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Abstract: Fifty-two weanling pigs from six litters(Pond et al., 1968) were fed a standard 18% protein corn-soybean meal diet from weaning to slaughter. The six litters were from gilts paired on the basis of parturition date so that one gilt fed the control diet and one fed the "protein-free" diet (0.5% protein) from week 4 of pregnancy to parturition made tip each pair. Each dam was fed the control diet throughout lactation and nursed one-half of her own litter and one-half of a pairmate's litter resulting from reciprocal transfer of one-half of each litter at birth. Individual bodyweight gains and feed consumption of each litter recorded from weaning to slaughter at 93 kg. revealed no differences associated with prenatal or preweaning treatment. Carcass backfat and cross-sectional area of the I. dorsi muscle between the 10th and 11th ribs also failed to reveal differences in carcass characteristics which could be considered as a crude index of muscle cell number as influenced by prenatal and early postnatal protein nutrition. It is concluded that in pigs the dam acts as an efficient "buffer" to at least partially protect the developing fetus against the effects of maternal protein deprivation during the final three-fourths of one gestation period.

WEIGHT GAIN AND CARCASS MEASUREMENTS OF PIGS FROM GILTS FED ADEQUATE *VS.* PROTEIN-FREE DIETS DURING GESTATION [1]

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The effect of protein levels of swine gestation diets on postnatal growth and development of the progeny has received only limited attention. Clawson *et al.* (1963) and Rippel *et al.* (1965) reported normal reproduction in gilts fed 5% protein diets. Normal reproduction has also been reported in gilts fed diets almost devoid of protein from day 24 of pregnancy to parturition (Pond *et al.*, 1968). The present data describe the postweaning weight gain and carcass characteristics of pigs from those gilts.

Materials and Methods

The animals used in this experiment were continued from a previous experiment (Pond *et al.*, 1968). Briefly, the previous experiment involved a comparison of the reproductive performance (number of pigs per litter, individual pig birthweight and livability) and lactation performance (preweaning weight gains and weaning weight of pigs) of three gilts fed a protein-free diet from week 4 of pregnancy to parturition and three fed an adequate diet throughout gestation. Reciprocal transfer of one-half of each litter at 2 days of age to a foster dam produced weight gains in favor of pigs suckling control gilts, indicating a greater effect of postnatal than of prenatal treatment on weaning weight.

The present report describes the postweaning performance of 52 pigs from six litters representing the four previous treatment groups: (1) pigs from "protein-free" dams (fed a protein-free diet during gestation) and kept with their own dam through the suckling period (PF–PF), (2) pigs from "protein-free" dams but transferred to foster "control" dams (fed an adequate diet during gestation) through the suckling period (PF–C), (3) pigs from "control" dams but transferred to foster "protein-free" dams through the suckling period (C–PF) and (4) pigs from "control" dams and kept with their own dam through the suckling period (C–C). The six litters were from gilts paired on the basis of parturition date so that one C and one PF gilt made each pair. Dams were fed 1.82 kg. of feed daily throughout gestation and *ad libitum* on the complete diet throughout lactation. All pigs were castrated at 3 to 4 wk. and weaned at 6 wk. of age. At this time, full-sibs were penned together in 3 x 3.5 m. concrete-floor pens and fed a standard 18% protein corn-soybean meal diet from a wooden self-feeder to slaughter weight of approximately 93 kg. Feed consumption of each litter was recorded. Water was supplied twice daily from cast iron troughs.

A blood sample was taken from the anterior *vena cava* of each pig midway through the postweaning period (90 to 110 days of age) for serum protein determination (Gornall *et al.*, 1949).

Carcass measurements were taken on the chilled carcass after 24 hr. at 4° C. These were backfat (average of three measurements taken on the split carcass at the first rib, last rib and last lumbar vertebra), length (anterior edge of first rib to pubic bone) and cross-sectional area of the *longissimus dorsi* muscle (as determined by planimeter from a tracing of the cut surface between the 10th and 11th rib).

The data were treated statistically by analysis of variance of unweighted means as illustrated in table 2. The means square for prenatal × pair interaction was used to test the prenatal effect and the residual mean square was used to test postnatal and prenatal × postnatal effects.

Results and Discussion

The results are summarized in table 1 and the mean squares from analyses of variance are in table 2. There were no significant differences related to prenatal or preweaning treatment for any of the criteria considered except for a difference in initial (weaning)

[1] Grateful acknowledgments are due Robert White, James O'Connor and George Kiger for their assistance in this work.
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TABLE 1. EFFECT OF GESTATION DIET OF GILTS ON SUBSEQUENT GROWTH AND CARCASS MEASUREMENTS OF THE OFFSPRING

Gestation diet of dam	Control			Protein-free		
Item / Gestation diet of gilt suckled	Control	Protein-free	Combined	Control	Protein-free	Combined
No. of pigs	15	13	28	12	12	24
Weaning wt., kg.	9.7	8.2	9.0	10.0	8.0	9.0
Daily gain, postwean., gm.	677	716	697	716	728	722
Age at slaughter, da.	167	161	164	159	158	159
Slaughter wt., kg.	93.0	92.7	92.9	93.0	91.0	92.5
Da. gain, birth to slaughter, gm.	557	571	564	583	578	581
Backfat, cm.	3.28	3.26	3.27	3.03	3.26	3.15
Area of *l. dorsi*, cm.^{2}	28.3	26.8	27.6	26.8	26.0	26.4
Length, cm.[a]	75.7	74.9	75.3	75.6	74.0	74.8
Serum protein, gm./100 ml.[b]	6.6	6.4	6.5	7.0	7.1	7.1
Gain/unit feed, kg.	....	....	0.354	....	....	0.359

[a] C–C and PF–C greater than PF–PF and C–PF (P<.01).
[b] PF–PF and PF–C greater than C–PF and C–C (P<.01). Also, prenatal×postnatal interaction (P<.01)

weight in favor of pigs suckling control gilts regardless of prenatal treatment. Also, serum protein of pigs born to PF dams was significantly higher (P<.01) than that of pigs born to C dams and carcasses of pigs that had suckled C gilts were slightly longer (P<.01) than those of pigs that had suckled PF gilts. The biological significance of these differences is not clear. In the case of serum protein, it would appear that this might be a compensatory response since serum protein of these pigs was lower than that of pigs from C gilts at birth (Pond *et al.*, 1968). One might have expected a detrimental effect on subsequent performance of pigs from PF gilts based on earlier work in which low protein gestation diets were used (Evvard *et al.*, 1914; Jespersen and Olsen, 1940) and on the relationship between cell number established during early life and subsequent growth (Hammond, 1962). However, Rippel (1967) concluded, from an exhaustive review of the subject that "the usual criteria of reproductive performance (total and live pigs farrowed, birthweight and livability) are unresponsive to various levels of protein during the last third of gestation." Widdowson

TABLE 2. MEAN SQUARES OF ANALYSIS OF VARIANCE OF SEVERAL CRITERIA

		M.S.				
Source of variation	d.f.	Wean. wt.	Postwean. gain	Postwean. ADG	Age at slaughter	ADG, birth to slaughter
Prenatal	1	0.46	1.98	8707	364.71	3194
Pair	2	2.36	4.28	5071	214.87	1880
Prenatal × pair	2	5.06	20.52	15921	708.02	6440
Postnatal	1	38.71*	14.01	7376	102.81	297
Prenatal × postnatal	1	0.94	0.19	1985	65.78	1049
Pair × postnatal; Prenatal × pair × postnatal	4	11.82	17.69	2831	195.91	1584
Residual	40	2.00	7.45	3504	158.31	1633
	d.f.	Slaughter wt.	Backfat	Loin eye area	Length	Serum protein[a]
Prenatal	1	1.99	0.19	16.0	3.4	3.05**
Pair	2	5.18	0.23	11.1	12.8	0.69
Prenatal × pair	2	6.01	0.30	28.1	8.2	0.04
Postnatal	1	6.05	0.14	16.6	17.5*	0.02
Prenatal × postnatal	1	2.04	0.19	1.1	1.6	0.34
Pair × postnatal; Prenatal × pair × postnatal	4	3.88	0.10	1.4	4.1	0.11
Residual	40	6.11	0.10	12.1	2.4	0.16

[a] One blood sample was lost, therefore, residual d.f. is 39 for serum protein.
* P<.01.

and McCance (1960) obtained differences which persisted to adulthood in body size of rats fed a low or high plane of nutrition up to weaning. The implication was that a restricted plane of nutrition at this stage of development limited permanently the cell number. Winick and Noble (1966) have suggested that cell number is established during late prenatal life in the rat, whereas Joubert (1956) has suggested that the increase in muscle cell number in the sheep ceases after the third month of fetal life. The corresponding time in the pig is not known, but it is probable that the pig more nearly resembles the rat than the sheep (Hammond, 1962).

Since there was only a small and statistically nonsignificant reduction in birthweight of pigs from PF gilts used in the present study, it would appear that the nutritional environment of the fetus was not greatly affected by deprivation of dietary protein to the dam from week 4 of pregnancy to parturition. If this was the case, the effect on cell number was minimal and perhaps nil. This would account for the lack of prenatal treatment on subsequent weight gain and carcass measurements observed.

There is a considerable body of data in the literature showing an effect of level of energy intake during early life on subsequent performance of pigs (McMeekan, 1940a,b,c; Lucas *et al.*, 1962; Robinson, 1964; Nielsen, 1964). However, Meade (1967) found no effect of diet from 3 to 8 or 9 wk. of age on subsequent performance or carcass measurements. Elsley and McDonald (1964) concluded from their own data and from recalculations of the data of McMeekan (1940a,b,c) that plane of nutrition has no effect on the carcasses of pigs when variations in fat content are excluded. In the present experiment the small, but statistically significant, greater initial (weaning) weight of C–C and PF–C pigs as compared to C–PF and PF–PF pigs apparently did not represent a sufficient difference to significantly affect subsequent performance. It is concluded that the gilt acts as an efficient "buffer" to at least partially protect the developing fetus against the effects of maternal protein deprivation extended over the final three-fourths of one gestation period.

Summary

Fifty-two weanling pigs from six litters (Pond *et al.*, 1968) were fed a standard 18% protein corn-soybean meal diet from weaning to slaughter. The six litters were from gilts paired on the basis of parturition date so that one gilt fed the control diet and one fed the "protein-free" diet (0.5% protein) from week 4 of pregnancy to parturition made up each pair. Each dam was fed the control diet throughout lactation and nursed one-half of her own litter and one-half of a pairmate's litter resulting from reciprocal transfer of one-half of each litter at birth. Individual bodyweight gains and feed consumption of each litter recorded from weaning to slaughter at 93 kg. revealed no differences associated with prenatal or preweaning treatment. Carcass backfat and cross-sectional area of the *l. dorsi* muscle between the 10th and 11th ribs also failed to reveal differences in carcass characteristics which could be considered as a crude index of muscle cell number as influenced by prenatal and early postnatal protein nutrition. It is concluded that in pigs the dam acts as an efficient "buffer" to at least partially protect the developing fetus against the effects of maternal protein deprivation during the final three-fourths of one gestation period.

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