter (Table 3) . Sallam (1990) reported that litter milk efficiency in Ca , NZW and Ch rabbits increased with increasing of litter size at birth till six young per litter and declined thereafter .

The effect of doe within breed , month of kindling and interaction between breed group and month of kindling on litter milk efficiency were not significant (Table 3) .

Lactation pattern

The patterns of 24 hr. milk yield during suckling period (36 days post partum) of different breed groups are presented in figures 1,2 and 3. Lactation patterns were plotted from least squares means of all pure breeds and their crosses for each 3 days of lactation . Clear curvilinear relationships existed for all breed groups studied. Lukefahr *et al* (1983) reported similar curvilinear trends for the Californian , New Zealand White

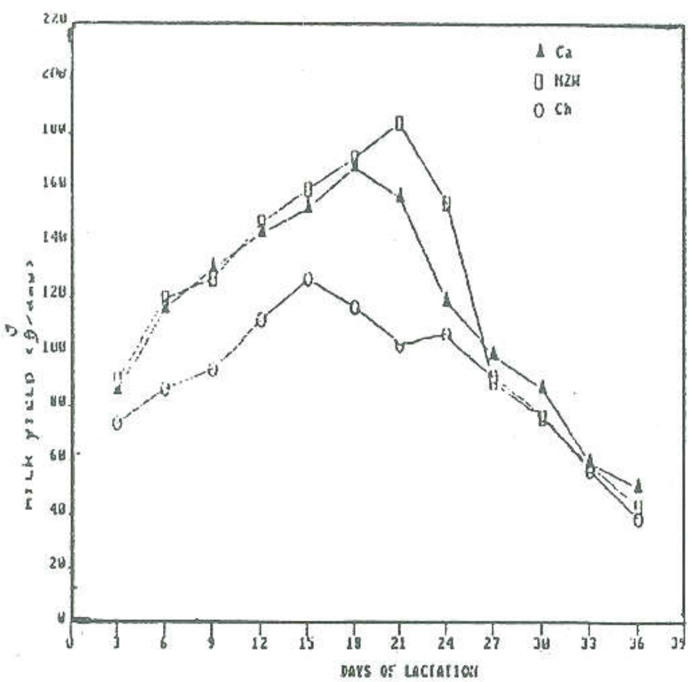

Fig. (1). Milk yield of Californian (Ca), New zealand wilte (NZW) and Chinchilla (Ch) pure breeds rabbits.

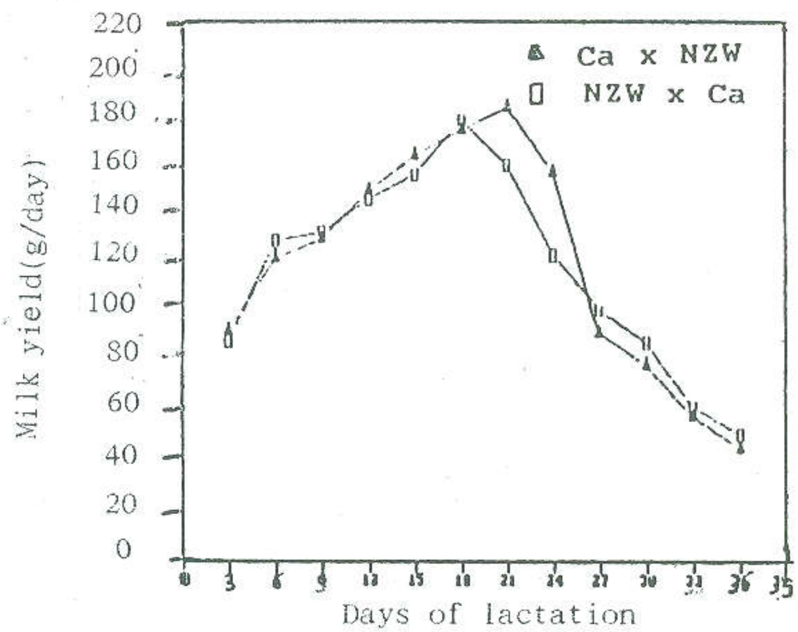

Fig. (2). Milk yield of Ca x NZW and NZW x Ca two-breed crosses rabbits.

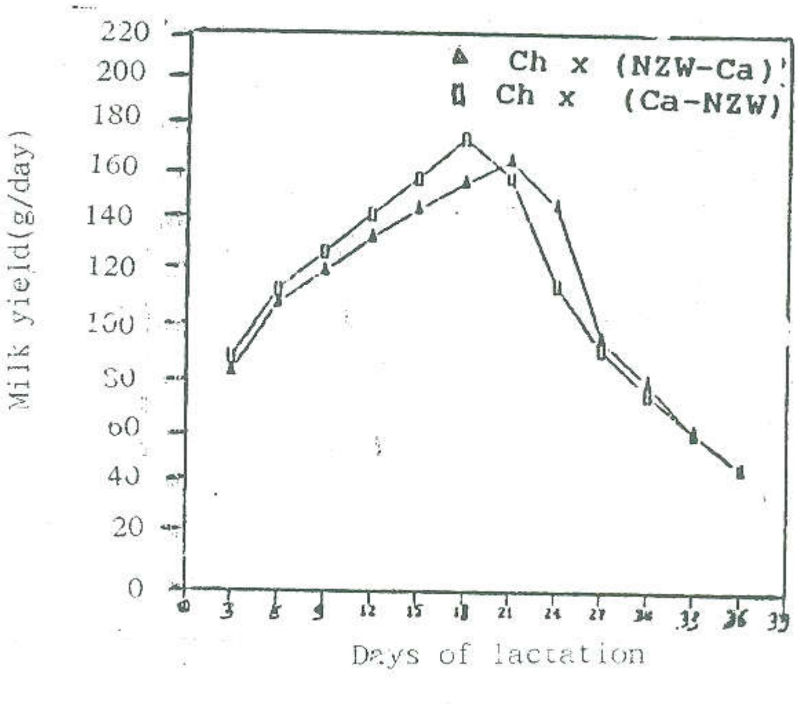

Fig. (3). Milk yield of Ch x (NZW-Ca) and Ch x (Ca-NZW) three breed crosses rabbits.

and their crosses . Recently , McNitt and Lukefahr (1990) came to the same trends for Californian , New Zealand White , Palomino and white Satin breeds.

Among pure breeds (Fig 1) , the NZW does produced more milk than either Ca or Ch does (4291 g vs . 4076 and 3323 g , respctively). The average milk yield of NZW does increased gradually till reaching the peak of lactation (184 g/day) at approximately 21 days followed by a sharp decline up to the end of suckling period . The peak of lactation pattern occurred at approximately 18 days in Ca does (167 g), followed by a sharp decline to the end of suckling period . The maximum daily milk yield for Ch does was attained at 15 days (126 g), decreased gradually thereafter up to the end of suckling period . McNitt and Lukefahr (1990) with Californian , New Zealand White , palomino and White Satin rabbits reported that estimated days in milk at which the paek of the pattern occured is 19.4, 20.6, 18.4 and 21.3 days of lactation and declined thereafter . Ibrahim (1985) reported that milk yield averaged 3999 g in Giza white rabbits throughout the suckling period (4 weeks) and the average milk yield in this breed increased progressively with advancement of days of lactation till reaching the maximum at the third week and declined thereafter . In the study of lebas (1969), involving 143 lactation records of Fauve de Bourgogne does , the peak of lactation curve occured at approximatly 19 days of lactation (240 g) , followed by a sharp decline thereafter up to the 42 days of lactation . Lukefahr *et al* (1983) reported that the NZW does produced more milk than that of Ca does over the entire first 3 weeks lactation period . The peak of lactation pattern occurred at approximately 15 and 21 days in Ca and NZW does , respectively , followed by a sharp decline up to the end of suckling period .

Among tow-breed cross litters (Fig.2) , the average 24 hr. milk yield of Ca x NZW litter increased reaching the maximum at 186 g/day at approximately 21 days , declined sharply thereafter up to the end of suckling period . The peak of lactation pattern in NZW x Ca litters occurred at approximately 18 days (180 g), followed by a sharp decline up to the end of suckling period.

The patterns of 24 hr. milk yield during suckling period for the three-breed crosses (Fig . 3) show a similar trend to those of the two-breed crosses . The peak of lactation patterns in three-breed crosses of Ch x (NZW - Ca) and Ch x(Ca- NZW) occurred at approximately 21 and 18 days, respectively , declined thereafter sharply up to the end of suckling period . Differences in lactation patterns could be attributed to that NZW maternity surpassed Ca maternity .

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تقييم انتاج اللبن وكفاءة تحويل اللبن الى نمو للخليط الثنائى والثلاثى لثلاث سلالات من الارانب

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قسم الانتاج الحيوانى - كلية الزراعة - جامعة المنيا

أجريت هذه الدراسة بهدف تقييم ثلاث سلالات نقية من الأرانب وهى النيوزيلاندى الابيض والكاليفورنيا والشنشلا والهجـن الثنائيـة والثلاثيـة الناتجـة مـن الخلـط بينـها وهـى (نيوزيلاندى x الكاليفورنيا) ، (كاليفورنيا x نيوزيلاندى) ، شنشلا (نيوزيلاندى - كاليفوريا) ، شنشلا x كاليفورنيا - نيوزيلاندى) مـن حيث انتاج اللبن وكفاءة تحويل اللبن الى نمو ومنحيات الحليب .

وقد تم دراسة تاثير كل من مجاميع التربية ، موسم الولادة وتتابع البطون وعدد الخلفة فى البطن عند الميلاد على الصفات المذكورة - وقد تم تنفيذ الدراسة على عدد ٤١٠ بطن منتجة بواسطة ٩٨ أم من المجاميع المختلفة خلال الفترة من سبتمبر ١٩٨٩ وحتى ١٩٩٠ بمزرعة ارانب بقرية منسافيس - محافظة المنيا .

وقد أظهرت نتائج الدراسة مايلى :-

١- وجد أن تاثير كل من مجاميع التربية وتتابع البطون خلال موسم الولادة وعدد الخلفة فى البطن عند الميلاد جوهريا جدا على محصول اللبن خلال فترة الرضاعة (٣٦يوم) - وعلى كفاءة تحويل اللبن الى نمو بواسطة الخلفة (من الميلاد وحتى ٢١ يوم) - بينما كان تاثير موسم الولادة والتاثير العشوائى للأمهات داخل السلالة غير جوهرى على هذه الصفات .

٢-فيما بين السلالات النقية ، انتجت اناث النيوزيلاندى الابيض اكبر كمية من اللبن خلال فترة الرضاعة متبوعة بالامهات الكاليفورنيا فى حين كانت سلالة الشنشلا أقلها . وقد أظهرت الخلفة الناتجة من الأمهات نفس الاتجاه بالنسبة لكفاءة تحويل اللبن الى نمو .

٣- كان متوسط انتاج اللبن للأمهات الخليط الناتجة من خلط سلالتين أو ثلاث سلالات أعلى من متوسط انتاج اللبن للأمهات

النقية وهذا راجع الى قوة الهجين وكذلك تأثير الأم الجيد للأمهات الخليط – وقد تفوق الخليط الثنائى الناتج من خلط ذكور الكاليفورنيا مع اناث النيوزيلاندى الابيض فى محصول اللبن على باقى مجاميع التربية حيث كان انتاجه ٤٣٨٣ جم خلال فترة الرضاعة بينما وجد أن كفاءة تحويل اللبن الى نمو كانت أعلى جوهريا بالنسبة للأمهات الثلاثية بالمقارنة بالثنائية .

٤- أظهرت الأمهات الناتجة من خلط سلالتين قوة خلط موجبة بالنسبة لمحصول اللبن من الولادة وحتى الفطام (٨٤، ٢٪) ، و قد أظهرت النتائج ان الهجين الثلاثى (شنشلا x (كاليفورنيا – نيوزيلاندى) أعطت أعلى قيم قوة هجين لمحصول اللبن حيث سجلت ٥٦ر١٢٪ فى الفترة من الميلاد وحتى الفطام . وقد كان التأثير الأمى على محصول اللبن كبيرا حيث كان ٤ر١٧٧ جم خلال الفترة من الولادة وحتى الفطام .

٥- وجد أن محصول اللبن خلال البطن الأولى والخامسة اقل جوهريا من محصول اللبن للبطون الأخرى وكان اعلى انتاج فى البطن الثانية وقد وجد ان خلفات البطن الرابعة اعطت أحسن النتائج بالنسبة لكفاءة تحويل اللبن الى نمو بالمقارنة بخلفات البطون الأخرى . ووجد كذلك ان انتاج اللبن يزداد بزيادة عدد الخلفة فى البطن عند الميلاد ، بينما وجد أن كفاءة تحويل اللبن الى نمو تزداد بزيادة حجم الخلفة عند الميلاد حتى عدد سبعة أرانب فى البطن ثم يحدث انخفاض بعد ذلك بزيادة حجم الخلفـــة .

٦- قد وصل الانتاج اليومى الى اقصاه عند الايام ٢١، ١٨ ، ١٥ من موسم الادراربمتوسط انتاج قدرة ١٨٤ ، ١٦٧ ، ١٢٦ جم/ يوم لكل من سلالة النيوزيلاندى الابيض والكاليفورنيا والشنشلا على التوالى – ثم ينخفض بعد ذلك انخفاض حاد حتى نهاية فترة الرضاعة عند ٣٦ يوما – فى حين وصل الانتاج الى القمة فـــى الأمهـات الثنائية – كاليفورنيا x النيوزيلاندى الابيض) (النيوزيلاندى الابيض x كاليفورنيا) عند الايام ٢١ ، ١٨ من بداية موسم الادرار بمتوسط قدرة ١٨٦ جم ، ١٨٠ جم/ يوم على التوالى – وقد أظهرت الأمهات الخليطة من ثلاث سلالات نفس الاتجاه السابق .