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THE EFFECT OF ARTIFICIALLY EXTENDED PHOTOPERIOD DURING LACTATION ON MATERNAL PERFORMANCE OF THE SOW[1]

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Summary

A 20-stall farrowing facility was partitioned into two separate rooms of 10 stalls each so that photoperiod could be controlled. In addition, temperature and air movement were equalized in the two rooms. The two light regimens utilized were 8 h light: 16 h dark, and 16 h light:8 h dark. A total of 26 sows in two replicates were used. Females were moved into the facility on d 103 ±2 of pregnancy, litters were equalized at birth and weaning was at 28 d of age. Traits evaluated included litter size at birth and weaning, 21-d pig and litter weights, milk yield on d 15, survival rate and number of days from weaning to estrus for the sow. The number of pigs born alive was similar across treatments. However, after equalization of litter size, differences in the number weaned/litter were significant (P<.05) as sows exposed to 16 h of light weaned approximately one pig more per litter. The survival rate within each litter from birth (after equalization) to 21 d of age was greater (P<.05) for sows exposed to 16 h light (91.2%) than for those from sows exposed to 8 h light (81.5%). Milk yield at d 15 was measured for 21 of the sows. The sows exposed to 16 h light produced significantly more milk (P<.05) than sows exposed to 8 h light. The time from weaning to first estrus was similar for each treatment group.

(Key Words: Photoperiod, Lactation, Milk Yield, Maternal Performance, Sow.)

Introduction

Maternal performance of sows during lactation in swine has not been significantly improved in the last 20 yr in spite of progress in nutrition and breeding programs. Neonatal death loss in swine is of major importance, because 20 to 25% of pigs farrowed alive die before weaning (ARS, 1965). Fahmy and Bernard (1971) have shown that from 20 to 30% of this baby pig mortality is due to a lack of adequate nutrition and that 20 to 50% is due to crushing by the sow. At least some of the pigs are laid on because of inactivity due to inanition. It is possible, then, that increases in the energy intake of baby pigs could decrease baby pig mortality.

One method of increasing the energy the baby pig receives would be to increase the milk production of the sow. Lactational production has been shown to be associated with level of prolactin (Cowie, 1969; Turner and Bagnara, 1971; Anderson, 1974; Tucker, 1974). In addition, increased light period has been shown to increase prolactin concentrations in sheep (Forbes et al., 1975; Pelletier and Ortavant, 1975), goats (Buttle, 1974; Hart, 1975) and cattle (Bourne and Tucker, 1975). Research with dairy cattle (Peters et al., 1978a, b) has demonstrated that a 16 h photoperiod increased milk production by 10 to 15% and increased body growth compared to an 8 h photoperiod. On the basis of data from other species, exposure of sows to increased photoperiod during lactation should promote increased milk production and thus greater baby pig survival and growth rates. Moreover, Komorov and Turkov (1973) demonstrated that additional lighting during the night reduced mortality rate. Photoperiod in confinement farrowing facilities could be controlled easily by either manual control or automatic timers on the lighting system.

The objectives of this investigation were to determine the effects of an extended photoperiod during lactation on milk yield at d 15 of lactation, 21 d pig and litter weights, baby pig survival to 21 d, and subsequent rebreeding performance of the sows.

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TABLE 1. MILK YIELD ON DAY 15 OF LACTATION BY TREATMENT AND REPLICATE[a]

Treatment	Milk yield (kg)		
	Replicate 1	Replicate 2	Overall
8L:16D[b]	6.73 (4)[c]	5.21 (7)	5.76[d](11)
16L:8D	7.71 (4)	6.81 (6)	7.17[e](10)

[a]Least-squares means.

[b]8L:16D = 8 h light:16 h dark; 16L:8D = 16 h light:8 h dark.

[c]Number in parenthesis is number of litters.

[d,e]Means within a column with different superscripts differ ($P<.05$).

Materials and Methods

A total of 26 sows were used in replicates. Replicate 1 consisted of 13 Yorkshire × Landrace primiparous sows that farrowed in August. Replicate 2 consisted of 13 Yorkshire crossbred multiparous sows that farrowed in October. All sows were housed in an open-sided gestation unit before being moved into the farrowing facility on d 103 ±2 of gestation. Sows were randomly assigned to 8 h (8L:16D) or 16 h (16L:8D) of white fluorescent light (400 to 500 lux) per day when placed in the farrowing house. The farrowing house consisted of two identical chambers, each containing 10 farrowing crates. All windows were covered to eliminate natural light. Temperature in the chambers ranged from 21 to 35 C and relative humidity ranged from 60 to 79%, and were equal for both sides at all times. Sows were fed a 14% crude protein corn-soybean meal lactation diet according to the following schedule: 1.82 kg prior to parturition, .91 kg on d 1 of lactation, 1.82 kg on d 2, 2.73 kg on d 3 and 5.45 kg on d 4 and for the remainder of lactation. Water was available at all times.

Sows were induced to farrow on d 110 to 114 of gestation with 10 mg prostaglandin $F_2\alpha$ and litters were adjusted to equal numbers across treatments within 36 h after farrowing by transfer of average size male pigs. Supplemental heat was provided for baby pigs by .30 × .91 m electric heating pads.

Litter traits measured included baby pig survival rate to 21 d (number of pigs alive at 21 d ÷ adjusted litter size × 100), 21-d litter weight, percentage of sows returning to estrus after weaning and number of days to post-weaning estrus. In addition, milk yield was determined on d 15 of lactation for 21 randomly selected sows. Milk yield was determined by the weigh-suckle-weigh procedure of Lewis et al. (1978). Pig traits measured included birth weight, 21-d weight and survival to 21 d.

The statistical model used for analysis of the litter traits was:

$$Y_{ijkl} = \mu + r_i + g_j + t_k + (rt)_{ik} + (gt)_{jk} + e_{ijkl},$$

where

$i = 1, 2 \quad j = 1, \ldots, 6 \quad k = 1, 2$

and

μ = overall mean,
r = effect due to i^{th} replicate,
g = effect due to the j^{th} group within the i^{th} replicate,
t = effect due to the k^{th} treatment,
$(rt)_{ik}$ = effect due to the interaction of the i^{th} replicate with the k^{th} treatment,
$(gt)_{jk}$ = effect due to the interaction of the j^{th} group with the k^{th} treatment and
e = random error.

The statistical model used for analysis of the pig traits was:

$$Y_{ijklmno} = \mu + b_i + w_j + s_k + p_l + t_m + g_n + (wt)_{jm} + e_{ijklmno},$$

where

$i = 1, \ldots, 4 \quad j = 1, \ldots, 4 \quad k = 1, 2 \quad l = 1, 2$
$m = 1, 2 \quad n = 1, \ldots, 6$

and

μ = overall mean,
b = effect due to i^{th} breed of sire,
w = effect due to j^{th} birth weight class,
s = effect due to k^{th} sex,
p = effect due to l^{th} parity of dam,
t = effect due to m^{th} treatment,
g = effect due to n^{th} group within the l^{th} parity,

TABLE 2. LITTER TRAITS FOR SOWS EXPOSED TO 8 OR 16 H OF LIGHT PER DAY

Trait	8L:16D	16L:8D
No. born alive[b]	11.1	9.9
No. weaned	8.4[c]	9.3[d]
Survival rate, %	81.5[c]	91.2[d]
21-d litter weight, kg	39.0[c]	44.8[d]

[a]Least-squares means.

[b]Litter size was equalized across treatment prior to 36 h of lactation.

[c,d]Means in same row with different superscripts differ (P<.05).

$(wt)_{jm}$ = effect due to the interaction of the j^{th} birth weight class with the m^{th} treatment and

e = random error.

All litter traits and pig traits were analyzed by the least-squares procedure of the Statistical Analysis System (Barr et al, 1979) using the models previously described.

Results and Discussion

Analysis of variance results revealed that length of photoperiod affected (P<.05) number of pigs weaned, 21-d litter weight, litter survival percentage, milk yield and 21-d pig weight. Furthermore, replicate had significant effects on number weaned (P<.05) and 21-d litter weight (P<.05). Twenty-one day pig weight was also affected by breed of sire (P<.05), birth weight class (P<.01), sex (P<.01), parity (P<.05) and group (P<.05).

The effects of treatment and replicate on milk yield are shown in table 1. Sows exposed to 16 h light produced significantly heavier milk yields (P<.05) than sows exposed to 8 h light. This finding is in agreement with the results of Peters et al. (1978a, b) who reported a 10 to 15% increase in milk production of dairy heifers exposed to 16 h of light compared to 8 h of light. The mechanism by which the increased photoperiod and increased milk yield is related in the sow, however, is not known. Lactational production has been shown to be associated with level of prolactin, and increased light period has been shown to increase prolactin levels in sheep (Forbes et al., 1975; Pelletier and Ortavant, 1975), goats (Buttle, 1974; Hart, 1975), and cattle (Bourne and Tucker, 1975). Therefore, possible explanations include hormonal differences or an increased suckling frequency with the increased photoperiod. The effects of light in stimulating milk yields could be by a direct effect on the sow, on the litter, or a combination of both.

In this experiment the first replicate consisted of multiparous sows. Thus, replicate and parity were confounded. There was no difference (P>.05) between the replicates in milk yield, although the Landrace × Yorkshire primiparous sows in replicate 1 produced slightly more milk than the Yorkshire crossbred multiparous sows in replicate 2.

The litter traits of sows are shown in table 2. Although the difference was not significant, there were more pigs born alive from sows in the 8 h light treatment than from sows in the 16 h treatment; however, since the treatment was not imposed on the sows until 7 d prior to parturition this might have been a chance difference. After litter size was equalized across treatments, sows exposed to 16 h light weaned more (P<.05) pigs than sows exposed to 8 h light. This is in agreement with Komorov and Turkov (1973).

Survival rate to 21 d for each birth weight

TABLE 3. SURVIVAL RATE[a] OF PIGS, BY BIRTH WEIGHT CLASS AND TREATMENT

	Weight at birth, kg			
Treatment	<.91[b]	.91 to 1.14	1.14 to 1.36	>1.36
	Survival rate, %			
8L:16D	29.1[c] (9)[c]	54.6[c] (12)	80.6[c] (24)	91.0 (84)
16L:8D	66.8[d] (6)	100.0[d] (9)	95.2[d] (31)	94.3 (75)

[a]Least-squares means.

[b]Number in parenthesis is number in each cell.

[c,d]Means within a column with different superscripts differ (P<.05).

TABLE 4. PROPORTION OF SOWS RETURNING TO ESTRUS AND MEAN INTERVAL TO ESTRUS, BY TREATMENT

Treatment	Proportion of sows returning to estrus	Days to estrus[a]
8L:16D	10/13 (77%)	6.1 ± 1.0
16L:8D	10/13 (77%)	5.9 ± 1.0

[a]Mean ± SE.

class is shown in table 3. There were no differences in survival among pigs weighing 1.36 kg (three pounds) or more at birth. However, pigs in all other weight classes had significantly greater (P<.05) survival to 21 d. This was perhaps attributable to the increased milk yield of the dams exposed to the longer photoperiod. Furthermore, the 21-d litter weight was greater (P<.05) for sows in the 16 h light compared to those in 8 h light. This was due to a combination of larger litter size at 21 d due to better survival and heavier pig weights at 21 d. This finding is in general agreement with other research showing that extended photoperiod accelerates growth in boars (Mahone et al., 1979), lambs (Forbes et al., 1975), dairy heifers (Peters et al., 1978a, b) and broilers (Moore, 1957).

The effect of photoperiod on rebreeding performance is shown in table 4. No differences due to treatment were seen in the proportion of sows returning to estrus or in the interval to estrus.

In conclusion, an increase in photoperiod from 8 to 16 h light increased milk yield, baby pig survival to 21 d and 21-d pig weight while not influencing rebreeding performance.

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