

## **Chapter 4**

### **4.0 RESULTS**

#### **4.1 PROGESTERONE AND OESTRADIOL LEVELS IN DIFFERENT GOAT GENOTYPES WITH DIFFERENT TYPES OF OESTROUS CYCLE (EXPERIMENT 1)**

From a total of 25 goats studied, 15 goats (60%) showed normal oestrous cycle. Jermasia goats had the highest percentage (90%) among the breeds with normal oestrous cycle. Nine (9) (90%), 3 (60%) and 3 (30%) of the Jermasia goats, Katjang goats and Boer crossbred goats, respectively, showed normal oestrous cycle (Table 4). Normal oestrous cycle ranged between 19 to 22 days, 19 to 21 days and 19 to 22 days in Jermasia goats, Katjang goats and Boer crossbred goats, respectively (Figure 8). Long oestrous cycle comprised of 5 goats (20%). 4 goats (40%) and only 1 goats (20%) from Boer crossbred goats and Katjang goat, respectively, showing long oestrous cycle. Long oestrous cycle among Boer crossbred and Katjang goats were between 25 to 28 days.

From 25 goats studied, only 1 goat (40%) had short oestrous cycle that is a Boer crossbred goat with 17 days oestrous cycle (Figure 8 and Figure 9). Progesterone levels started rising on day 3 after oestrus and reached the peak on day 12 at 9.566 ng/ml. Levels declined from then on until oestrus. Among the goats with 19 days oestrous cycle, Katjang breed had had the highest progesterone levels, followed by Jermasia goats and the lowest being Boer

Table 4. Percentage of goats with various oestrous cycle types

Genotype \ Type of Oestrous Cycle	Number of Animals	Normal Oestrous Cycle	Long Oestrous Cycle	Short Oestrous Cycle	Anoestrus
Jermasia	10	9 (90%)	0	0	1 (10%)
Katjang	5	3 (60%)	1 (20%)	0	1 (20%)
Boer crossbred	10	3 (30%)	4 (40%)	1 (10%)	2 (20%)
Overall		15 (60%)	5 (20%)	1 (4%)	4 (16%)

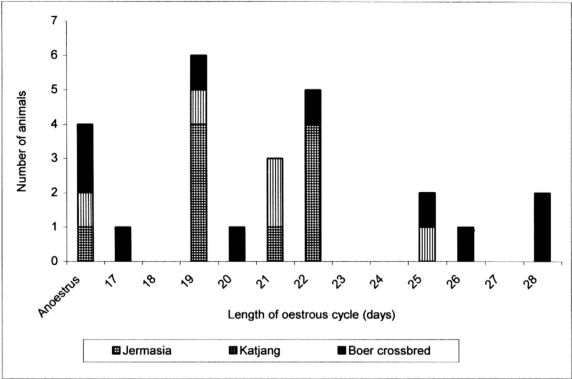


Figure 8. Distribution of oestrous cycle among different goat breed

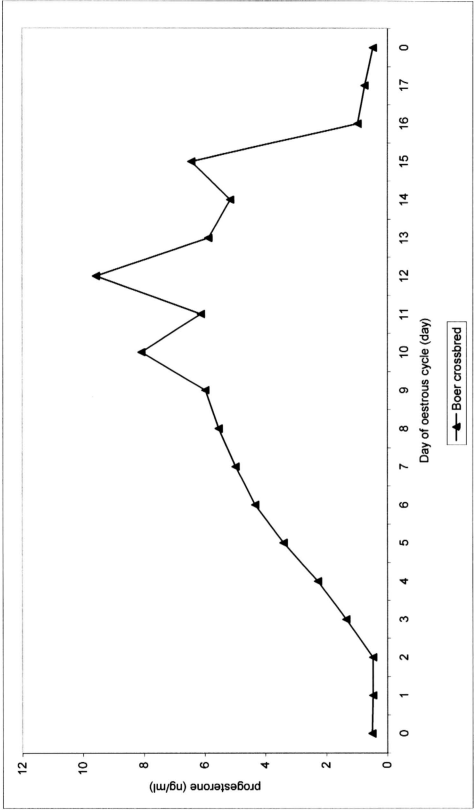


Figure 9. Average daily variation of progesterone levels in goat with 17 days oestrous cycle



crossbred goats. Progesterone levels in Jermasia goats started rising on day 1, in Katjang goats also on day 3 but only starting to rise on day 10 for Boer crossbred goats (Figure 10). Progesterone peaks were on day 11 (7.93 ng/ml), on day 12 (3.42 ng/ml) and day 16 (1.29 ng/ml) for Katjang, Jermasia and Boer crossbred goats, respectively. The progesterone levels rose on day 4 in the Boer crossbred goats with 20 days oestrous cycle and reached the peak on day 14 at 6.60 ng/ml. The drop in progesterone levels before oestrus happened on day 18 (Figure 11). In both Jermasia and Katjang goats, progesterone levels in goats with 21 day oestrous cycle rose from day 3. The peak for progesterone level was achieved in day 8 (8.75 ng/ml) for Jermasia goat but on day 12 (9.46 ng/ml) for Katjang goats (Figure 12). Progesterone levels in Katjang goats were slightly higher than Jermasia goats with alternating peaks between the breeds. Both breeds showed a drop on day 17 before the oestrus. In goats with 22 day of oestrous cycle, Boer crossbred goats showed higher progesterone level as compared to Jermasia goats. Progesterone levels rose on day 3 and dropped on day 18 after oestrus (Figure 13). Progesterone peaks were achieved on day 16 (11.20 ng/ml) and on day 14 (7.82 ng/ml) for Boer crossbred goats and Jermasia goats, respectively. Katjang goats had a higher level of progesterone than Boer crossbreed goats among goats with 25 days oestrous cycle (Figure 14). Apart from reaching a higher peak (11.09 ng/ml) on day 16, progesterone levels declined later (on day 21) as compared to Boer crossbred goats at 7.82 ng/ml before declining on day 19. Only Boer crossbred goats showed 26 days oestrous cycle. Progesterone level rose on day 3 and reached the peak on day 10 at 6.67 ng/ml.

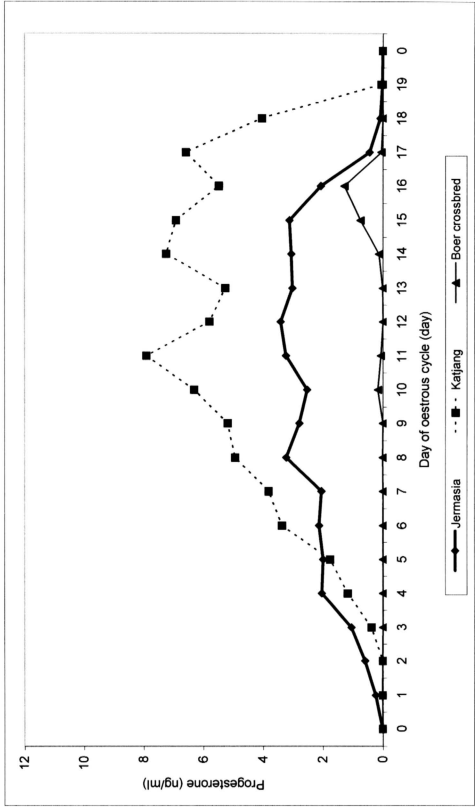


Figure 10. Average daily variation of progesterone levels in different goat breeds with 19 days oestrous cycle

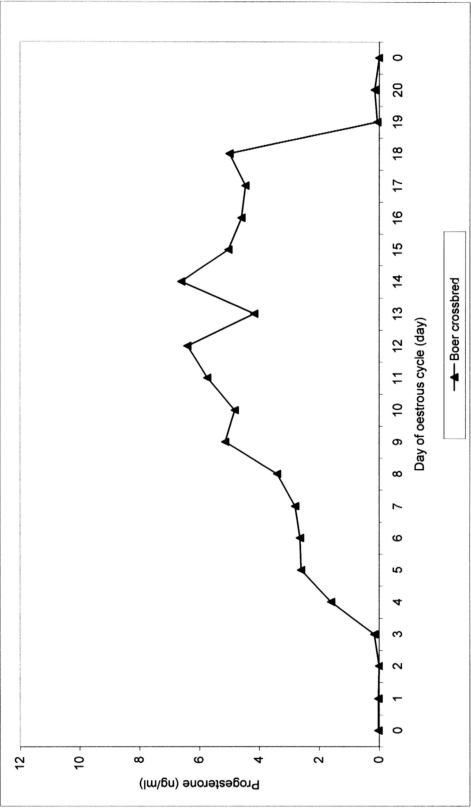


Figure 11. Average daily variation of progesterone levels in different goat breeds with 20 days oestrous cycle

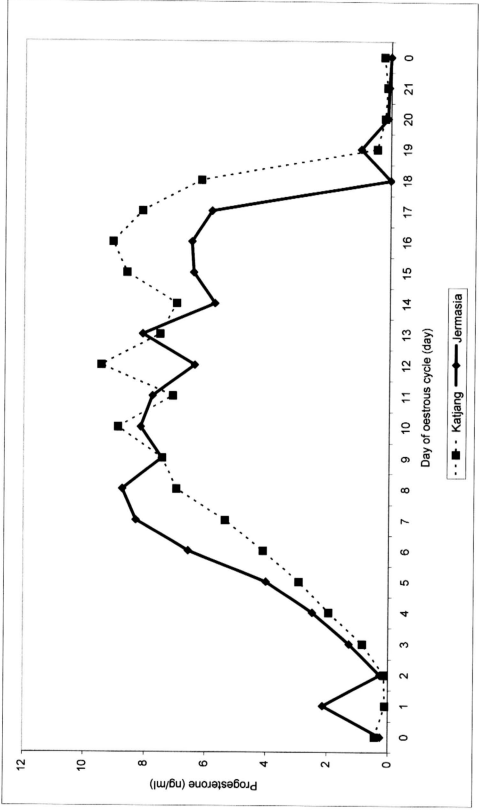


Figure 12. Average daily variation of progesterone levels in different goat breeds with 21 days oestrous cycle

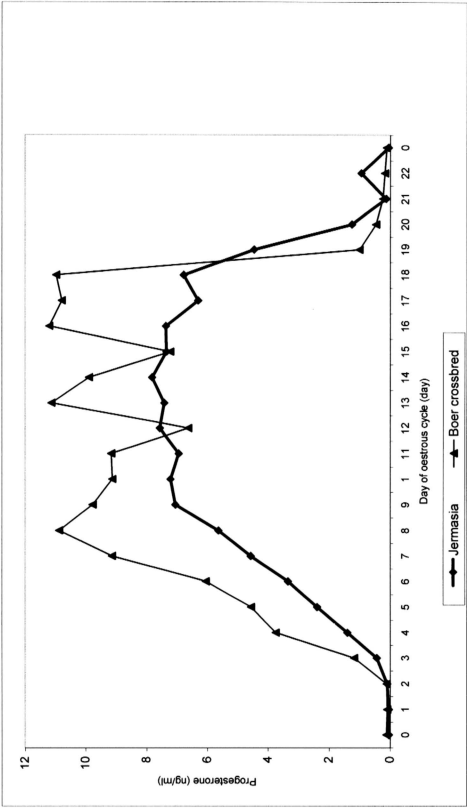


Figure 13. Average daily variation of progesterone levels in different goat breeds with 22 days oestrous cycle

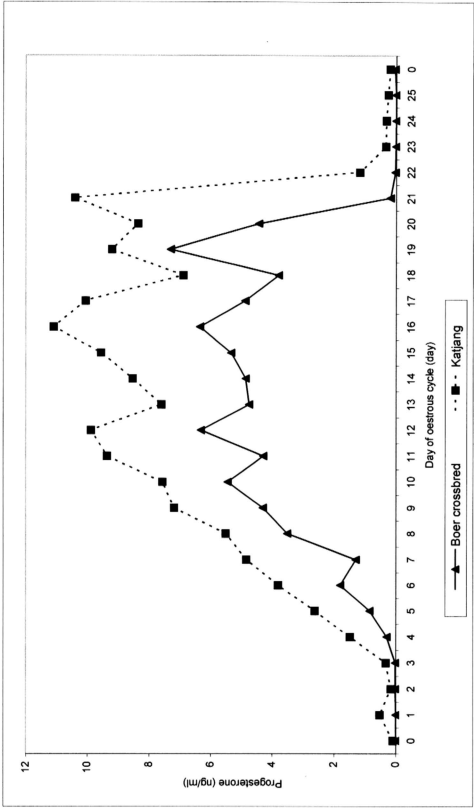


Figure 14. Average daily variation of progesterone levels in different goat breeds with 25 days oestrous cycle

Progesterone levels started to decline on day 18 (Figure 15). For goats which showed 28 days oestrous cycle progesterone levels rose the day after oestrus until day 16 (3.29 ng/ml) and declined on day 17 (Figure 16) .

In animal with 17 days oestrous cycle, the levels of oestradiol was undetected throughout the whole period (Figure 17). Similarly, no oestradiol level was detected in Boer crossbred goats with 19 days oestrous cycle (Figure 18). However, Katjang goats had higher levels of oestradiol as compared to Jermasia goats with same oestrous cycle duration. Katjang also showed the classical peaks of oestradiol before oestrus (18.84 pg/ml). In 20 days oestrous cycle, levels of oestradiol were detected as peak on day 6 and day 9 (Figure 19). In Jermasia goats with 21 days oestrous cycle, oestradiol levels were detected only on days closest to oestrus which were prior to day 0 (4.23 pg/ml) and day 21 (2.03 pg/ml) (Figure 20). In Katjang goats the oestradiol levels were higher with multiple peaks. However the highest level was 17.25 pg/ml, on day 19. The peak prior to oestrus was on day 21 at 12.47 pg/ml. In goats with 22 days oestrous cycle, Boer crossbred goat had higher peaks of oestradiol prior to oestrus at 9.51 pg/ml on day 22. The peak in Jermasia goat was 4.24 pg/ml on day 22 (Figure 21). For goats with 25 day oestrous cycle, Katjang goats had higher oestradiol level throughout the oestrous cycle while Boer crossbred goats did not have a detectable level of the oestradiol hormone, except immediately after oestrus on day 1 at 24.54 pg/ml and prior to oestrus on day 25 at 24.55 pg/ml (Figure 22). Level of oestradiol in Katjang goats before oestrus was 30.82 pg/ml on day 25. Similar with Boer crossbred goats with 25 days oestrous cycle, Boer crossbred goats with 26 days oestrous cycle only had detectable oestradiol levels on day 0 of the oestrous cycle. The

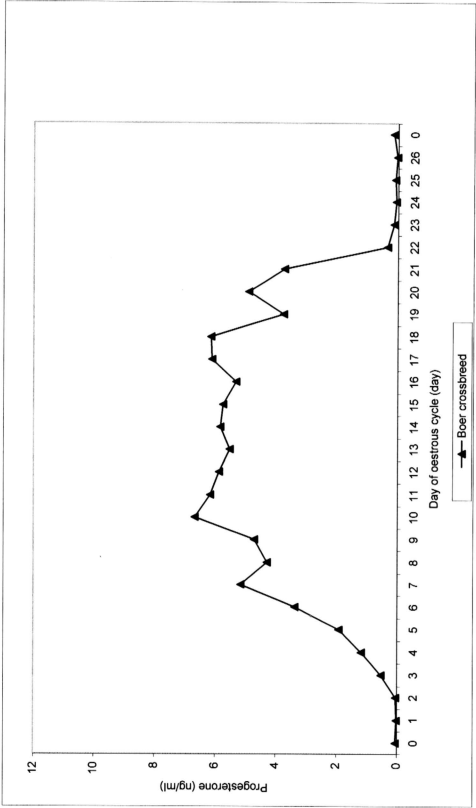


Figure 15. Average daily variation of progesterone levels in different goat breeds with 26 days oestrous cycle.



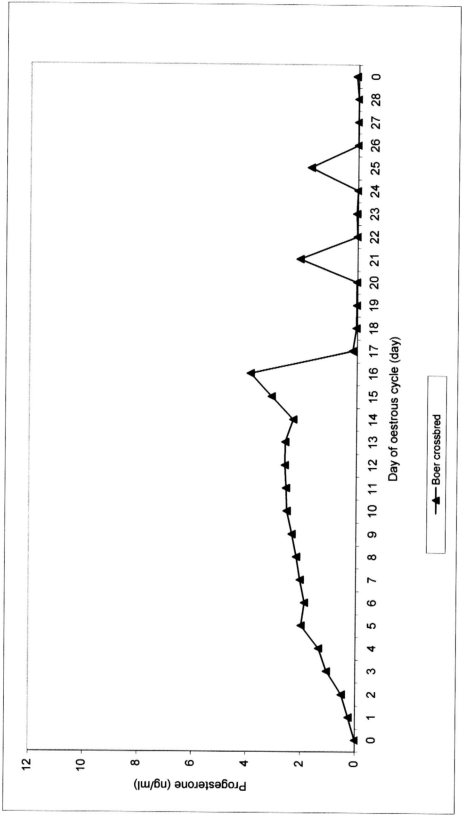


Figure 16. Average daily variation of progesterone levels in different goat breeds with 28 days oestrous cycle.

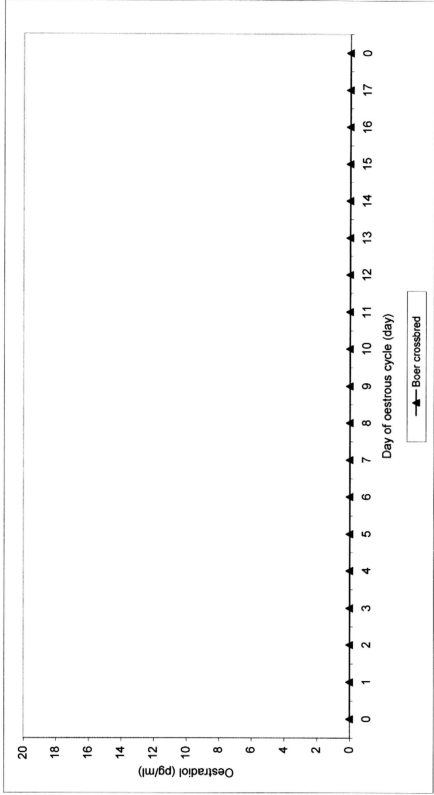


Figure 17. Average daily variation of oestradiol levels in different goat breeds with 17 days oestrous cycle.

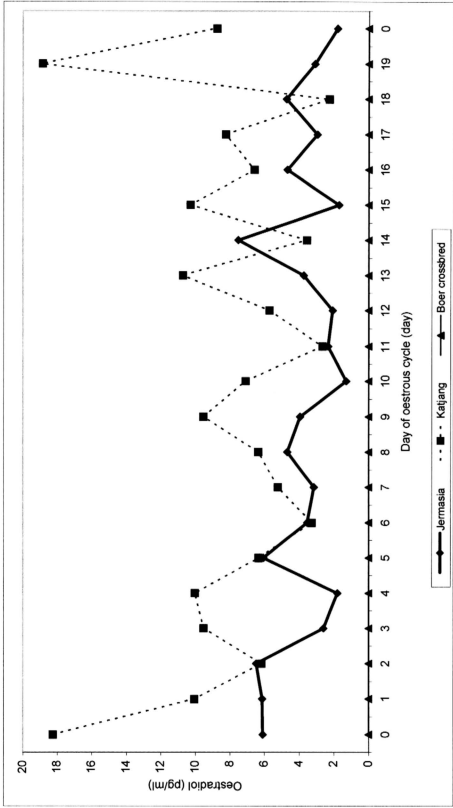


Figure 18. Average daily variation of oestradiol levels in different goat breeds with 19 days oestrous cycle.

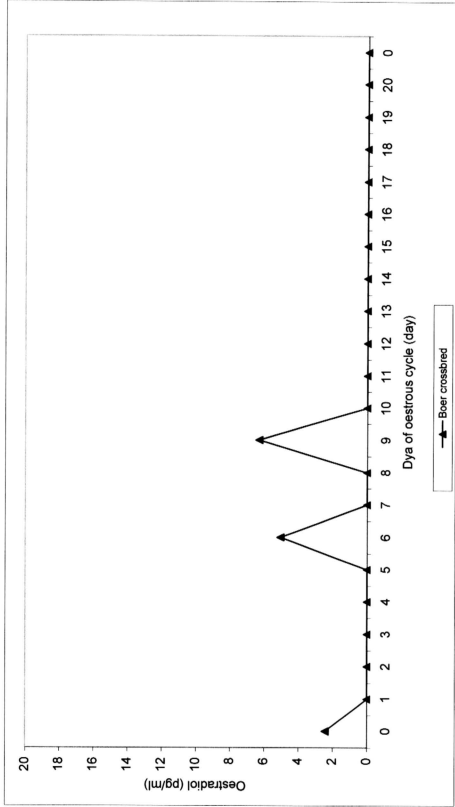


Figure 19. Average daily variation of oestradiol levels in different goat breeds with 20 days oestrous cycle.

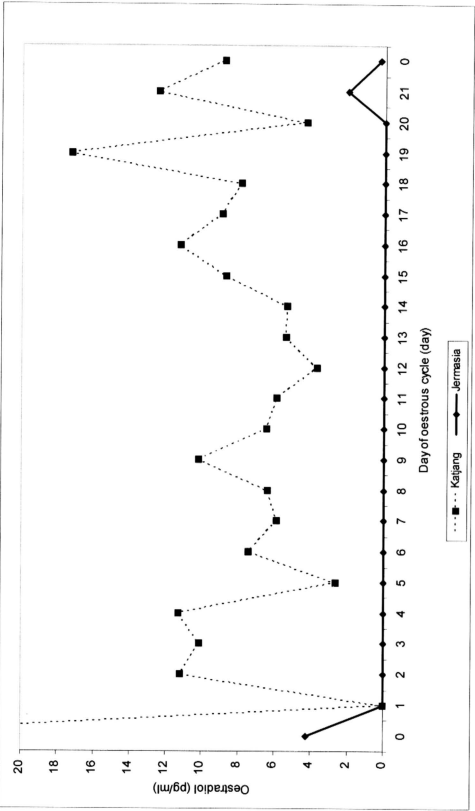


Figure 20. Average daily variation of oestradiol levels in different goat breeds with 21 days oestrous cycle.

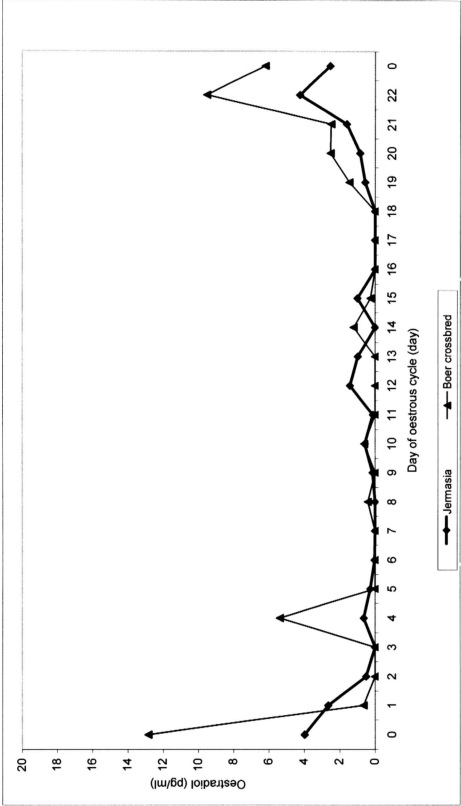


Figure 21. Average daily variation of oestradiol levels in different goat breeds with 22 days oestrous cycle.

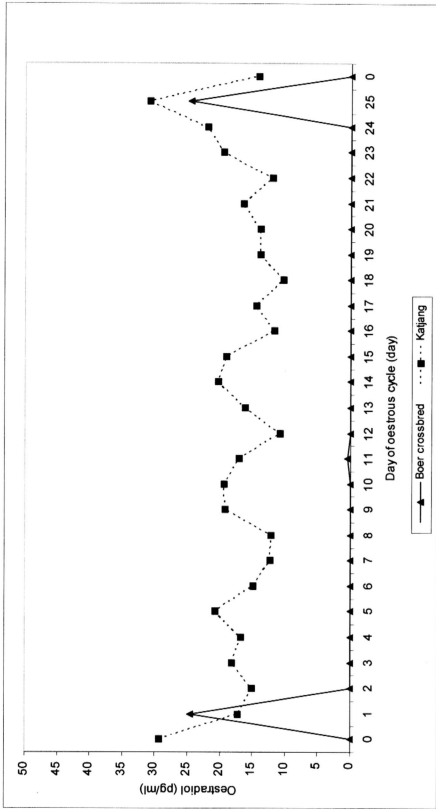


Figure 22. Average daily variation of oestradiol levels in different goat breeds with 25 days oestrous cycle.

levels were 11.645 pg/ml on day 26 and 13.00 pg/ml on day 0 (Figure 23). The individual Boer crossbred goat with 28 days oestrous cycle did not display the clear peaks seen in the Boer crossbred goat with shorter oestrous cycle. However, the level of oestradiol was high at the beginning of the oestrous cycle and decreased until day 28 (Figure 24).

Jermasia goats with longer oestrous cycle showed higher mean progesterone levels and lower mean oestrogen levels, respectively (Table 5). Levels of progesterone was significantly lower in goats with 19 day oestrus cycle as compared to levels seen in Jermasia goats with 21 and 22 day oestrus cycles. In Boer crossbred goats the mean progesterone levels did not showed any obvious pattern. However, oestradiol levels were generally higher in longer oestrous cycle (Table 6). In Katjang goats, the same trend of higher progesterone levels coinciding with longer oestrous cycle, as was seen in Jermasia was observed. However, oestradiol levels increased with longer oestrous cycle as seen in Boer crossbred (Table 7). The differences in various oestrus groups were however insignificant.

It was also observed that dioestrus durations lengthened from 15 to 16 days whereas proestrus period was between 2 to 4 days in animals with normal oestrous cycles (Figure 25 to Figure 32). Jermasia goats with normal oestrous cycle (19 to 22 days), goats with longest oestrous cycle (22 days) had the longest dioestrus period that is 16 days (Figure 25, Figure 26 and Figure 27). Katjang goats with normal oestrous cycle, showed the similar trend as seen in Jermasia goats with normal oestrous cycle (Figure 30 and Figure 31). But for Boer crossbred goats, it does not show the similar trend as seen in the other two breeds. Dioestrus period remain the same that is 15 days



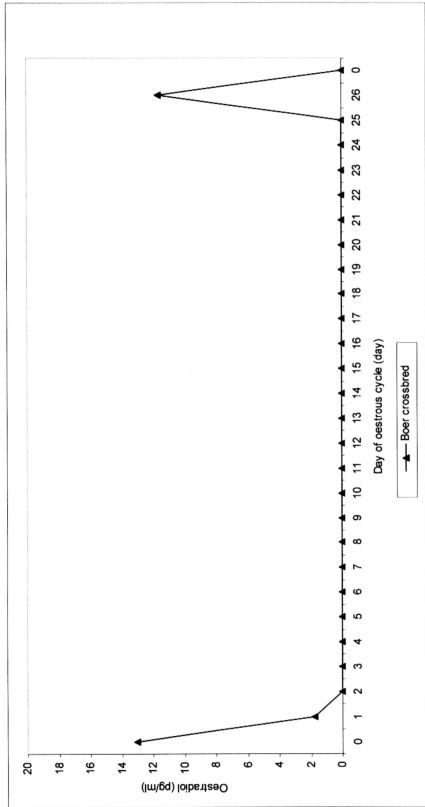


Figure 23. Average daily variation of oestradiol levels in different goat breeds with 26 days oestrous cycle.

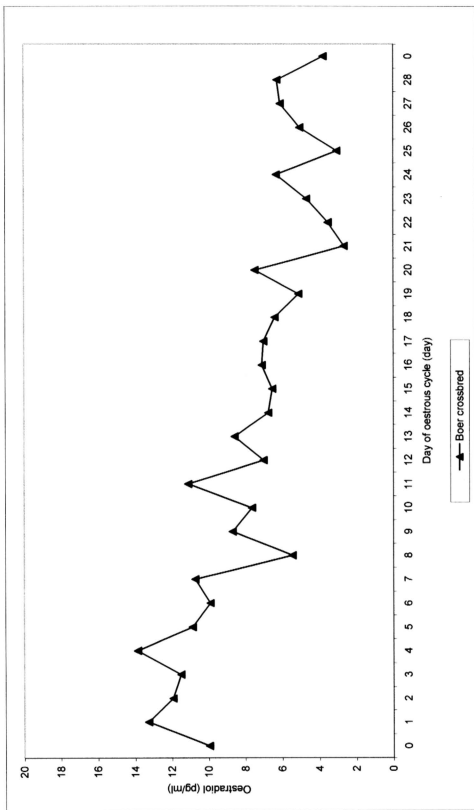


Figure 24. Average daily variation of oestradiol levels in different goat breeds with 28 days oestrous cycle.

Table 5. Average progesterone and oestradiol levels for Jermasia goats with different lengths of oestrous cycle

Oestrous cycle length (day)	N	Progesterone (ng/ml)	Oestradiol (pg/ml)
19	84	1.77 <sup>a</sup>	3.84 <sup>b</sup>
21	23	4.24 <sup>b</sup>	0.28 <sup>a</sup>
22	88	4.03 <sup>b</sup>	0.92 <sup>a</sup>
	Mean	3.35	1.68

N : number of replicates ( number of goats x number of sampling days)

a, b: superscripts a, b in a column within a group were significantly different

(  $P \leq 0.05$  )

Table 6. Average progesterone and oestradiol levels for Boer crossbred goats with different lengths of oestrous cycle

Oestrous cycle length (day)	N	Progesterone (ng/ml)	Oestradiol (pg/ml)
17	19	3.83 <sup>b</sup>	0.00 <sup>a</sup>
19	21	0.12 <sup>a</sup>	0.00 <sup>a</sup>
20	22	2.97 <sup>b</sup>	0.63 <sup>a</sup>
22	24	5.58 <sup>c</sup>	1.81 <sup>a</sup>
25	27	2.60 <sup>a</sup>	1.83 <sup>b</sup>
26	28	3.14 <sup>b</sup>	0.94 <sup>a</sup>
28	60	1.24 <sup>a</sup>	7.61 <sup>c</sup>
	Mean	2.78	1.83

N : number of replicates ( number of goats x number of sampling days)

a, b, c : superscripts a, b, c in a column within a group were significantly different  
( P≤ 0.05 )

Table 7. Average progesterone and oestradiol levels for Katjang goats with different lengths of oestrous cycle

Oestrous cycle length (day)	N	Progesterone (ng/ml)	Oestradiol (pg/ml)
19	21	3.63 <sup>a</sup>	8.08 <sup>a</sup>
21	46	4.49 <sup>a</sup>	8.80 <sup>a</sup>
25	27	5.08 <sup>a</sup>	16.90 <sup>a</sup>
	Mean	4.40	11.26

N : number of replicates ( number of goats x number of sampling days)

a : superscripts a in a column within a group were significantly different

( P≤ 0.05 )

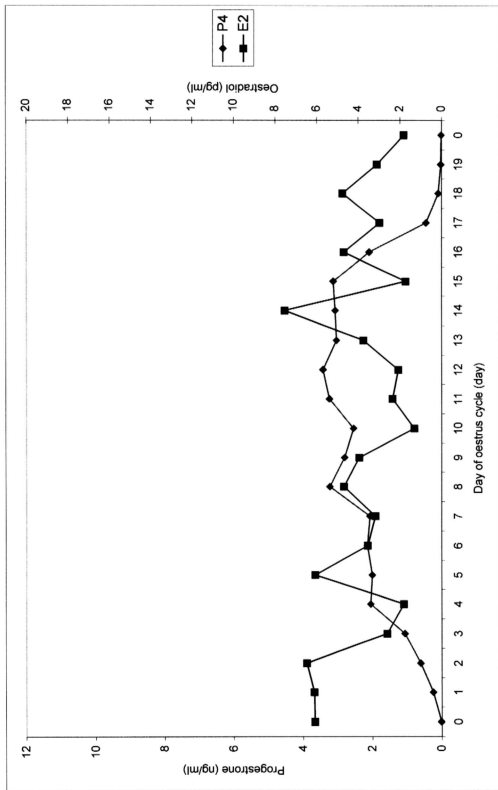


Figure 25. Average daily variation of progesterone and oestradiol levels in Jermasia goats with 19 days oestrous cycle.

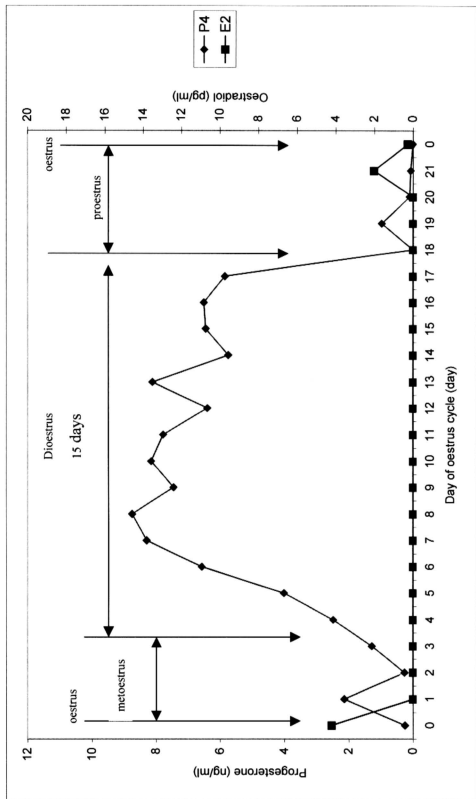


Figure 26. Average daily variation of progesterone and oestradiol levels in Jermasia goats with 21 days oestrous cycle.

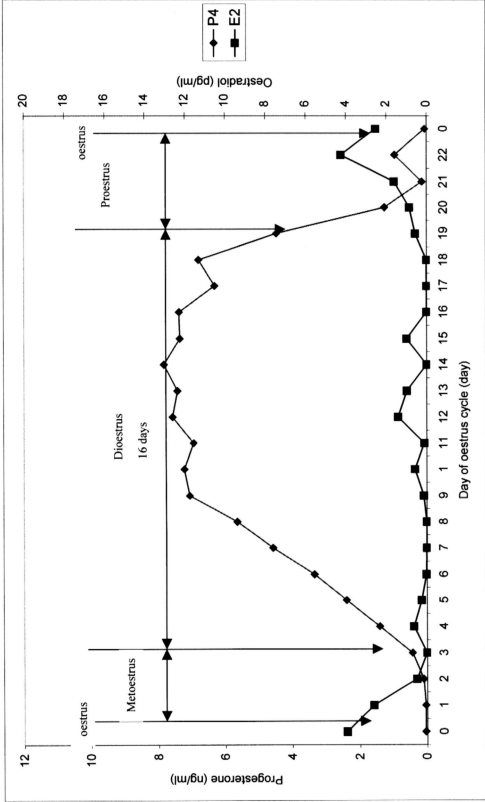


Figure 27. Average daily variation of progesterone and oestradiol levels in Jermasia goats with 22 days oestrous cycle.



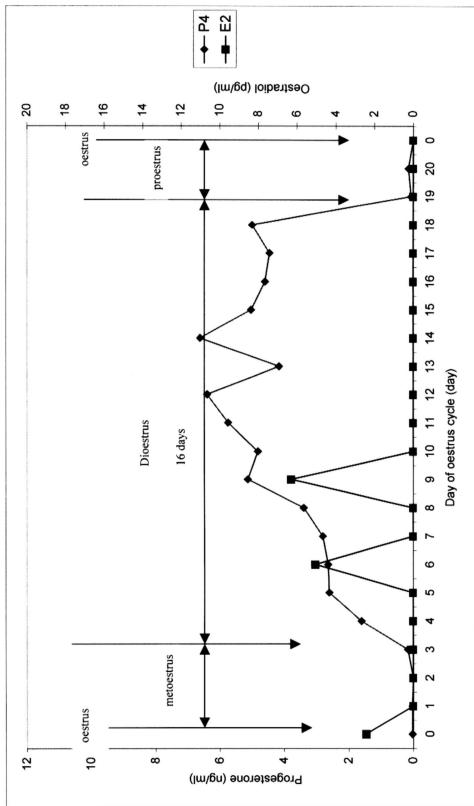


Figure 28. Average daily variation of progesterone and oestradiol levels in Boer crossbred goat with 20 days oestrous cycle.

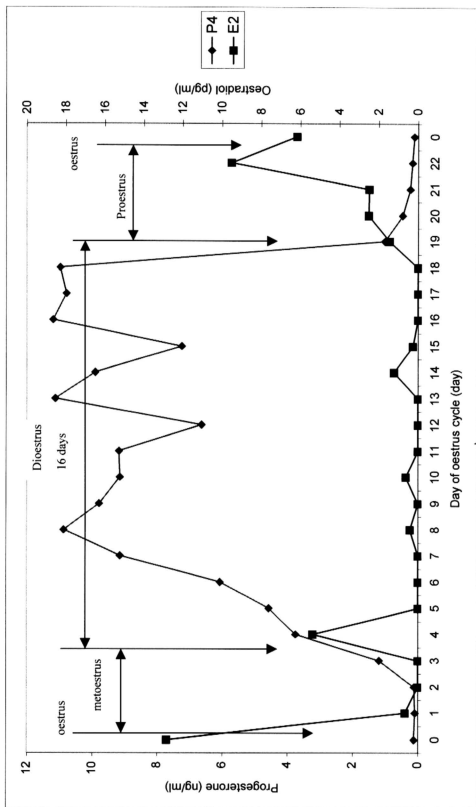


Figure 29. Average daily variation of progesterone and oestradiol levels in Boer crossbred goats with 22 days oestrous cycle.

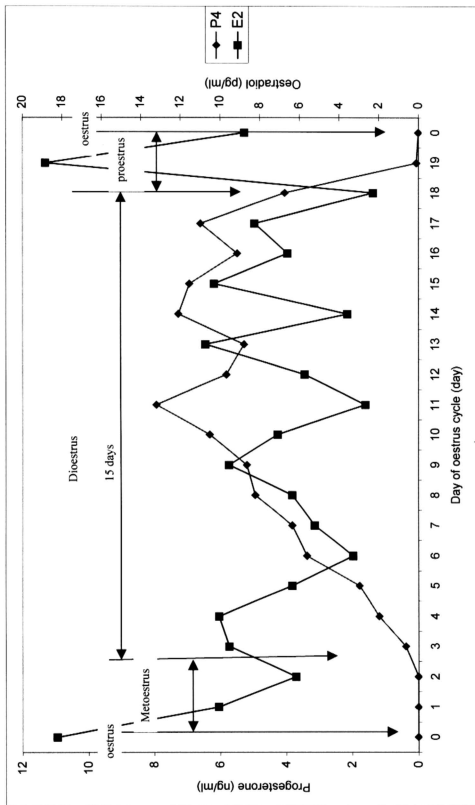


Figure 30. Average daily variation of progesterone and oestradiol levels in Katjang goats with 19 days oestrous cycle.

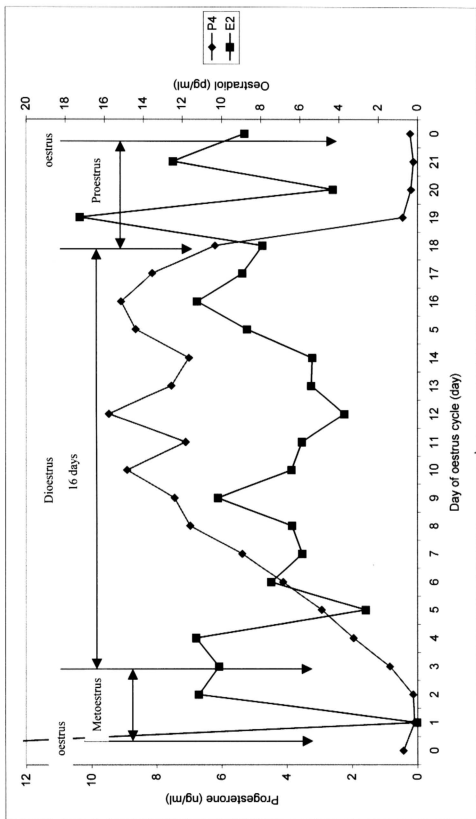


Figure 31. Average daily variation of progesterone and oestradiol levels in Katjang goats with 21 days oestrous cycle.

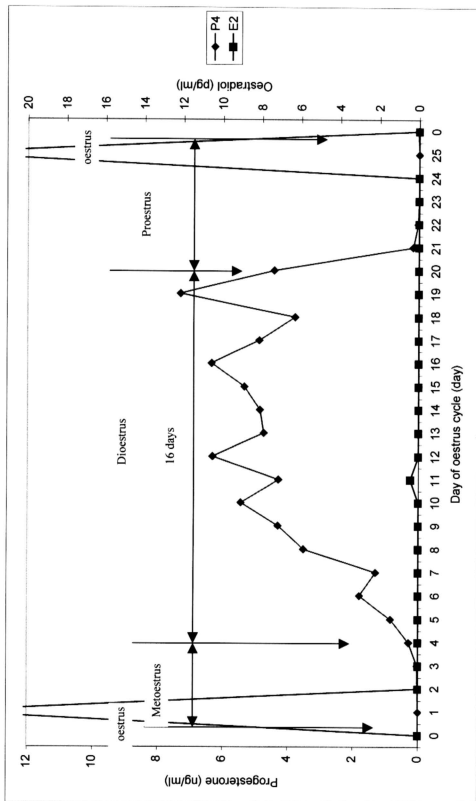


Figure 32. Average daily variation of progesterone and oestradiol levels in Boer crossbred goats with 25 days oestrous cycle.

(Figure 28 and Figure 29). For goats which showed long oestrous cycle, dioestrus durations lengthened from 16 to 24 days whereas proestrus period had also increased to 4 to 6 days. Metoestrus period stayed between 3 to 4 days for both normal and long oestrous cycle goats. Similar trend was observed as in normal oestrous cycle goats where goats with longest oestrous cycle had the longest dioestrus period (Figure 32 to Figure 35). In goats with shortest oestrous cycle (17 days) had the shortest dioestrus period that is 13 days (Figure 36). There was a total of 16% of the goats that did not show the sign of oestrus when detected using male goat. This was 10% of the Jermasia goats and 20% of the Katjang goats and Boer crossbred goats. Among the anestrus female, a single individual was observed to have male characteristics comprising of build and behaviour. Hormone profile of this individual showed undetectable progesterone levels and extremely high oestradiol levels. Hormone profile of this individual is reflected in Figure 37. In the other anestrus goats, average daily variation showed alternating peaks of oestradiol and progesterone but for most of the duration, oestradiol levels were higher (Figure 38).

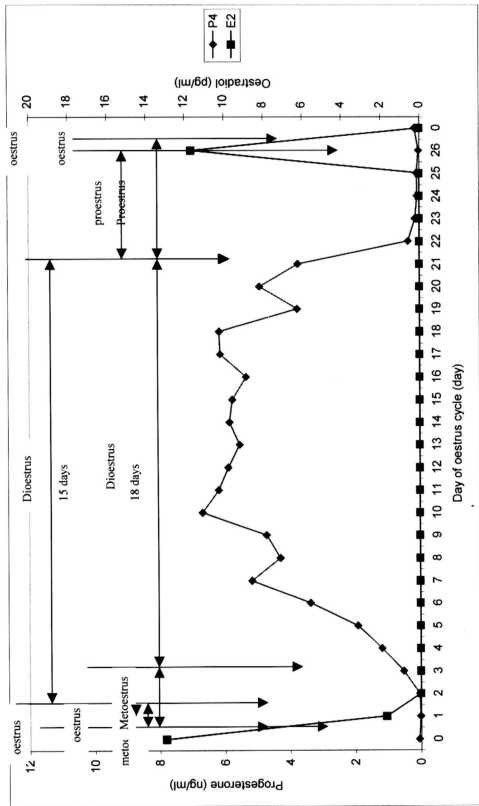


Figure 33. Average daily variation of progesterone and oestradiol levels in Boer crossbred goat with 26 days oestrous cycle.

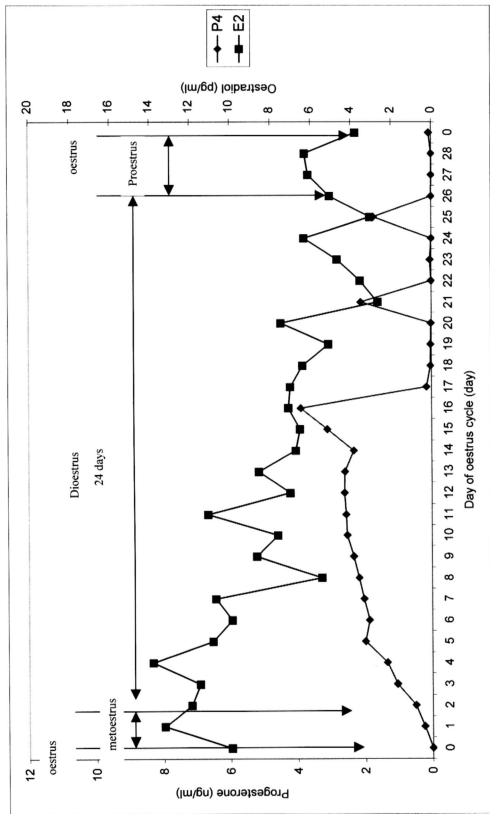


Figure 34. Average daily variation of progesterone and oestradiol levels in Boer crossbred goats with 28 days oestrous cycle.



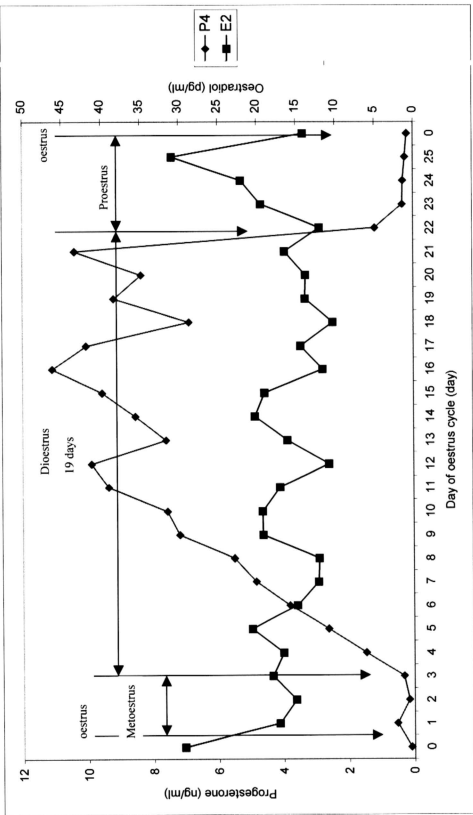


Figure 35. Average daily variation of progesterone and oestradiol levels in Katjang goats with 25 days oestrous cycle.

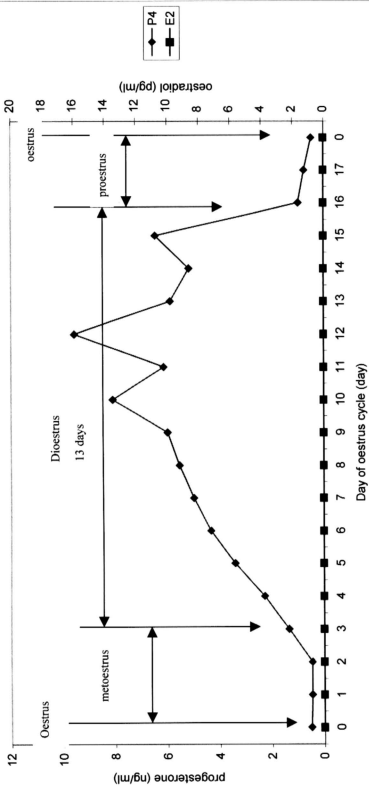


Figure 36. Average daily variation of progesterone and oestradiol levels in goats with 17 days oestrous cycle.

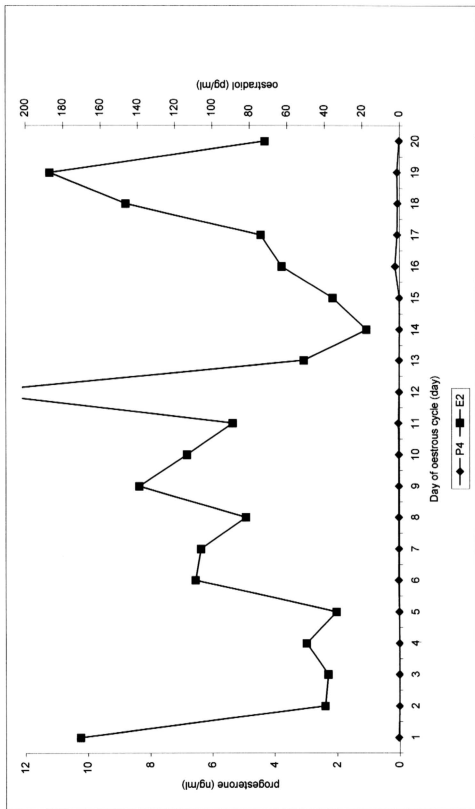


Figure 37. Average daily variation of progesterone and oestradiol levels in an oestrous female goat with male characteristics.

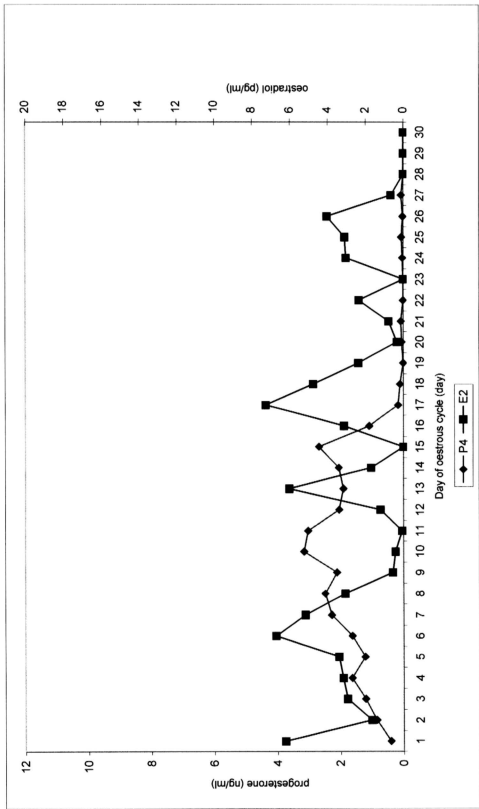


Figure 38. Average daily variation of progesterone and oestradiol levels in anoestrus goats.

#### **4.2    PROGESTERONE AND OESTRADIOL LEVELS 2 DAYS BEFORE OESTRUS UNTIL 2 DAYS AFTER OESTRUS FOR JERMASIA GOATS WITH NORMAL OESTROUS CYCLE (INTENSIVE STUDY- EVERY 8 HOURS) (EXPERIMENT 2)**

Progesterone and oestradiol levels for 5 Jermasia goats were averaged over the five sampling days i.e days -2, -1, 0, 1 and 2 whereby day 0 was the day of oestrus. Progesterone levels declined from day -2 onwards. After day -2, progesterone levels (1.12 ng/ml) declined significantly ( $P \leq 0.05$ ) (that is, on day -1, day 0 and day 1) with the values of 0.05 ng/ml, 0.01 ng/ml and 0.03 ng/ml and started to increase again on day 2 (0.30 ng/ml) (Table 8 and Figure 39). On day -2 oestradiol level was 0.54 pg/ml and increased significantly and hit the peak at day -1 (1.87 pg/ml). From then on, oestradiol levels declined to 0.17 pg/ml on oestrus day ( $P \leq 0.05$ ) and later to undetected level (0.00 pg/ml) (Table 8 and Figure 39).

A detailed breakdown of progesterone and oestradiol levels show that progesterone level decreased rapidly from early morning of day -2 to early morning day 0 with the values of 1.18, 1.00, 0.56, 0.11, 0.03, 0.01 and 0.02 ng/ml (Table 9 and Figure 40). By then the level was very low and continued dropping and leveling off until early morning of day 2 (0.19 ng/ml). From day 2, the level of progesterone started to increase again rapidly (0.19, 0.25 and 0.47 ng/ml). Oestradiol levels increased rapidly from 0700 hours on day -2 with the value of 0.00 pg/ml, 0.50 pg/ml, 1.13 pg/ml and reaching a peak at 0700 hours at day -1 (2.62 pg/ml). The oestradiol level later decreased rapidly until the afternoon of oestrus at 1500 hours (1.17, 1.29, 0.49 and 0.02 pg/ml) and later to undetectable level (0.00 pg/ml) (Table 9 and Figure 40).

Table 8. Average progesterone and oestradiol levels 2 days before oestrus until 2 days after oestrus (intensive study) for Jermasia goats

Day of oestrous cycle	N	Progesterone (ng/ml)	Oestradiol (pg/ml)
-2	15	1.12 <sup>b</sup>	0.54 <sup>a</sup>
-1	15	0.05 <sup>a</sup>	1.87 <sup>b</sup>
0	15	0.01 <sup>a</sup>	0.17 <sup>a</sup>
1	15	0.03 <sup>a</sup>	0.0000 <sup>a</sup>
2	15	0.30 <sup>b</sup>	0.0000 <sup>a</sup>

N : number of replicates (number of goats x number of sampling days)

a, b: superscripts a, b in a column within a group were significantly different ( P ≤ 0.05 )

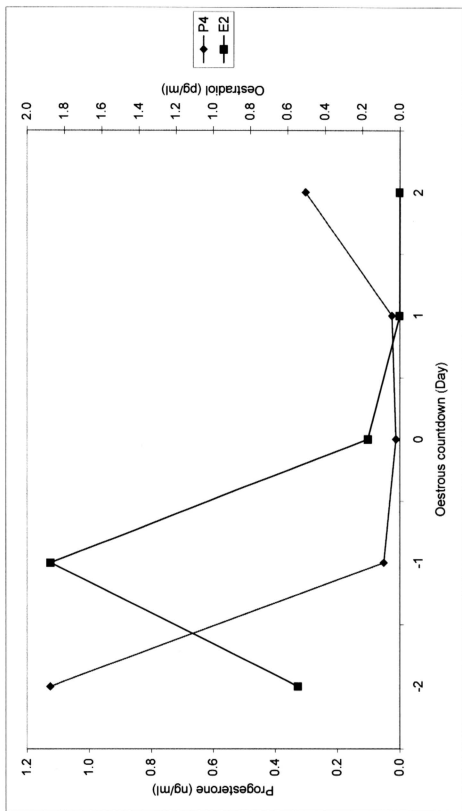


Figure 39. Average hormone levels during 5 days samplings from 2 days prior to oestrus until 2 days after oestrus in Jermasia goats.

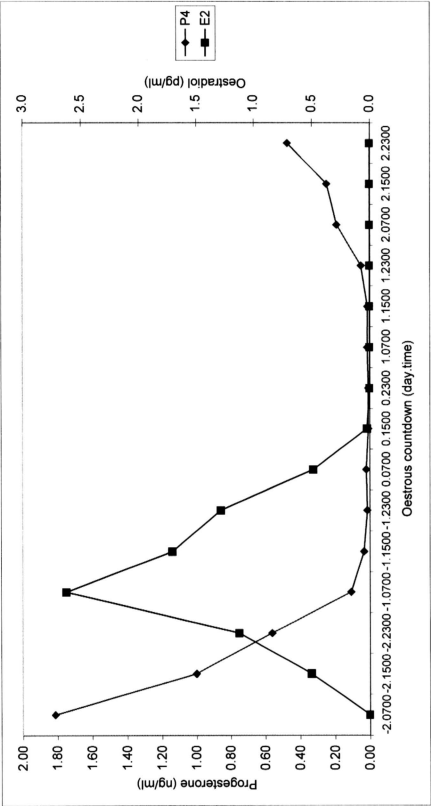


Figure 40. Detailed breakdown of hormone levels during 5 days samplings from 2 days prior to oestrus until 2 days after oestrus in Jermasia goats.



Table 9. Average progesterone and oestradiol levels 2 days before oestrus until 2 days after oestrus (intensive study) for Jermasia goats

Day.Time (hrs)	N	Progesterone (ng/ml)	Oestradiol (pg/ml)
Day -2 , 0700	5	1.18 <sup>b</sup>	0.00 <sup>a</sup>
Day -2 , 1500	5	1.00 <sup>ab</sup>	0.50 <sup>ab</sup>
Day -2 , 2300	5	0.56 <sup>ab</sup>	1.13 <sup>ab</sup>
Day -1 , 0700	5	0.11 <sup>a</sup>	2.62 <sup>c</sup>
Day -1 , 1500	5	0.03 <sup>a</sup>	1.71 <sup>bc</sup>
Day -1 , 2300	5	0.01 <sup>a</sup>	1.29 <sup>ab</sup>
Day 0 , 0700	5	0.02 <sup>a</sup>	0.49 <sup>ab</sup>
Day 0 , 1500	5	0.01 <sup>a</sup>	0.02 <sup>a</sup>
Day 0 , 2300	5	0.01 <sup>a</sup>	0.00 <sup>a</sup>
Day 1 , 0700	5	0.01 <sup>a</sup>	0.00 <sup>a</sup>
Day 1 , 1500	5	0.01 <sup>a</sup>	0.00 <sup>a</sup>
Day 1 , 2300	5	0.01 <sup>a</sup>	0.00 <sup>a</sup>
Day 2 , 0700	5	0.19 <sup>a</sup>	0.00 <sup>a</sup>
Day 2 , 1500	5	0.25 <sup>a</sup>	0.00 <sup>a</sup>
Day 2 , 2300	5	0.47 <sup>ab</sup>	0.00 <sup>a</sup>

N : number of replicates (number of goats x number of sampling days)  
a, b, c : superscripts a, b, c in a column within a group were significantly different  
( P ≤ 0.05 )

Hormone pattern of each individual studied is available in Appendices 8, 9, 10, 11 and 12.

#### **4.3 PROGESTERONE AND OESTRADIOL LEVELS IN DIFFERENT GOAT GENOTYPES AFTER OESTRUS SYNCHRONIZATION (EXPERIMENT 3)**

Blood was taken on day 1 before CIDR implant was inserted to obtain initial levels of hormone in goats that were undergoing CIDR treatment. Progesterone levels on day 1 were 2.67 ng/ml, 1.17 ng/ml and 0.02 ng/ml whereas oestradiol levels were 69.73 pg/ml, 59.02 pg/ml and 19.33 pg/ml for Jermasia goats, mixed breed goats and Boer crossbred goats, respectively. CIDR implant was inserted on day 2 and this cause progesterone levels to rise immediately after implantation (Figure 41). In Jermasia goats, progesterone level was highest on day 6 (11.02 ng/ml) while Boer crossbred goats and mixed breed goats peak on day 3 (6.81 ng/ml and 5.81 ng/ml). The progesterone levels were then maintained throughout the period the implant was in place with some decrease in the progesterone level as the experiment progressed. Jermasia goats consistently had the highest progesterone levels throughout the whole experiment. Levels of progesterone were lowest in mixed breed goats compared to Boer crossbred goats and Jermasia goats. In mixed breed goats the progesterone levels were lower than the Boer crossbred goats and Jermasia goats on day 1 to 4, 8, 10 to 18 days. Hence , the progesterone levels in the mixed breed goats tend to be the lowest of the breed. On day 12 levels of progesterone for Jermasia goats and mixed breed goats were higher than Boer crossbred goats significantly. The insertion of CIDR implant

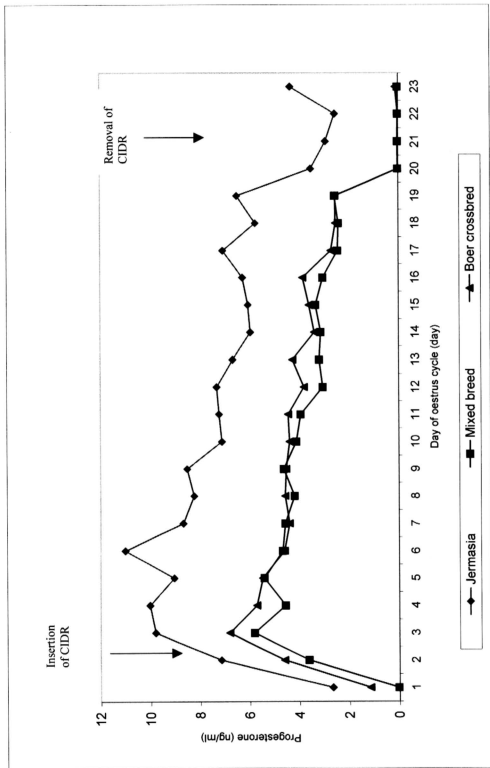


Figure 41. Average progesterone levels in Jermasia goats, Mixed breed goats and Boer crossbred goats undergoing CIDR treatment.

caused a slight drop in oestradiol levels (Figure 42) but later maintained throughout the experimental period. For the oestradiol levels, Jermasia goats had highest levels followed by mixed breed goats and Boer crossbred goats had lowest oestradiol levels. Significantly higher levels of progesterone were seen in Jermasia goats on day 4 to day 10 and day 13 compared to the Boer crossbred and mixed breed goats. While for oestradiol, the trend of hormonal levels did not show significant differences between the breeds except on day 21 for mixed breed goats and Jermasia goats as compared to Boer crossbred goats. While the trend of hormone levels for oestradiol did not show significant difference between the breeds except on day 21 for mixed breed goats and Jermasia goats as compared to Boer crossbred goats.

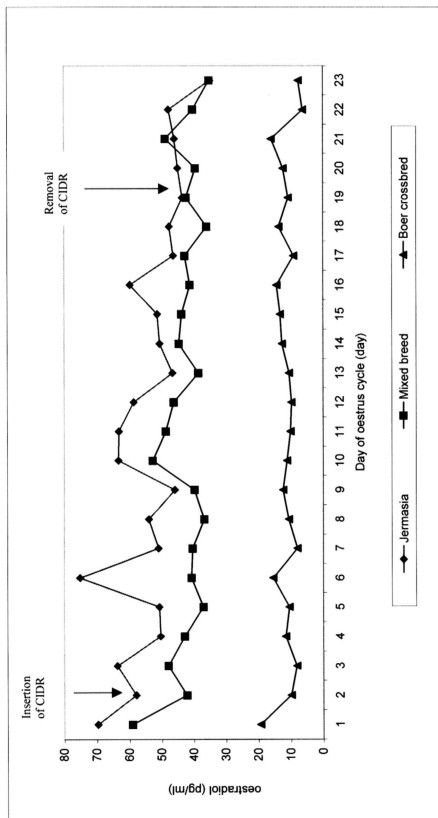


Figure 42. Average oestradiol levels in Jermasia goats, mixed bred goats and Boer crossbred goats undergoing CIDR treatment.