Table (19) the components of lactation curve for the different parity order groups of crossbred cows.

Traits / Parity	No	Initial milk yield (kg/wk)	Rate of increase to the peak yield (kg/wk)	Rate of decrease from peak yield (kg/wk)	The week of peak yield (weeks)	The peak yield (kg/wk)	Persistency of lactation curve (weeks)
1st	112	40.147	0.575	0.027	22.5	117.31	5.79[a]
2nd	112	37.013	0.589	0.027	28.7	113.55	5.95[a]
3rd	83	40.857	0.568	0.029	20.8	114.95	5.68[b]
4th	51	38.428	0.619	0.029	24.3	119.68	5.90[a]
5th	25	34.631	0.621	0.028	24.6	117.73	5.93[a]
6th	14	44.666	0.506	0.021	23.3	112.45	5.93[a]
7th	5	26.105	0.568	0.020	28.7	107.65	6.40[a]
8th	3	43.954	0.557	0.029	19.1	123.69	5.51[b]
SE		7.042	0.099	0.004	6.156	10.675	0.221
Level of significance		**NS**	**NS**	**NS**	**NS**	**NS**	**S***

Figure (3) lactaion curves of the examined yeargroups calvers

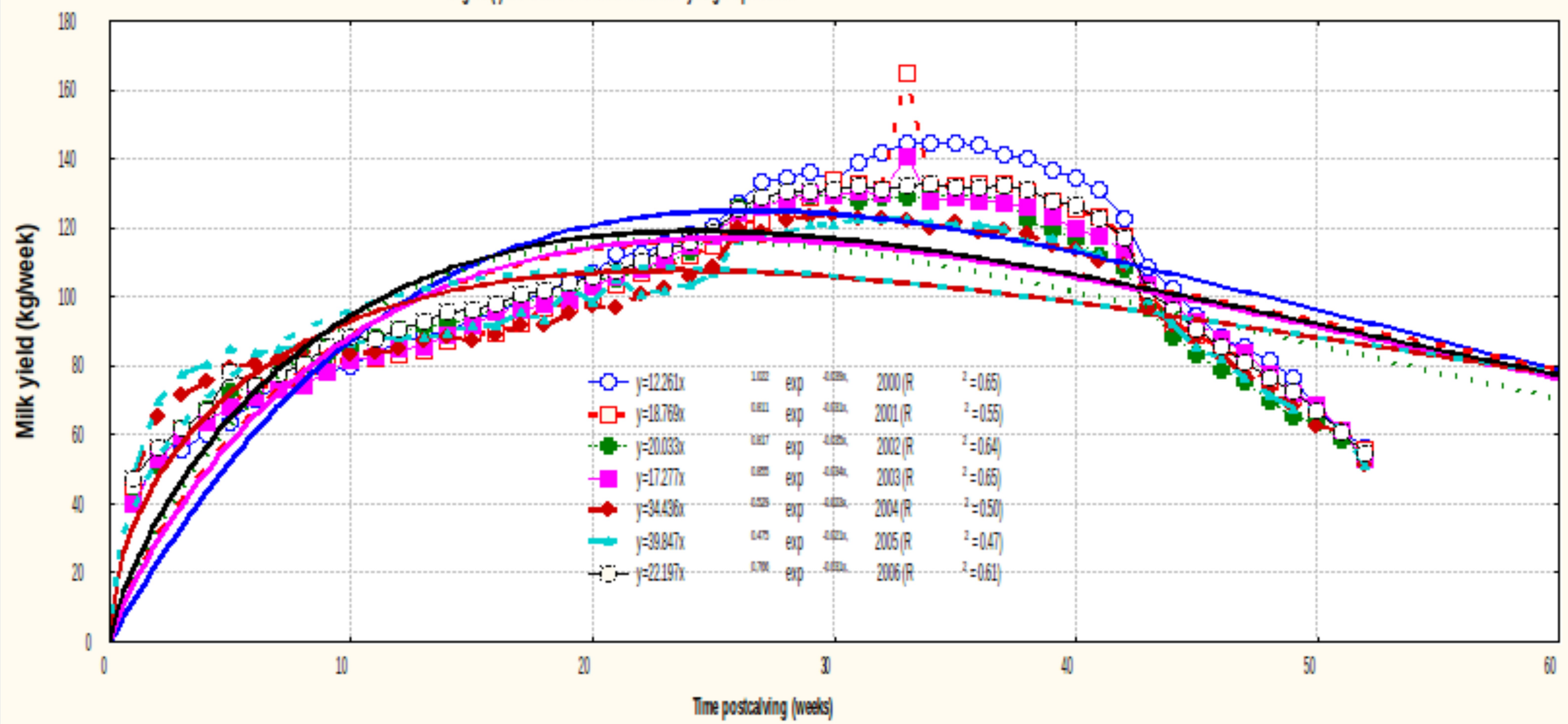
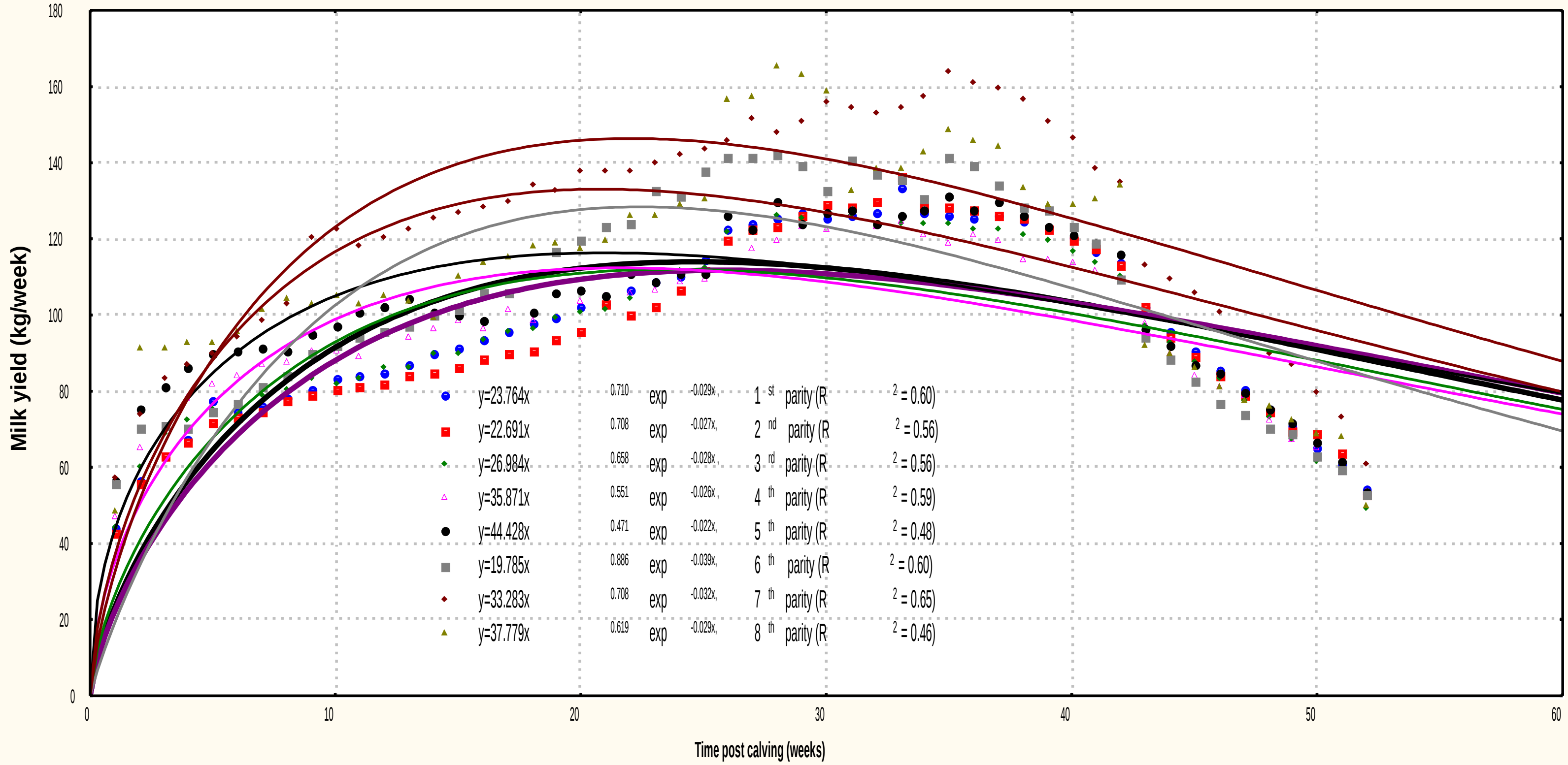


Figure (4) Lactation curves of the examined parity order groups



4.2 Udder measurements:-

The means, standard deviation and coefficient of variation of some udder measurements before and after milking (circumference, length, width, fore udder depth, hind udder depth and udder capacity) were shown in table 19.The results showed that the coefficient of variation of the udder capacity after milking was the highest (27.72%), while the coefficient of variation of the fore udder depth after milking was the lowest (13.12%).

The effect of the lactation stage (early, mid and late) on the udder measurements under study was shown in table 20. The results revealed that the length before milking, length after milking and hind depth after milking were significantly affected by lactation stage, where their values in the early and mid lactation stage were significantly higher than those in the late lactation stage. Moreover, the results showed that lactation stage had no significant effect on circumference before and after milking, width before and after milking, fore udder depth before and after milking, and hind udder depth before milking. Results in table 21 demonstrated that the udder capacity before and after milking and the udder capacity difference (capacity before – capacity after) were not significantly affected by lactation stage.

Table 22 reflected the effect of milking time (morning and noon milkings) on the udder measurements. Circumference before milking, length before and after milking and width before milking were significantly higher at morning milking time. On the other hand, Circumference after milking, width after milking, fore udder depth before and after milking, hind udder depth before and after milking were not affected by milking time. Results in table 23 showed that the udder capacity before milking and udder capacity difference were significantly higher at the morning milking time, while udder capacity after milking was not affected by milking time.

Table 24 and table 25 showed the effect of parity order on the udder measurements studied. The results showed that all the udder measurements and the udder capacity before and after milking were significantly increased with the increase of cows' parity order.

Table (19).Means and standard deviation of some Udder measurements of cross bred cows before and after milking at Kafori dairy farm.

Measurements (number of observations,551)	Mean ±SD	C.V %
Circumference before (cm)	105.32±15.02	14.26
Circumference after (cm)	89.32±4.44	16.17
Width before (cm)	19.29± 3.56	18.46
Width after (cm)	15.27±3.18	20.83
Length before (cm)	44.79±7.43	16.59
Length after (cm)	36.61±6.24	17.04
Fore depth before (cm)	23.70±3.11	13.12
Fore depth after (cm)	22.14±3.43	15.49
Hind depth before (cm)	23.59±3.71	15.73
Hind depth after (cm)	21.48±3.45	16.06
Udder capacity before (cm^3)	1067.12±264.62	24.79
Udder capacity after (cm^3)	808.03±223.99	27.72

SD = Standard deviation.
C.V = Coefficient of variation.

$$\text{Udder capacity} = \frac{\text{fore udder depth} + \text{hind udder depth}}{2} \times UdderLength$$

.(Sid Ahmed and El Barbary, 2000)

Table (20) Udder measurements before and after milking of crossbred cows at Kafori dairy farm during early, mid and late lactation stages.

measures / lactation stage	NO	Circumference before (cm)	Circumference after (cm)	Length before (cm)	Length after (cm)	Width before (cm)	Width after (cm)	Fore depth before (cm)	Fore depth after (cm)	Hind depth before (cm)	Hind depth after. (cm)
Early stage	100	105.4	90.2	20.25[a]	15.92[a]	45.44	37.34	23.28	21.96	23.30	22.37[a]
Mid stage	76	105.3	88.6	19.72[a]	15.60[a]	44.71	36.16	24.11	22.61	24.08	21.49[a]
Late stage	49	105.2	88.6	18.13[b]	14.42[b]	43.59	35.82	23.94	21.78	23.41	20.80[b]
SE		1.82	1.75	0.418	0.377	0.895	0.751	0.374	0.413	0.446	0.409
Level of significance		**NS**	**NS**	**S***	**S***	**NS**	**NS**	**NS**	**NS**	**NS**	**S***

In this table and the following ones:
NO = Number of observations.
S=Significance ($p<0.05$).
NS = Not significant ($p>0.05$).
Early stage = (first 3 months after calving), Mid stage = (3 – 6 months after calving) and Late stage = (after 6 month post calving).

Table (21). Measurements capacity of Udder of crossbred cows at Kafori dairy farm during early, mid and late lactation stages.

measures / lactation stage	NO	Udder capacity before (cm^3)	Udder capacity after (cm^3)	Udder capacity difference (cm^3)
Early stage	100	1070.0	809.73	206.24
Mid stage	76	1085.0	826.32	258.72
Later stage	49	1033.5	776.20	257.31
SE		31.945	27.019	19.294
Level of significance		**NS**	**NS**	**NS**

$$\text{Udder capacity} = \frac{\text{fore udder depth} + \text{hind udder depth}}{2} \times UdderLength.$$

(Sid Ahmed and El Barbary, 2000).

Table (22).Udder measurements before and after milking of crossbred cows at Kafori dairy farm during morning and noon milkings

time	NO	Circumference before (cm)	Circumference after (cm)	Length before (cm)	Length after (cm)	Width before (cm)	Width after (cm)	Fore depth before (cm)	Fore depth after (cm)	Hind depth before (cm)	Hind depth after (cm)
Morning milking	118	110.7	90.9	20.2	15.7	48.3	37.2	23.9	22.3	23.7	21.6
Noon milking	107	99.4	87.5	18.22	14.8	40.9	36.0	23.5	21.9	23.4	21.3
SE		1.315	1.358	0.323	0.297	0.608	0.587	0.294	0.324	0.351	0.325
Level of significance		**S***	**NS**	**S***	**S***	**S***	**NS**	**NS**	**NS**	**NS**	**NS**

Morning milking = 4am.
Noon milking = 11am.

Table (23). Measured capacity of crossbred cows at Kafori dairy farm for morning and noon milkings

measures time	NO	Udder capacity before (cm^3)	Udder capacity after (cm^3)	Udder capacity difference (cm^3)
Morning milking	118	1157.9	824.31	333.58
Non milking	107	967.01	790.07	176.93
SE		23.345	21.129	13.132
Level of significance		**S***	**NS**	**S***

Table (24).Udder measurements before and after milking of crossbred cows at Kafori dairy farm during first 8^{th} parities.

measures parity	NO	Circumference before (cm)	Circumference after (cm)	Length before (cm)	Length after (cm)	Width before (cm)	Width after (cm)	Fore depth before (cm)	Fore depth after (cm)	Hind depth before (cm)	Hind depth after (cm)
1^{st}	12	107.3^{a}	88.8^{a}	19.7^{b}	17.5^{a}	42.8^{b}	32.3^{b}	21.7^{b}	19.2^{b}	21.5^{b}	19.3^{b}
2^{nd}	4	85.5^{b}	81.5^{b}	23.5^{a}	14.5^{b}	36.5^{c}	33.5^{b}	24.5^{a}	22.0^{a}	20.0^{c}	19.0^{b}
3^{rd}	30	93.5^{b}	77.7^{b}	18.1^{b}	14.1^{b}	42.3^{b}	34.1^{b}	21.9^{b}	20.5^{a}	21.0^{b}	18.7^{b}
4^{th}	71	107.6^{a}	89.1^{a}	19.1^{b}	14.9^{b}	46.1^{b}	37.3^{b}	23.7^{a}	22.7^{a}	23.3^{b}	21.9^{a}
5^{th}	40	102.4^{a}	86.6^{b}	18.9^{b}	14.9^{b}	43.9^{b}	36.6^{b}	23.8^{a}	22.1^{a}	24.9^{a}	23.0^{a}
6^{th}	30	112.4^{a}	98.3^{a}	19.1^{b}	15.3^{a}	43.5^{b}	34.6^{b}	23.9^{a}	22.8^{a}	23.4^{b}	21.7^{a}
7^{th}	30	111.0^{a}	96.1^{a}	21.3^{a}	17.2^{a}	46.7^{b}	40.0^{a}	25.8^{a}	23.0^{a}	26.9^{a}	22.3^{a}
8^{th}	8	102.8^{a}	94.0^{a}	17.8^{b}	14.5^{b}	52.3^{a}	42.8^{a}	25.0^{a}	22.5^{a}	22.5^{b}	21.0^{a}
SE		3.668	3.559	0.913	0.811	1.896	1.556	0.779	0.879	0.877	0.852
Level of significance		**S***	**S***	**S***	**S***	**S***	**S***	**S***	**S***	**S***	**S***

Table (25). Measured capacity of crossbred cows at Kafori dairy farm for 8th parities.

measures / parity	NO	Udder capacity before (cm^3)	Udder capacity after (cm^3)	Udder capacity difference(cm^3)
1st	12	926.50[b]	621.00[b]	305.50[a]
2nd	4	814.75[c]	686.75[b]	128.00[b]
3rd	30	908.47[b]	665.60[b]	242.87[a]
4th	71	1084.6[a]	841.65[a]	243.00[a]
5th	40	1073.7[a]	826.32[a]	247.38[a]
6th	30	1034.2[b]	783.27[a]	250.93[a]
7th	30	1252.3[a]	930.53[a]	321.80[a]
8th	8	1239.6[a]	927.00[a]	312.63[a]
SE		67.182	57.109	43.203
Level of significance		**S***	**S***	**S***

Table (26) represented the simple regression of the pooled values of milk volume on the udder measurements before milking. The results showed that the regression of milk volume on udder circumference, width, length, hind depth, and udder capacity were significant, the highest coefficient of determination for the udder length (r^2 = 0.43) indicated higher goodness of fitting for its regression with milk volume.

Table (27) represented the simple regression of milk volume on the udder measurements differences. The results showed that the regression of milk volume on all udder measurements differences were significant and the highest coefficient of determination for the udder length difference (r^2 = 45) indicated higher goodness of fitting.

The multiple regression of the milk yield on the udder measures before milking (Table 28) showed 0.47 coefficient of determination and only the regressions milk volume on udder length and circumference were significant. In this multiple regression the higher regression coefficient (b) was observed for the udder length 0.291.

Table (26). Pooled simple regressions of produced milk volume (kg) on the examined udder measurements (cm) before milking.

Udder measurements	NO	a	B	SE of b	SE of estimate	R^2	Level of significance
Circumference	225	89.35	2.61	0.32	13.23	0.23	S*
Width		16.39	0.48	0.08	3.32	0.13	S*
Length		34.03	1.76	0.14	5.64	0.43	S*
Fore depth		22.89	0.13	0.08	3.10	0.01	NS
Hind depth		22.35	0.20	0.09	3.67	0.02	S*
Udder capacity (cm^3)		765.68	49.36	5.54	227.71	0.26	S*

Table (27) pooled simple regressions of produced milk volume on some of udder measurements (circumference difference, width difference, length difference and udder capacity difference).

Udder measurements	NO	a	B	SE of b	SE of estimate	R^2	Level of significance
Circumference difference(cm)	225	3.989	0.132	0.016	2.419	0.23	S*
Width difference(cm)		5.396	0.177	0.073	2.719	0.03	S*
Length difference(cm)		3.400	0.331	0.024	2.038	0.45	S*
Udder measured capacity difference(cm^3)		3.266	0.011	0.001	2.125	0.40	S*

In this table and the following ones:
a = intercept value of the regression
b = regression coefficient
R^2 = coefficient of determination.

Table (28) Pooled multiples regressions of produced milk volume on some of udder measurements (circumference difference, width difference and length difference).

Udder measurements	NO	a	B	SE of b	SE of estimate	R^2	Level of significance
Intercept	225	2.955			2.019	0.47	
Circumference difference(cm)			0.036	0.017			S*
width difference(cm)			0.048	0.056			NS
length difference (cm)			0.291	0.029			S*

5- Discussion

5.1-Total milk yield:

The total milk yield of crossbred cows Kafori dairy farm in the recent study is 5078.47± 1366.24 kg, with coefficient of variation 27 %. This result was higher than 5328.85 ± 152.62 lb that reported by Ishag (2000) for Friesian x Sudanese indigenous dairy cows (Kenana and Butana) having 62.5 % Friesian blood. The result was also higher than 4225 ± 160.6 kg that reported by Kabuga and Agyemang (1984) for Friesian in the humid forest of Ghana.

The result of the recent study was higher than (1709.49± 892.09 kg) reported by Badri (2008) for Butana dairy cows in the Sudan. It also higher than 1358.91 ± 819.30 kg that reported by Saeed et al. (1987) for Kenana dairy cows in Um-Banein research station in the Sudan. Abubaker et al. (1987) found lower result (4281 ± 1891 kg) for Friesian cows in Columbia. The result in the recent study was lower than 9046 kg that reported by Wade et al. (1990) for Holstein Friesian in different States of America.

The higher coefficient of variation (27%) of this trait revealed the high discrepancy level between observations.

Season of calving in the present study had no significant ($p > 0.05$) effect on the total milk yield. This result agreed with that reported by Yousif et al. (1998) for crossbred dairy cows in the Sudan, Badri (2008) for Butana dairy cows and Saeed et al. (1987) for Kenana dairy cows at Um-Banein research station. Year of calving in the present study had no significant ($p>0.05$) effect on the total milk yield. This result agreed with Dhumal et al. (1989). They noted that the year of calving had no significant effect on total milk yield in Red Kandhari and Jersey x Red Kandhari crossbred cows. No effect of season and year of calving on the total milk yield could be attributed to the best management practices such as good feeding system and health care in the Kafori dairy farm.

Analysis of variance in the present study showed that the parity order significantly ($p<0.05$) affected the total milk yield. The milk yield was significantly increased with the increase in lactation number until in reached maximum yield at seven parities, and then it decreased. Yousif et al. (1998) found that the parity order has significant effect on the total milk yield in crossbred dairy cows in University of Khartoum Farm, but the maximum milk yield was reached in the fifth lactation number. Similar result was reported by Badri (2008) for Butana dairy cows at Atbara research station and Saeed et al. (1987) for Kenana dairy cows at Um- Banein research station in the Sudan. The later authors reported that the maximum total milk yield reached in six lactation number. The recent study was in disagreement with that reported by Dhumal et al. (1989) for Jersey x Red Kandhari crossbred dairy cows and Bhatnager et al. (1986) for Karan- Swiss and Karan- Friesian crossbred dairy cows. They reported that no significant differences were found among cows of different parity order. The effect of parity order may be attributed to the developing of the mammary gland with advance of parity order.

5.2. Lactation length:

According to Bath et al. (1985) the accepted standard length for lactation records is 305 days. The lactation length in the present study is 389.22 ± 42.81 days with coefficient of variation 11%. Similar result (293 ± 12 days) was reported by Ageeb (2001) for crossbred in the Sudan. This result was higher than 248.4 ± 91 days that reported by Badri (2008) for

Butana dairy cows, 183 ± 40 days that reported by Abdalla et al. (1990) for Kenana dairy cows.

Lactation length of the crossbred in Kafori dairy farm in the present study was not significantly ($p>0.05$) affected by season of calving. Similar results were obtained by Ageeb and Hiller (1991) for Friesian x Butana and Frisian x Kenana crossbred dairy cows in the Sudan, Osman (1972) for the Sudanese indigenous dairy breeds, Yousif et al. (1998) and Ishag (2000) for Friesian x Kenana crossbred dairy cows, Kiwuwa et al. (1983) for the indigenous and crossbred dairy cows at Asela station in Ethiopia.

Lactation length of the crossbred dairy cows in the present study was insignificantly ($p>0.05$) affected by the year of calving. This result is matching with that reported by Ishag (2000) for Sudanese crossbred dairy cows, Badri (2008) for Butana dairy cows and Saeed et al. (1987) for Kenana dairy cows. The result is in disagreement with that reported by Musa (2001) who observed a significant effect of year of calving on the lactation length. Ageeb (2001) and Fadlel-Moula (1994), also observed significant effect of year of calving on the lactation length of Sudanese crossbred dairy cows.

Analysis of variance in the present study showed that the lactation length of crossbred Kenana X Friesian caws were not ($p>0.05$) affect by the parity order. Similar results were reported by Yousif et al. (1998) for crossbred dairy cows and Badri (2008) for Butana dairy cows at Atbara research station. On the other hand, this result was in disagreement with that reported by Fadlel- Moula (1994) for Kenan crossbred dairy cows with 37.5, 50 and 62.5 % foreign blood and Kiwuwa et al. (1983) for indigenous and crossbred dairy cows at Asela station in Ethiopia.

The insignificant effect of season, year of calving and parity order on the lactation length of crossbred caws at Kafori dairy farm could be attributed to the best and modern managing system in the farm, which is resulting in less stress of season and year of calving and parity order on the lactation length of the cows.

5.3-The persistency index:

The overall mean of persistency index of milk yield in the present study was 61.25 ± 9.26% with 15 % coefficient of variation. Comparable result was obtained by Badri (2008) who reported that persistency of Butana dairy cows was 75.16 ± 48.58% in the Sudan. On the other hand, this result was lower that 77.6 % that reported by Ponižil (1989) for Czech Pied (CP).

Regarding to season of calving, the analysis of variance in the present study showed that milk persistency was not affect by the season of calving. Similar result was reported by Fadlel-Moula (1994) and Badri (2008) for Friesian x Kenana crossbred and Butana dairy cows in the Sudan, respectively. Contradictory result was reported by Ishag (2000) who found that season of calving had significant effect in the milk persistency of Friesian x Kenana crossbred cows in the Sudan.

The present study showed that milk persistency of crossbred dairy cows was significantly ($p<0.05$) affected by year of calving. Similar results were reported Fadlel-Moula (1994) for Sudanese crossbred dairy cows. This result was in disagreement with findings of Badri (2008) and Ishag (2000). They reported that year of calving had no significant effect on the milk persistency of Butana and crossbred dairy cows in the Sudan, respectively.

Milk yield persistency in the present study was not significant affected by parity order. Similar results were reported by Badri (2008) and Chase .((1993

This result was in disagreement with that reported by Ishag (2000) and Fadlel-Moula (1994) for crossbred dairy cows in the Sudan.

5.4-Lactation curve components:

5.4.1-Initial milk yield:

The initial milk yield in the present study was 38.89 ± 23.84 kg/week with 61% of coefficient variation. Similar result 43.38± 1.58 kg/week was reported by Fadlel-Moula et al. (2007) for crossbred dairy cows in the Sudan. This result was higher than 21.02 ± 20.16 that reported by Badri (2008) for Butana dairy cows in the Sudan.

Analysis of variance in the recent study showed that the initial milk yield significantly ($p<0.05$) affected by season of calving. Dry summer in the present study showed higher initial milk yield that winter and wet summer. Similar result was reported by Ariek (2003) who found that season of calving had significant effect on the initial milk yield in Butana dairy cows. The author showed that the significant increase in the initial milk yield was in the wet summer than the other seasons. Contradictory results were reported by Badri (2008) and fadlel-Moula et al. (2007) for Butana and crossbred dairy cows in the Sudan, respectively.

Year of calving in the present study did not affect the initial milk yield significantly ($p < 0.05$). This result was in disagreement with that reported by Badri (2008), Ariek (2003) for Butana dairy cows and Fadlel-Moula et al. (2007) for crossbred dairy cows in the Sudan.

Analysis of variance in the present study showed that parity order had no significant ($p>0.05$) effect on the initial milk yield. The maximum initial milk yield was in 6th lactation order. The result was in disagreement with Badri (2008) and Ariek (2003) those reported significant effect of parity order on the initial milk yield. They reported that the initial milk yield reached its maximum value in 2nd and 7th lactation number, respectively. While Fadlel-Moula et al. (2007) reported that the initial milk yield reached the maximum in 5th lactation number in the Sudan.

5.4.2-The rate of increase to the peak yield:

The mean of rate of increase to the peak yield in the present study is o.584 ± 0.334 kg/week with 57% coefficient of variation. Comparable result (0.45 ± 0.23 kg/week) was reported by Fadlel-Moula et al. (2007) for Friesian x Kenana dairy cows. The present result was lower than 1.07 ± 0.54 kg/week that reported by Badri (2008) for Butana dairy cows.

Season of calving in the present study did not ($p>0.05$) affect the rate of increase to the peak yield. Similar result was observed by Badri (2008) and Ariek (2003) for Butana dairy cows and Fadlel-Moula et al. (2007) for Sudanese crossbred cows in the Sudan. However, Mehto et al. (1980) and Pandey (1990) found that season of calving had significant effect on the rate of increase to the peak yield. They also reported that the dry summer had higher rate of milk increase to the peak yield than other seasons.

Analysis of variance in the present study also showed that year of calving did not affect significantly ($p>0.05$) the rate of increase to the peak yield. Similar results were reported by Fadlel-moula et al. (2007) and Ariek (2003) for crossbred and Butana dairy cows, respectively. Similar results also were reported by Madalena et al. (1979) and Mehto et al. (1980). The result is in disagreement with that reported by Badri (2008) for Butana dairy cows in the Sudan.

Parity order of crossbred dairy cows in present study did not ($p>0.05$) affected the rate of increase to the peak yield. Similar results were reported by Fadlel-Moula et al. (2007) for Friesian x Kenana dairy cows and Badri (2008) for Butana dairy cows.

5.4.3-The rate of decrease to the peak yield:

The over all mean of rate of decrease from the peak yield in the present study is 0.027± 0.015 kg/ week with coefficient of variation 56%. Comparable result (0.0214 ± 0.0042 kg/week) that reported by Woods et al. (1980) for Friesian cows. However, this result was higher than 0.0112 ± 0.0047, 0.012 ± 0.0041 and 0.0024 ± 0.0012 kg/week for Aryshire, Jerensey and Jersey cows that reported by Woods et al. (1980). the present result was also lower than 0.09 ± 0.05 kg/week that reported by Badri (2008)

Analysis of variance in the present study showed no significant ($p>0.05$) effect of season of calving on the rate of milk decrease. Similar results were reported by Ariek (2003) and Badri (2008) for Butana dairy cows and Fadlel-Moula et al (2007) for crossbred cows in the Sudan.

Year of calving in the present study did not affect ($p<0.05$) the rate of milk decrease from the peak yield. Similar result was found by Ahunu and Kabuga (1994). They found that the year of calving did not affect the rate of decrease from the peak yield for Friesian x Haryana crosses. Contradictory results were reported by Fadlel-Moula et al. (2007), Badri (2008) and Ariek (2003) for crossbred and Butana dairy cows in the Sudan.

Analysis of variance in the recent study showed that the parity order did not .affect significantly ($p>0.05$) the rate of decrease from the peak yield Similar result was reported by Ariek (2003) who found that the (c value) was not affected by parity order in Butana dairy cows. The significant effect of parity order on the rate of decrease from the peak yield was revealed by Fadlel –Moula et al. (2007) and Badri (2008). They reported that c value was .increasing with the parity order increase

5.4.4-The week of peak yield:

The mean of week of peak yield in the present study was 24.43 ± 20.99 weeks with 86% coefficient of variation. This result was higher than 11.95 ± 4.42 weeks that reported by Badri (2008), 9.04 ± 3.09 weeks that reported by Fadlel-Moula et al (2007) and for Butana, dairy cows in the Sudan.

The statistical analysis showed that the week of peak yield was not affected by season of calving. Similar results were reported by Badri (2008), Fadlel-moula et al (2007) and Ariek (2003). They found that summer calvers reached the maximum yield at significantly later time than other season's calvers. El-Sharif (2002) reported that time taken to reached peak yield was higher in winter calvers than summer calvers in Kenana x Friesian crossbred cows.

Year of calving in the current study did not show significant ($p>0.05$) effect on the week of peak yield. Similar observation was reported by Fadlel-Moula et al (2007), Ahunu and Kabuga (1994) and Ariek (2003) for crossbred cows in the Sudan, Holstein Friesian and Butana dairy cows. Contradictor results were reported by Badri (2008), Bhutia et al (1988) and Garcha and Tiwana (1980).

Statistical analysis in the recent study showed that week of peak yield was not affected significantly ($p>0.05$) by parity order. Similar results were also reported by Ahunu and Kabuga (1994), Madalena et al (1979) and Fadlel-Moula et al (2007). They reported that parity order was not affected the week of peak yield. Whereas, Badri (2008), Ariek (2003), Biradar (1990) and Keown et al (1986) found that parity order had significant effect on the week of peak yield.

5.4.5-The peak yield:

The overall mean of the peak yield in the present study was 115.87 ± 36.00 kg/week with 31% coefficient of variation. This result was higher than 70.67± 21.57 kg/week, 79.49 kg/week and 50.6 kg/week that reported by Badri (2008), Fadlel-Moula et al (2007) and Ibeawuchi and Okoro (1980) for Butana, crossbred and Friesian x Fulani crossbred cows, respectively.

Season of calving in the current study did not affect ($p<0.05$) the peak yield of crossbred cows. Similar results were reported by Fadlel-Moula et al (2007) and Ariek (2003) for crossbred and Butana dairy cows in the Sudan. Disagreed results were reported by Badri (2008), Yadav and Rathi (1992) and Gajbhiye and Tripathi (1991). Later authors found that Murrah Buffaloes have the highest maximum peak yield when calved in winter season and lowest peak yield when calved in summer season.

Analysis of variance showed that year of calving had no significant ($p>0.05$) effect on the peak yield. Similar result was reported by Bhutia et al. (1988) in Friesian x Sahiwal crossbred dairy cows. The result was in disagreement with the finding of Fadlel-moula et al (2007), Badri (2008) and Ariek (2003) for Sudanese indigenous and cross cows.

Parity order in the current study did not affected significantly ($p>0.05$) the peak yield. This result was in disagreement with the finding of Fadlel-moula et al (2007) and Bhutia et al (1988) for crossbred cows. Similarly Badri (2008) and Ariek (2003) reported that the peak yield significantly increased as parity order increases.

5.4.6-The persistency of lactation curve:

The mean of persistency of lactation curve in the current study was 5.65± 0.754 weeks with 13% coefficient of variation. This result was higher than 4.97± 0.72 weeks that reported by Badri (2008) and 4.52 ± 0.51 weeks that reported by El-Sharif (2002) for crossbred dairy cows in the summer calvers.

In the current study, the season of calving did not ($p>0.05$) affect the persistency of lactation curve. Similar results were reported by Badri (2008) and Fadlel-Moula et al (2007) for Butana and crossbred dairy cows in the Sudan. The present result disagreed with the findings that reported by Ariek (2003) who reported that the wet summer calvers had the shortest persistent peak yield compared with the winter and dry summer calvers. El-Sharif (2002) found that the summer calvers were more persistent than winter calvers. Ahunu and kabuga (1994), Madalena et al (1979) attributed the effect of season of calving on persistency of peak of lactation curve to the supply of food and its intake rather than the direct climatic effects on the animal.

Year of calving had no effect on the persistency of peak of lactation curve in the present study. Similar results were reported by Areik (2002) for Butana cows and Ahunu and Kabuga (1994) for Ghana Holstein Friesian. Badri (2008) for Butana and Fadlel-Moula et al (2007) for crossbred dairy cows, reported that year of calving had significant effect on the persistency of peak of lactation curve. Later author reported that the persistency of lactation curve decreased as the years of calving increased.

In the current study the persistency of peak of lactation curve was significantly ($p<0.05$) effected by the parity order. The highest period of persistency was in the 7th parity, while the lowest period of persistency was in the 3rd parity. Similar results were reported by Badri (2008) for Butana dairy cows. He found that the period of persistency fluctuated through the 10 parities of study and the highest value was in the 1st parity, while the lowest value was in the 2nd parity. The significant effect of parity on the persistency of peak of lactation curve was also reported by Fadlel-Moula et al. (2007) who noted that for the 5 lactation orders studied the first lactation was significantly more persistent than the subsequent lactations which were similar in Friesian x Kenana crossbred cows. The effect of parity order on persistency of peak of lactation curve may be attributed to the fact that older animals which started their lactations at high level milk have a rapid rate of decline and the regression of alveolar cells increases with advance in age, which leads to decline in udder production (Wood, 1969).

5.5-Udder measurements:

5.5.1. Udder circumference:

The overall mean of udder circumference before milking in the present study was 105.32 ± 15.02 cm with 14.26 % coefficient of variation circumference after milking was 89.32 ± 4.44 cm with 16.17 % coefficient of variation. The udder circumference before milking was similar to 105.5 cm and 91.9cm that reported by Sid Ahmed and El- Barbary (2000) for udder cup shape and udder round shape in Friesian breeds. On the other hand, the results of udder circumference before milking in the present study was higher than 75.6 cm that reported by Sid Ahmed and El- Barbary (2000) for udder goat shape in Friesian dairy cows.

The udder circumference before milking in the present results ranged between 110.7 and 99.4 cm for morning and noon milking, respectively. These results showed that udder circumference before milking in the morning milking was significantly higher than in the noon milking. The udder circumference after milking in the current study ranged between 90.9 and 87.5 cm (noon milking). These results showed that the milking time had no significant effects on udder circumference after milking (morning and noon milking). The circumference size depended on the existence of milk, where the udder enlarged with milk secretion and shrink after milking.

The udder circumference before and after milking in the present was not affected by lactation stage (early, mid and late stage). The current results also showed that udder circumference before and after milking were significantly affected by parity order. The 6th parity order showed a higher before and after udder circumference size than the other parities. The udders tissues may be continuously developing up to 6th parity, after that the tissues start to regress with age.

The statistical analysis in the present study showed that simple regression of milk volume (kg) on the udder circumference measurements before milking was significant. The low coefficient of determination for udder circumference before milking (r^2=0.23) reflected that the lower goodness for fitting udder circumference when regressed on milk volume.

The current study results showed that the simple regression of milk volume (kg) on the udder circumference difference was significant. The coefficient of determination (r^2 = 0.23) indicated the weakness of fitting of udder circumference difference on milk volume. Furthermore, the multiple regression of produced milk volume on some udder measurements (circumference, width and length difference) was significant with circumference and length difference. While, its not significant with udder width difference.

5.5.3. Udder length:

The overall mean of udder length before milking in the present study is 44.79 ± 7.43 cm with 16.59 % coefficient of variation. The length of udder after milking is 36.61 ± 6.24 cm with 17.04 % coefficient of variation. These results showed that udder length before milking was higher than 32.6 cm, 29.5 cm and 21.3 cm in cup, round and goat udder shape of Friesian dairy breeds, respectively that reported by Sid Ahmed and El- Barbary (2000).

The length of udder before milking in the morning and noon milking ranged between 20.2 and 18.22 cm. While that after milking in the morning and noon milking ranged between 15.7 and 14.8 cm. The present results showed that, there are significant differences in the udder lengths between morning and noon milkings.

The analysis of variance in the current study illustrated that the lengths of udder during early, mid and late stage of lactations were significantly different ($p<0.05$). The udder lengths before and after milking in the early and mid stage were significantly higher than that in late stage.

Parity order in the current study significantly affected the udder length before and after milking. The highest udder length before milking was recognized during 2nd parity (23.5 cm) and the lowest was in 8th parity (17.8 cm). While, the udder length after milking was the highest during the 1st parity (17.5 cm) and the lowest in the 3rd parity (14.1 cm). The simple regressions of milk volume (kg) on the udder length measurements before milking and udder length difference were significant. The coefficient of determinations ($r^2=0.43$ and $r^2=0.45$) indicated the goodness of fitting of udder length before milking and udder length difference regression on milk volume. The milk secretion directly related to length and depth of udder extremely with udder capacity (Sid Ahmed and El- Barbary 2000). So the length of udder should be one of important base aspects for selection dairy breeds.

5.5.4. Udder width:

The overall means of udder width before and after milking in the present study were 19.29 ± 3.56 with 17.04% coefficient of variation and

15.27 ± 3.18 with 20.83 % coefficient of variation respectively. These results were higher than 24.4 cm, 22.6 cm and 17.5 cm for cup, round and goat shape of Friesian dairy cows, respectively that reported by Sid Ahmed and El- Barbary (2000).

The results in the current study showed that there were significant different in udder width before milking between morning (48.3 cm) and noon (40.9 cm) milkings. This could be referred to the time of milk left to accumulation that is long for morning milking and short for noon milking. On the other hand, there were no significant different in udder width after milking between morning and noon milking.

The stage of lactation in the current study was found to have no significant ($p>0.05$) effect on the udder width before and after milking.

The current analysis also showed that the parity order has significant ($p<0.05$) effect on the udder width before and after milking. The present study was also reported that the udder widths before and after milking were significantly increased with the parity order increase. The highest udder width before milking was in 8th parity (52.3cm), while the lowest width before milking was in 2nd parity (36.5cm). Whereas, the highest udder width after milking was in 8th parity (42.8cm) and the lowest width after milking was in 1st parity (32.3cm).

The simple regressions of milk volume (kg) on the udder width before milking and the udder width difference were significant ($p<0.05$) and the coefficient of determination were

5.5.5. Fore udder depth:

The overall means of fore udder depth before and after milking in the present study were 23.70 ± 3.11 cm with 13.12 % coefficient of variation and 22.14 ± 3.43 cm with 15.49 % coefficient of variation, respectively.

These results were lowers than 29.2 cm 27.4 cm and 25.2 cm for cup, round and goat udder shapes in Friesian breeds, respectively that reported by Sid Ahmed and El- Barbary (2000).

The statistical analysis in the present study illustrated that the time of milking (morning and noon milking) and the stages of lactation (early, mid and late) had no significant ($p>0.05$) effects on the fore udder depth before and after milking. Whereas, parity order significantly ($p<0.05$) affected the fore udder depth before and after milking. The fore udder depth before and after milking significantly increased with the parity order. The highest udder fore udder depth before milking (25.8) was in 7th parity and the lowest (21.7) was in 1st parity. On the other hand, the highest fore udder depth after milking (23.0) was in 7th parity and the lowest (19.2) was in 1st parity.

Simple regression of milk volume (kg) on the fore udder depth was not significant ($p>0.05$). The coefficient of determination was very low that reflected the weakness of fitting when fore udder depth regressed on milk volume. Therefore, if the milk secreted from the fore depth of the udder is 45% and more of the total udder production. It is considered as a good udder. The udder was considered as worse when the fore depth secretion is 30% and less of total udder production (Sid Ahmed and El- Barbary, 2000).

5.5.6. Hind udder depth:

The overall means of hind udder depth before and after milking in the present study were 23.59 ± 3.71 cm with 15.73 % coefficient of variation and 21.48 ± 3.45 with 16.06% coefficient of variation. These results were much lower than 33.7cm, 31.2cm and 27.9 cm for cup, round and goat udder shapes in Friesian dairy cows, respectively that reported by Sid Ahmed and El- Barbary (2000).

The time of milking in the current study had no significant (p>0.05) effect on the hind udder depth before and after milking, where the hind udder depths were similar during both mooring and noon milking. Regarding to stages of lactation, the hind depth before milking was not significantly affected by lactation stages. While, the hind udder depth significantly affected by the lactation stages. Results showed that the highest udder hind depth (22.37) recognized during early sage of lactation, and the lowest was recognized during late sage of lactation.

The parity order in the present study significantly affected the hind udder depth before and after milking. Both hind udder depths before and after milking were significantly increased with parity order increase. The highest udder hind depth before milking (26.9 cm) recognized during 7th parity and the lowest (20.0 cm) was in 2nd parity. On the other hand, the 7th parity order gained highest hind udder depth (22.3 cm) after milking and the 3rd parity was recognized with lowest hind udder depth (18.7 cm) after milking.

The linear regression of produced milk volume (kg) on the hind udder depth was significant. This means that the udder hind depth has a significant role in the milk production process, not less important than the udder fore depth.

5.5.7. Udder capacity:

The overall mean of udder capacity before and after milking were; 1070.12 ± 264.62 cm^3 with 24.79 % coefficient variation and 808.03 ± 223.99 cm^3 with 27.72 % of coefficient variation, respectively.

The time of milking in the present study significantly affected the udder capacity before milking. The morning milking was higher (1157.9 cm^3) than noon milking (967.01 cm^3). These could be referred to the duration of milk forming, where it was longer for morning milking than for noon milking. The lactation stages in the present study have no significant effects on the udder capacity before and after milking. While, the parity order have significant effects on the udder capacity before and after milking. The highest udder capacity before milking (1252.3cm^3) was recognized in the 7th and the lowest (814.75 cm^3) was in the 2nd parity. Whereas, the highest udder capacity after milking (930.53 cm^3) noticed in the 7th parity order and the lowest (621.00 cm^3) was in the 1st parity order.

The simple regression of produced milk volume (kg) on the udder capacity and udder capacity differences were significant. The coefficient of determination of udder capacity (R^2=0.26) and udder capacity differences (R^2=0.40) reflected the goodness of fitting data of udder capacity regressed on the produced milk volume. This indicated that milk production directly related to udder length, diameter and udder capacity. So the udder capacity considered as one of the important measurements in dairy cattle selection.

Conclusion & Recommendation:

From the first experiment it can be concluded that. The season of calving had no effect on the intensively reared caws that is to say the complete confinement of the Kenana X Friesian crossed caws of Kafori farm will not subject them to the seasonal variation stress.

The variation on milking performance due to the annual changes in management systems (year of calving effect) and animal age (parity order effect) should be considered on evaluation of the farm milking performance.

The second experiment concluded that the period between milkings affected the milk yield and should be considered on evaluation of the udder function or assessment of udder shape. It is also concluded that the udder length is the measurement that is the most related to the milk yield and can be used for production of milk yield with the highest label of precision according to the formula

$$y = 34.03 + 1.76\ x$$

With the SE of estimation 5.64

Where:

y = is the milk yield kg

x = is the length measurement cm.

More over the addition of the udder measurement to the udder length in multiple regressions add very slight precision to the production formula.

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