

**FERTILITY OF ESTRUS SYNCHRONIZED  
DAIRY HEIFERS TREATED WITH CAP ALONE  
OR IN COMBINATION WITH ESTRADIOL BENZOATE.  
HCG OR GnRH**

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**SUMMARY**

In 1970, 1971 and 1973 in a single dairy farm a total of 206 German red pied heifers were subjected to synchronization treatment. Treatment schedules consisted of chlormadinone acetate (CAP) given orally daily for 18 days 10 mg/day). Half of the animals were used to measure the effect of additional hormones on conception rate. 31 heifers received 5 mg of estradiol benzoate, 35 animals, 1,000 IU of HCG and 30 heifers 1.5 mg of GnRH 24, 6 and 5 hours before the first insemination, respectively. Estrogen treatment had no-effect on the pregnancy rate (30.8 p. 100 vs. 33.3 p. 100), treatment with 1,000 IU of HCG decreased the conception rate after insemination in the first post-treatment estrus (53 p. 100 vs. 31.4 p. 100 ;  $P < 0.05$ ). An improvement of the pregnancy rate was obtained after injection of 1.5 mg of GnRH (36.4 p. 100 vs. 63.3 p. 100,  $P < 0.05$ ). In heifers treated only with CAP it seems that the occurrence of marked estrous symptoms and the time of ovulation is related with the pregnancy rate. Post-estrous bleeding had no detrimental effect on conception rate. About 80 p. 100 of all experimental heifers, which failed to conceive in the first post-treatment estrus, showed a regular estrous cycle (19-24 days). There was no difference in the average length between the first and second post-treatment estrous cycles.

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**INTRODUCTION**

In cattle estrus can be successfully synchronized using progestins. The conception rate of the treated animals bred at the first post-treatment estrus was variable, but in general low (HANSEL, 1967). Several workers have attempted to improve both the fertility and the degree of synchronization attained following progestin application by injection of additional hormones (estrogen : FULTON *et al.*, 1971 ; GRUNERT and SCHULZ, 1972 ; SCHMIDT *et al.*, 1973 ; ULBERG and LINDLEY, 1960 ;

WILTBANK *et al.*, 1965; HCG : BAKER and COGGINS, 1968; BOYD and TASKER, 1971; GRUNERT and ANDRESEN, 1973; HANSEL *et al.*, 1960; SCHMIDT *et al.*, 1973; SPAHR *et al.*, 1970; PMSG + HCG : BOYD and TASKER, 1971). These treatments had relatively little success. Only BROWN *et al.* (1973) and WAGNER *et al.* (1973) obtained an increased conception rate in synchronized cattle after HCG administration.

The objectives of this study were to investigate the improvement of conception rate in CAP-treated heifers by application of estradiol benzoate, HCG or GnRH shortly before the first insemination.

## MATERIALS AND METHODS

This report summarizes experiences obtained during 3 years of studies. In 1970, 1971 and 1973 in one dairy farm with optimal farm management a total of 206 German red pied heifers were subjected to synchronization treatment. Half of the animals were used to measure the effect of additional hormones on conception rate. These hormones were applied shortly before the first insemination after withdrawal of the progestin.

The 20-24-month-old, cycling heifers, kept under relatively constant maintenance and feeding conditions, received in the above mentioned years in November 10 mg CAP/head/day orally for 18 days. The progestagen was individually administered once daily (morning). In 1970 and 1971 the CAP was given in tablets which were powdered and mixed with the concentrate. The intake of the progestin was good, but not always optimal. In 1973 CAP was given in a liquid form. As the solution had an apple-like aroma it proved to be very palatable to the animals, and they ate all the mixed ration eagerly.

In experiment I (1970) 81 heifers were randomly divided into two groups. The following treatment schedules were employed : 1) CAP (42 heifers, control) ; 2) CAP, followed by a single injection of 5 mg of estradiol benzoate intramuscularly 24 hours before the first insemination (39 heifers).

In experiment II (1971) 73 heifers were treated as follows : 1) CAP (38 heifers, control) ; 2) CAP and 1,000 IU of HCG intravenously 6 hours before the first insemination (35 heifers).

In experiment III (1973) the treatment of 52 heifers consisted of : 1) CAP (22 heifers, control) ; 2) CAP and 1.5 mg of GnRH intramuscularly 5 hours before the first insemination (30 heifers).

All inseminations were carried out with frozen semen by 2 skilled inseminators at the third and also at the fourth day after withdrawal of CAP. Checks for estrus were made twice daily by observation. In experiment II some animals, which still showed marked signs of estrus were inseminated also at the fifth and sixth day. These animals were daily examined rectally between the third and fifth day after the last CAP administration. In experiment III the rectal palpations were carried out at the third and fourth day after the last CAP-feeding. Pregnancies were confirmed by rectal exploration 6-7 weeks after the last insemination.

## RESULTS

In experiment I, 39 CAP synchronized heifers with an additional injection of 5 mg of estradiol benzoate showed — if compared with the 42 only CAP-treated ones — a significant improvement of both external signs of heat (behaviour and discharge of mucus) and internal signs (dilation of the cervix, uterine contractions) on the third day after withdrawal of CAP. Despite improvement of the estrous symptoms the pregnancy rate, resulting from the first breeding period, was found similar to that of the 42 control heifers, which received only CAP (30.8 and 33.3 p. 100 respectively).

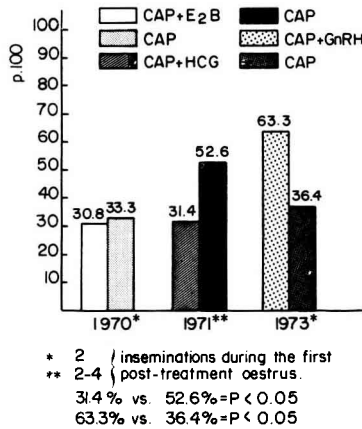


FIG. 1. — Conception rate in 206 CAP-treated heifers bred in the first post-treatment estrus

In experiment III 15.8 p. 100 of the heifers only treated with CAP exhibited marked signs of estrus (behaviour and discharge of clear mucus) on the third day after CAP withdrawal. On the fourth day we observed in 63.2 p. 100 and on the fifth day in 21.0 p. 100 marked estrous symptoms. The corresponding findings in the additional with HCG treated animals were similar (22.9 p. 100, 60.0 p. 100 and 17.1 p. 100, respectively). But these heifers showed a distinct shortening in the duration of both external signs of heat and internal estrous symptoms (dilation of the cervix, uterine contractions, maturation of the follicles). Postestrous bleeding occurred in 60.5 p. 100 of the 38 CAP-treated heifers within a period of 3 days, 69.6 p. 100 of the postestrous bleeding heifers were found at the sixth day. There was no significant difference concerning the occurrence of postestrous bleeding between the CAP-treated heifers and the synchronized animals which additionally received HCG. 2.6 p. 100 of the CAP-treated heifers had ovulated until 10 h a.m. of the 4th day and 34.2 p. 100 until 10 h a.m. of the 5th day after withdrawal of the progestin. The percentage of ovulations in the synchronized HCG-treated heifers was until the fourth day (10 h a.m.) 31.4 p. 100 and reached until 10 h a.m. of the fifth day 74.3 p. 100. The conception rate of the CAP- and additional HCG-treated heifers resulting from the first breeding period was found to be 20 p. 100 lower than that of the only CAP-treated ones (31.4 p. 100 and 52.6 p. 100, respectively; P < 0.05).

In experiment III 68.2 p. 100 of all synchronized heifers exhibited marked signs of estrus three days and 31.8 p. 100 four days after the last feeding of CAP. Ovulation occurred until the 4th day (11 h a.m.) after withdrawal of the progestin in 31.8 p. 100 of the 22 CAP-treated heifers and in 16.7 p. 100 of the 30 CAP and GnRH-treated ones. Postestrous bleeding was observed in 32 of all the 52 synchronized heifers (61.5 p. 100) from the fourth until the sixth day after the last feeding of CAP. 53.1 p. 100 of all the 32 postestrous bleeding heifers were found at the 5th day. There was no apparent difference between the two groups concerning occurrence of estrus and postestrous bleeding. In experiment III the peak of occurrence of heat and post-estrous bleeding occurred one day earlier and the signs of estrus were generally more marked than in experiment II. The pregnancy rate of

the CAP and GnRH-treated heifers was 26.9 p. 100 higher than that of the CAP-treated animals (63.3 and 36.4 p. 100, respectively;  $P < 0.05$ ).

In experiments I-III about 80 p. 100 of all animals which failed to conceive in the first post-treatment estrus, showed a regular estrous cycle. The percentage of shortened or prolonged estrous cycles does not deviate from non synchronized heifers. Only the heifers which in addition received 5 mg of estradiol benzoate had a high percentage of irregular prolonged estrous cycles. The difference to the other groups is statistically significant ( $P < 0.05$ ) (fig. 2). There was no difference in the average length between the first and second post-treatment estrous cycles (fig. 3).

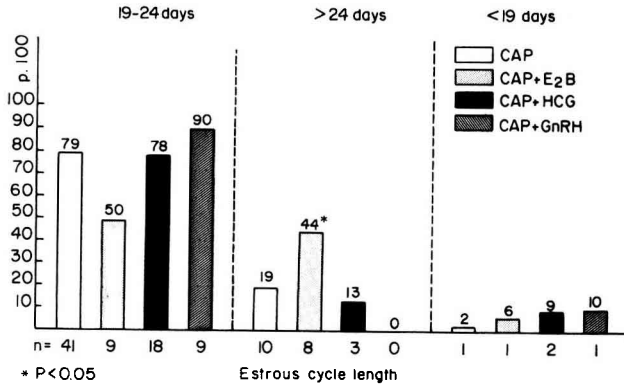


FIG. 2. — Length of estrous cycle in 103 CAP-treated dairy heifers, which failed to conceive in the first post-treatment estrus

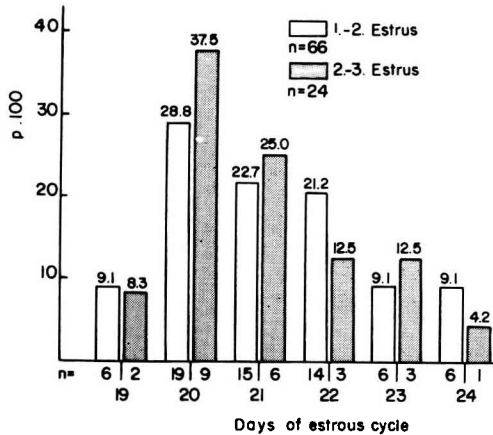


FIG. 3. — Length of first and second synchronized estrous cycle in 66 repeat breeding heifers

## DISCUSSION

The pregnancy rate of the experimental heifers bred at the first estrus following CAP administration ranged between 33.3 and 52.6 p. 100. These results are lower than those usually obtained in non-synchronized ones. The precise cause of this subfertility remains unknown.

The fact that some investigators obtained an excellent fertility in the first synchronized breeding period (VAN BLAKE *et al.*, 1963) suggests that in synchronized cattle the fertility is not reduced *per se*.

In all three experiments the occurrence of the first estrus and also the time of ovulation after withdrawal of CAP were not exactly synchronized. BUSCH *et al.* (1972) reported that in CAP-treated heifers the ovulations scattered over six days. Therefore, no optimal service time could be determined. A better synchronization and a higher conception rate in the first post-treatment estrus were observed after administration of MAP (HANSEL *et al.*, 1966). In CAP-treated heifers an improvement of the conception rate could be attained by increasing the number of inseminations in the first estrus after progestin withdrawal. We registered in 1970 and 1973 after a total of 2 inseminations in 24-hour-intervals in the first post-treatment heat a conception rate of 33.3 and 36.4 p. 100 respectively. In 1971 after 2-4 inseminations under the same conditions the pregnancy rate was 52.6 p. 100. BUSCH and SCHNELL (1969) obtained with 2-8 inseminations a pregnancy rate of 82 p. 100 in CAP-treated heifers.

Using additional hormones we observed an improvement of the pregnancy rate only after injection of GnRH 5 hours before the first insemination.

Despite improvement of the estrous symptoms in the additionally estradiol-treated heifers, the pregnancy rate resulting from the first post-treatment breeding period was found to be similar to that of the control heifers which received only CAP. This finding is in close agreement with that reported by ULBERG and LINDLEY (1960) and SCHMIDT *et al.* (1973).

The cause of the lowered conception rate in heifers additionally treated with HCG is not known. The ovulation rate in these animals until the 5th day after withdrawal of CAP was 74.3 p. 100 and in the controls only 34.2 p. 100 ( $P < 0.001$ ). A decreased pregnancy rate in CAP- or MAP-synchronized cattle after HCG application was also obtained by SCHMIDT *et al.* (1973) and SPAHR *et al.* (1970).

TABLE I

*Relationship between the occurrence of marked signs of estrus after withdrawal of CAP and the pregnancy rate*

Treatment	N° of cattle	Animals in		Animals in		Animals in	
		heat on 3rd day	animals pregnant	heat on 4th day	animals pregnant	heat on 5th day	animals pregnant
CAP (1971) <sup>(1)</sup>	38	6	0	24	17 (70.8 %)	8	3 (37.5 %)
CAP (1973) <sup>(2)</sup>	22	15	7 (46.7 %)	7	1 (14.3 %)		
CAP + GnRH <sup>(2)</sup>	30	23	13 (56.5 %)	7*	5 (71.4 %)		

<sup>(1)</sup> 2-4 inseminations during the 1st synchronized estrus.

<sup>(2)</sup> 2 inseminations during the 1st synchronized estrus.

\* 2 heifers without marked signs of estrus.

The increased conception rate in synchronized cattle after HCG administration reported by BROWN *et al.* (1973) and WAGNER *et al.* (1973) may be attributed to the differences concerning time and route of HCG application.

It seems that the conception rate of heifers treated only with CAP is related to the appearance of marked estrous symptoms (table 1). It seems also that the pregnancy rate of these heifers is related with the time of ovulation (table 2). Concerning the fact that the animal numbers in experiment III is small, the difference is not significant. The difference between the CAP-treated heifers which ovulated after the fourth day and the corresponding additionally with GnRH treated animals is significant ( $P < 0.05$ ). This led to the conclusion that GnRH had an effect on synchronized heifers which did not ovulate until the fourth day after withdrawal of CAP (table 2).

TABLE 2

*Relationship between the time of ovulation after withdrawal of CAP and the pregnancy rate*

Treatment	N° of cattle	Animals ovulated		Animals ovulated	
		before the 5th day (10 h a.m.)	animals pregnant	after the 5th day (10 h a.m.)	animals pregnant
CAP (1971) <sup>(1)</sup>	38	13	12 (92.3 %)	25	10 (40 %)*

Treatment	N° of cattle	Animals ovulated		Animals ovulated	
		before the 4th day (11 h a.m.)	animals pregnant	after the 4th day (11 h a.m.)	animals pregnant
CAP (1973) + <sup>(2)</sup>	22	7	4 (57.1 %)	15	4 (26.7 %)**
CAP + GnRH <sup>(2)</sup>	30	5	3 (60 %)	25	16 (64 %)**

<sup>(1)</sup> 2-4 inseminations during the first post-treatment estrus.  
<sup>(2)</sup> 2 inseminations during the first post-treatment estrus.  
\* 92.3 % vs. 40 % =  $P < 0.01$ .  
\*\* 26.7 % vs. 64 % =  $P < 0.05$ .

In all three experiments postestrous bleeding did not influence the pregnancy rate. 49 p. 100 of the CAP-treated heifers with metrorrhagia and 51 p. 100 of the non bled synchronized heifers conceived.

The three experiments have led to the following conclusions :

I. After individually feeding dairy heifers with 10 mg of CAP per day for 18 days estrus and the time of ovulation scattered over more than 3 days. Therefore, no optimal service time could be determined.

2. In heifers only treated with CAP the conception rate ranged from 33.3-36.4 p. 100, where these heifers were artificially inseminated without regard to estrus on Days 3 and 4 following the cessation of CAP feeding.

3. Using additional hormones a significant improvement of the pregnancy rate in CAP synchronized dairy heifers was only obtained by injection of 1.5 mg of GnRH 5 hours before the first insemination.

4. The high percentage of regular estrous cycles in the synchronized repeat breeding heifers suggests that the major causes of the reduced fertility are to be found in events occurring at or about the time of ovulation and fertilization (HANSEL, 1967).

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## RÉSUMÉ

FERTILITÉ A L'ŒSTRUS SYNCHRONISÉ CHEZ DES GÉNISSES TRAITÉES AU CAP SEUL OU EN COMBINAISON AVEC DU BENZOATE D'ŒSTRADIOL DE L'HCG OU DU GnRH

En 1970, 1971 et 1973, 206 génisses *Pie-rouges* appartenant au même élevage laitier ont été soumises à un traitement de synchronisation des cycles œstriens à l'aide d'une administration orale et journalière de chlormadinone acétate (CAP) pendant 18 jours (10 mg/jour). La moitié des animaux a été utilisée pour analyser l'effet d'une addition d'autres hormones sur la fertilité.

Trente et une génisses ont reçu 5 mg de benzoate d'œstradiol, 35 1 000 UI de HCG et 30 1,5 mg de GnRH respectivement 24, 6 et 5 heures avant la première insémination. Le traitement d'œstrogènes n'a pas eu d'effet sur le pourcentage de gestations (30,8 p. 100, 33,3 p. 100). Le traitement avec 1 000 UI de HCG a diminué le pourcentage de fertilité après insémination lors de la première chaleur après traitement. Après injection de 1,5 mg de GnRH on obtient une augmentation du pourcentage de fécondité (36,4 p. 100, 63,3 p. 100,  $P < 0,05$ ). Chez les génisses traitées simplement avec du CAP il semble que les symptômes de chaleurs extériorisés et le moment de l'ovulation soient en relation directe avec le pourcentage de fertilité. Un saignement post œstral n'a pas d'effet précis sur la fécondité. 80 p. 100 des génisses soumises à l'essai, qui n'ont pas été fécondées, montraient un cycle œstral régulier (19-24-jours). Il n'y a pas de différence en ce qui concerne la durée moyenne du premier et du second cycle après le traitement.

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