IMPROVING SOW EFFICIENCY BY MANAGEMENT
TO ENHANCE OPPORTUNITY FOR NUTRITIONAL INTAKE
BY NEONATAL PIGLETS$^1,2$

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ABSTRACT

Starvation, primarily during the first week postpartum, is the direct or indirect cause of at least one-half of preweaning mortalities in healthy herds. Causes of starvation originate from characteristics of the dam, of the litter and of individual piglets. A major cause of starvation is congenital weakness associated with birth weights <1000 g. Increasing energy during late gestation shows inconsistent effects on birth weight; some dietary component energy sources appear to improve stamina of newborn and/or energy content of sow’s milk with favorable effects on survival. Total or partial supplemental nutrient intake supplied by caretakers, automated feeding devices or transfer of piglets to foster dams are the primary means of providing enhanced nutrient intake opportunity.

Nutrient intake from non-dam sources ranges from temporary tube-feeding, administered by caretakers to excessively small or weak pigs, to self-feeding by pigs from simple or sophisticated dispensers of sow milk substitutes. Transfer of piglets to foster dams as a nutrient intake source is most successful when characteristics such as size of dam, size of teats, stage of lactation and temperament are in harmony with characteristics affecting pigs’ needs. If other dams are not available, sows 2 to 3 wk into lactation can serve as foster dams for large and strong newborn piglets after resident litters are removed. Planning for availability of appropriate foster dams, based on prior or projected prolificacy and other sow and litter traits, should be done at time of assembling each mating group. Research results show that, on a weight-to-weight basis, pigs requiring artificial or foster dam rearing perform similarly to other pigs and thus justify management to secure their survival. (Key Words: Piglets, Neonates, Survival.)

Introduction

Increasing the number of pigs produced per sow per year is a major means of improving efficiency of sow productivity. Weaning pigs at the youngest age consistent with adequate performance by the early-weaned pigs and non-impaired next reproduction by the dam is an application of this principle, as also are genetic programs and management practices designed to maximize number of pigs born per litter and to achieve individual birth weights of 1 kg or more to enhance capability for survival. Inasmuch as both the number of pigs per litter in excess of sow nursing capacity and the occurrence of 15 to 20% of pigs with birth weights less than that needed for high percentage survival are common (Vestal, 1938; England and Day, 1970; Fahmy and Bernard, 1971; English, 1985), management practices capable of supporting such piglets during the early postnatal period to weaning of the litter are essential.

As the number born per litter increases, there is also an increase in the number of pigs that cannot be cared for well enough by the sow to ensure a concurrent continuous increase in number weaned per litter. By d 3 or 4 postpartum each pig has selected a nipple that it nurses essentially exclusively (McBride, 1963; Hartsock et al., 1977). Maximum number reared by a given dam is thus limited to the number of functional teats.

Birth weight within litters varies from less than .5 kg to more than 2.0 kg. During the first postnatal days, competition for nursing position is considerable (Hartsock et al., 1977), resulting in dissipation of energy and failure of
adequate milk intake by many smaller pigs. Piglets reared by sows require colostral intake not only nutritionally but also for acquisition of initial passive immunity. The dam is generally receptive to piglets other than her own; thus, she can, up to the limit of number of functional teats, be used as a foster dam concurrently with or instead of nursing her natural litter. This attribute can, to some extent, adjust the inequity of number of pigs and number of functional teats. Inasmuch as starvation is the most prevalent cause of preweaning death (Fahmy and Bernard, 1971; English and Smith, 1978), the purpose of this paper is to present information relevant to enhancing livability of neonatal piglets, and thus sow efficiency, through management programs to achieve nutritional status of piglets sufficient to permit their survival.

**Nutrients for Neonatal Pigs**

Pigs are born with little fat that can be mobilized to provide energy, and with poor gluconeogenic capacity during animation. They are, therefore, dependent on glycogen stores and colostrum and milk intake to maintain adequate blood glucose levels (Spence et al., 1985). Even for nursing pigs, concentration of liver glycogen is reported to decline by as much as 70% during postnatal d 1 (Okai et al., 1978).

Potential sources of beneficial dietary influence on survival status of postnatal piglets have been extensively investigated. McCance and Widdowson (1959) established that carbohydrate is the chief energy reserve used by fasted newborn pigs. Goodwin (1957) concluded that the metabolism of the newborn pig is dependent upon the concentration of circulating blood sugars, and that metabolic stability is dependent on the pig's ability to regulate carbohydrate metabolism. Studies, including those by Becker et al. (1954), Curtis et al. (1966) and Aherne et al. (1969a,b) identify glucose and lactose as directly supportive of early postnatal survival, in contrast to lesser adequacy of fructose and sucrose. Bowland (1966), in a summary of his studies and of reviews by Perrin (1955) and von Neuhaus (1961), reported compositional data for sow colostrum and for milk at varying times up to wk 8 of lactation. In general, percent total solids and percent protein decreased with duration of lactation, whereas percent fat and percent lactose increased with time.

Studies documenting the extent of impaired survival ability of pigs of low birth weight include those by Vestal (1938), V. C. Speer (unpublished data), England and Day (1970) and Fahmy and Bernard (1971). Newland et al. (1952) demonstrated the adverse effect of low birth weight on maintenance of body temperature when pigs are exposed to chilling, their slower return to normal body temperature after cessation of chilling, and their greater elevation of blood sugar levels in response to chilling; the authors attributed the latter to utilization of stored glycogen for heat production. The authors pointed out that smaller piglets have a larger body surface area per unit of body mass, which results in greater heat loss for small vs larger pigs in inadequate temperatures. Pigs 24 h old withstood an environmental temperature of 1 C with less drop in body temperature than did pigs 4 h old. England (1974) reported average satiety milk intake for bottle-fed pigs housed from birth in cages at 35 C and fed five times daily during a 5-h period ranged linearly from 43 ml per feeding for pigs with birth weights of .54 to .91 kg to 70 ml for pigs with birth weights of 1.41 to 1.45 kg.

**Compensating for Neonatal Inadequacy**

The preceding relationships and the inadequacy of competitive nursing ability of smaller and weaker pigs, documented by Hartsock et al. (1977), emphasize the requirement for special husbandry if pigs with birth weight less than 1 kg are to survive. Potential solutions to the problems resulting from low birth weights include genetically increased birth weight, nutritional regimens to enhance birth weight, gestation-lactation regimens to enhance piglet stamina inately or through metabolic responses by the dam such as favorably altered composition of milk with or without increase in birth weight, and rearing practices designed to compensate for impaired survival status. Heritability of birth weight is near zero, thus offering little promise of genetic change; the other approaches appear more promising. Reports vary regarding the extent to which increased energy intake of dams during gestation increases birth weights of pigs. Clawson et al. (1963), Lodge et al. (1966), Vermedahl et al. (1969) and Baker et al. (1969) report positive results, whereas Frobish et al. (1966) and Meade et al. (1966) report no effect. Investiga-
IMPROVING SOW EFFICIENCY BY NUTRIENTS FOR PIGLETS

In the past, the efficiency of sow performance has been limited by the quality of the diet provided to the dam during gestation and lactation. The use of specific nutrients has shown promise in improving birth weight and survival of piglets. Seerley et al. (1974) reported a comparison of corn oil vs. corn starch as the source of 24 kcal of added digestible energy per kg of body weight in gestation rations from d 109 to parturition at or after d 113. Added energy did not significantly increase birth weight, strength score at birth, or 21-d weight of pigs, but dams fed corn oil weaned a higher, though not significantly different, percentage of pigs than did the dams fed the control or corn starch diets. Additionally, the corn oil diet resulted in improved survival rate (P<.05) for pigs weighing <1,000 g at birth compared with the corn starch and control diets. Numerous subsequent experiments comparing fat vs starch as added energy sources in late gestation and/or lactation rations have been reported; Pettigrew (1981) summarized and interpreted results from a large number of these. From this comprehensive review he concluded, relative to piglet survival, that: 1) supplemental fat in the sow's diet during late gestation does not affect the piglets' body stores of carbohydrates at birth, but does slightly increase carcass fat stores; 2) supplemental dietary fat during late gestation and/or lactation increases milk production and the fat content of colostrum and milk, with a consequent increase in survival of piglets if mean survival rate in the herd is less than 80% and the sow consumed at least 1,000 g of fat before farrowing and 3) average influence on survival is greater (17.1%) for pigs weighing less than 1.0 or 1.1 kg at birth than for larger litter mates (2.7%).

Inclusion of 2,2-dichlorovinyl dimethyl phosphate (dichlorovos) in the ration during late gestation increased birth weights (Batte et al., 1968; Foster, 1968; Singh et al., 1968; Hays et al., 1969; England and Day, 1970). Anderson and Wahlstrom (1970) reported no significant influences of dichlorovos or pre-farrowing energy on birth weights, but dichlorovos significantly increased liver glycogen at birth. Among gilts fed dichlorovos, those having higher gestation gains produced pigs having higher liver glycogen content at birth than did those from gilts which gained less. England and Day (1970) reported decreased incidence of birth weights less than 1.15 kg and a 5% mean increase in survival of these pigs in litters from dams fed dichlorovos in late gestation. Stahly et al. (1980) concluded that dietary-induced ketosis in late gestation through inclusion of 1,3-butanediol (BD) in the ration increased survival to d 14 and 28 without increasing birth weights. In a second study, liver glycogen levels were higher in newborn, in 12-h-old suckled pigs and in fasted pigs from dams fed BD; blood glucose levels also tended to be higher. In a study by Steele et al. (1980) induction of ketosis through inclusion of ketotic substrates to replace glucose as the source of 20% of the total metabolizable energy in the ration resulted in ketosis, increased fetal liver glycogen, and neonatal survival.

Spence et al. (1985) conducted a study to investigate the principle of fetal metabolic regulation potentially available through sow feeding programs. Gestating sows were fed diets in which 15% of the metabolizable energy was in the form of glucose monohydrate (control), BD or an equimolar mixture of acetate and lactate (AL) to study the effects of ketogenic, gluconic and lipogenic substrates on fetal energy storage. Diets were initiated on d 90 of gestation. The authors concluded in part: “Increasing total glycogen at birth in pigs from sows receiving AL and BD demonstrates the ability to manipulate fetal energy storage through sow gestation diets. Both a metabolic regulator (BD) and an enlarged pool of alternative energy substrates (AL) were effective in enhancing fetal glycogen storage. Based on the glucose data in fasting pigs, it appears that smaller newborn pigs from sows fed BD or AL diets may be more resistant to development of hypoglycemia, improving their chances for survival in the competitive environment of the litter.”

**Fostering as Supportive Care**

Birth weight is not a meaningful predictor of genetic potential for future performance; h² is near zero. Therefore, feasible programs to enhance survival of high-risk piglets offer performance potential similar to that for other pigs. Fostering and artificial rearing are the primary sources of programs to provided the needed supportive care.

The need for such care arises from three primary sources: characteristics of the dam, characteristics of the litter and characteristics of the individual piglets. These sources are not mutually exclusive, and are often interrelated. Needs arising from the dam include occurrence of partial or total agalactia; antagonism of dam...
to offspring; sow nipples too large for effective nursing by very small pigs; inadequate nipple expression because the dam is so large that midsection teats on the upper side are too high for small and/or weak pigs to nurse effectively, or on opposite side some teats are covered by the sow’s body; and death of dam (English, 1985). Characteristics of the litter that create the need for cross-fostering include number of pigs born in excess of number of functional teats available, and substantial within-litter variation in birth weight (English, 1985).

In a population of 39 healthy litters, Bel Isle and England (1978) assessed characteristics of litters in which four or more mortalities occurred. These high-mortality litters averaged four more live pigs at birth and weighed an average of 172 g less per pig than the population mean. The litters were from only 18% of the dams but resulted in 46% of the total deaths. Similar findings were reported for 250 litters by England (1978) and by Maddock (1980) in which almost one-half of the deaths were contributed by about one-sixth of the litters. Within-litter variation of birth weights per se was reported by English and Brampton (1982) to be detrimental to survival. This litter trait increases with increased pigs born per litter; its extent and effects are likely compounded by the simultaneous occurrence of increased number of pigs in both the high and low birth weight categories as litter size increases (table 1).

Characteristics of individual pigs contributing to the need for fostering include low birth weight, inadequate energy storage and thermoregulatory ability, and weakness due to other causes. Starvation is the largest single cause of neonatal mortality. From carefully compiled data, including postmortem examinations, English and Smith (1978) attributed 42.8% of postnatal deaths to starvation, 18.2% to crushing and 14.9% to weakness at birth. It is reasonable to interpret that deaths due to crushing and to weakness at birth were due in part to inadequate nutrient intake. It follows that assurance of adequate nutrient intake is a major component in preventing mortality of newborn pigs. Some pigs are too small or too weak to nurse effectively, avoid crushing, and maintain adequate body temperature, but respond with increased survival rates to supplemental feedings. England et al. (1961) reared 89 pigs artificially from birth with individual hand-feeding of colostrum and sow milk replacer at 5-h intervals for the first 5 d and feeding in small groups thereafter. Of the 27 pigs that weighed less than 910 g at birth, all survived to weaning; 61 of the 62 pigs weighing more than 910 g survived. Winship et al. (1982) reported 82% survival to weaning in litters in which pigs weighing less than 1 kg at birth were fed 15 ml colostrum at birth and 25 ml of a commercial sow milk replacer at each of 11 successive feedings at 6-h intervals; only 43% of pigs of similar size in non-attended litters that were not provided supplemental feeding survived to weaning. England et al. (1976) reported a continuous availability of milk from the dam, without specific milk let-down, for an average of only 8 h following completion of farrowing; during this time 76% of the pigs gained weight, whereas only 62% and 47% gained weight during the 8- to 16- and 16- to 24-h periods, in which milk was available only periodically. Steinman and Benevenga (1985) reported a decreased loss of liver glycogen at 24 h post-birth from a single oral load of 12 ml of a medium chain triglyceride.

Agalactia may be present during the first few days post-parturition as a general condition, or may occur then or later to varying degrees in specific udder sections. Antagonism of the dam to the newborn is generally of less than 24-h duration, but occasionally longer. Appropriate fostering, if dams are available, can alleviate much of the consequences. Piglets can be temporarily fostered to one or more recipient dams by removal of resident piglets for 2 to 5 h several times daily, depending on size and condition, to provide a sequence of alternate nursing opportunity by fostered and resident piglets. Pigs not with the sow should be kept warm and dry. Cross-fostering to provide a small dam for small pigs and large pigs for larger dams reduces adverse effects of competition among newborn, minimizes size of pig-size of dam incompatibility for the very small pigs (author’s observation), and thereby facilitates effective nursing. The death of the dam of a newborn litter may best be dealt with by transfer of piglets to foster dams. If no dams with adequate excess functioning udder sections are available, weaning a 1- to 2-wk-old litter to provide a foster dam is effective; the older litter can be artificially reared more easily than can the newborn one. A supply of fresh or frozen colostrum should always be available for such newborn piglets if they have not nursed before their dam’s death.
### TABLE 1. CHARACTERISTICS OF LITTERS WITH DIFFERENT NUMBERS OF PIGS BORN ALIVE IN 450 CONSECUTIVE LITTERS

<table>
<thead>
<tr>
<th>Litter size</th>
<th>No. litters</th>
<th>% of litters</th>
<th>Avg birth wt, kg</th>
<th>Avg no. per litter</th>
<th>Avg % per litter</th>
<th>Avg no. weaned/litter</th>
<th>Avg % per litter</th>
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<tr>
<td>1</td>
<td>2</td>
<td>.4</td>
<td>1.52</td>
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<td>5.8</td>
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<tr>
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<td>1.33</td>
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<td>5.6</td>
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<td>5.44</td>
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<tr>
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<tr>
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<td>52</td>
<td>11.6</td>
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<td>9.56</td>
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*England and Day (1970).*
A decade ago, concepts and practices for fostering consisted largely of transfer of pigs from one litter to another with the age of the two litters differing by no more than 3 d. Foster pigs were generally in excess of their dam’s ability to nurse; dams usually reared only their own offspring unless they had available functional teats beyond the needs of their litter. England (1978) advocated a broadened approach to fostering piglets on the following precepts:

1) A few hours of nursing to obtain colostrum provides maximum blood levels of immunoglobulins for the baby pig.

2) Immunoglobulins are present in sow’s milk, though in decreased quantities, after the colostrum phase and are active in protecting against unfavorable bacteria in the digestive tract.

3) Pigs gain physiological maturity with increased age or size. Thus, large newborn pigs are physiologically more mature than are small newborn; 10-d-old pigs are more mature than newborn; 3-wk-old pigs are more mature than 10-d-old pigs. Husbandry practices in artificial rearing are less demanding with increasing maturity.

4) Rapidity of growth is of less economic importance in the preweaning pig than is increased numbers of pigs surviving for each dam that farrows.

In this conceptual framework, any suitable sow is potentially a foster mother for pigs that are best adapted to her size and other traits. Also, a given pig or pigs may be fostered more than once if success is optimized by doing so. Depending on the number of pigs to be fostered and the age and number of piglets in the foster dam’s litter, none, some or all of the foster dam’s offspring will be removed to be reared artificially. When only the pigs in excess of their dams’ ability to nurse are to be fostered, and natural and foster dams are equally adequate, the largest and strongest should be transferred unless cross-fostering among litters is used to reduce variation within nursing group. Choice of rearing option and of dam to be nursed should first optimize potentials for survival of least-competitive pigs. Needs of piglets too small or too weak to nurse successfully require more individualized artificial rearing care until they attain sufficient maturity for nursing. Such pigs should nurse dams most nearly optimal for them. Piglets capable of nursing dams of lesser suitability should be so allotted within appropriate ranges of adequacy.

Foster dams should be gentle, non-nervous and not overly large. Newborn pigs to be transferred should receive colostrum through nursing of their own or other dams with newborn litters or by artificial feeding of stored colostrum. To effect the transfer procedure, the foster dam should be in a farrowing crate and allowed 2 to 4 h without pigs to enhance readiness for nursing activity before the foster pigs are placed in the crate. An injection of oxytocin may be given a few minutes before transfer to create milk letdown and enhance mothering tendencies.

A further extension of the concepts and usages of fostering is occurring in some intensive production units in the following ways: 1) excess litters are farrowed to provide enough pigs after early death losses or due to small litters to provide each dam an optimal number of pigs to be nursed. Transfer is made of all pigs from some sows that are then sold instead of fed during a lactation; 2) as some nursing pigs become “poor-doers” due to inadequate milk availability they are fostered onto later newborn litters and 3) large pigs are weaned early and their dams are used as foster dams for composited “litters” of near-weaning-age poor-doers. In this program, a pig may be transferred more than once and a given dam may receive foster pigs at more than one time.

Data reported by Hays (1963) show no increase in average number weaned per litter as number born exceeds 12; data reported by Thornton (1985) are in agreement for pigs reared only by their birth dam. Reports by England (1974) and Thornton (1985) show near-linear continued increase in number weaned per litter as number born increases to 17 or 18 pigs per litter when supportive rearing practices, in addition to the capabilities of the birth dam, are utilized. The major alternatives to rearing of piglets by birth dam only are artificial rearing and fostering. There are a number of reasons why one or both of these may be needed by maximize numbers weaned. The choice between fostering and artificial rearing depends on availability of foster dams, capability of piglets to nurse adequately dams that are available, and quality of artificial rearing programs and facilities.

Concepts and general guidelines for successful fostering should be an integral part of the
information used in making management decisions for achieving highest sow productivity, and their implementation should begin at mating time. These include: 1) an awareness of the individual and average prolificacy records of the group of sows and the projected prolificacy of gilts to be mated at a given breeding period; 2) record of previous litter characteristics, especially the number and percentage of newborn pigs weighing less than 1 kg; 3) prior average incidence of interferences with normal milk production and of antagonism of dams to newborn pigs during the first 24 h after farrowing; 4) age of other suckling litters that will be present at the time a given mating group will farrow and 5) the parity profile for each mating group.

The preceding guidelines assume availability of dams and artificial rearing conditions appropriate to the needs of the pigs. Synchronized breeding dates supplemented by induced synchronized farrowing enhance the availability of adequate and optimal dams to provide fostering opportunities for all pigs. Mating management to provide adequate foster dams for newborn pigs should take into account that beyond 3 d of age her litter, a potential foster dam will not generally have functional udder sections in excess of the number of pigs nursing her. Three approaches can be taken to enhance availability of foster dams: 1) calculation of the number of dams required to farrow within a specified time span to provide opportunity for necessary transfer by age of 3 d of the foster dam’s litter, 2) rotational short-term temporary transfer of pigs among dams to keep non-used udder sections of newly farrowed dams functional for an extra few days for potential use by pigs from litters to be born during that added time, but not within the functional life span of non-nursed udders and 3) realization that even newborn pigs, especially strong pigs weighing more than 1 kg, can be fostered onto a dam whose up to 3-wk-old litter is weaned to provide a foster dam. Larger pigs from current young litters generally should be the ones temporarily rotationally cross-fostered to maintain udder productivity for an extra few days. By sequential transfer by age of 3 d of the foster dam’s litter, foster-dam availability for excess pigs in newborn litters by the time foster dams’ litters were no more than 3 d of age was made by Page and England (1976). Calculations were based on mean and variation in days from weaning to mating, percent of dams conceiving, days from mating to farrow and number born per litter. In their herd, the number of matings needed to provide farrowing at times to ensure fostering opportunities for all newborns, if each foster dam was allotted 11 pigs, was 20; if all dams farrowing at the “right time” were allotted 12 pigs, only 10 dams were required to accommodate all live births. Synchronized parturition would decrease the numbers required by achieving more simultaneous farrowings.

Repeatability of prolificacy is low—generally .10 to .20. A recent three-parity analysis of 86 dams (D. C. England and C. G. Chitko, unpublished) shows repeatability of number and percentage of undersized pigs to be at least as high as repeatability of number born. Assessment of prior records of a mating group thus appears to be a somewhat useful basis for estimating needs for foster dams or alternative rearing programs for undersized pigs. Planning for effective foster dam use should include availability of some smaller dams to which newborn pigs can be transferred. These dams can be first-parity or small, later-parity sows. Teat size as well as body size should be assessed.

Performance of fostered pigs is influenced by their age and prior history at time of transfer to a foster dam. Those transferred at 1 d of age perform equally as well as resident pigs (English and Brampton, 1982), whereas those transferred at 1 wk of age have shown some reduction in gain (Horrell and Bennett, 1981). The major purpose in fostering at young ages is to prevent mortality; fostering at later ages is primarily to prevent further deterioration in performance. Ultimately, postweaning performance for either group must be sufficient to result in normal opportunity for profit. For healthy pigs, growth and feed efficiency are more highly associated with weight than with age. England et al. (1961) reported significantly greater milk intake and daily gain per unit of birth weight for individually fed, undersized piglets than for their larger litter mates during a 5-d period. Lecce (1975) reported similar proportional weight gains by artificially reared piglets of different initial weights.

In an informative and entertaining review, Lecce (1975) traces and interprets much of the more than 25-yr history of the infrequent successes, but more often failures, encountered in
efforts to develop reliable programs for artificial rearing of very young pigs under varying nutritional and management regimens. In other than disease-free environments embodying the principles used and described by Young et al. (1955), attempts to rear very young neonates away from the sow without access to colostrum and the absence of contamination with microflora from the dam or her environment, occurrence of piglet diarrhea, dehydration and/or death led to failure. Escherichia coli, serotype 08, was the most prevalent pathogen identified. After establishing that newborn pigs have non-selective ability to absorb macromolecules and lose that attribute before 2 wk of age, Lecce (1975) concluded on the basis of experiments by himself and coworkers that success in artificial rearing initiated while ability of piglets to absorb macromolecules exists must be based on either 1) use of dietary and management regimens that limit contact with, or production of, toxic macromolecules in the gut or 2) be certain that the intestinal epithelium is bathed continually in immunoglobulin while the gut is open and vulnerable. Subsequent experiments indicated that in some farm environments, pigs removed from nursing at the age of 12 h were not immunologically protected, whereas pigs removed from nursing after 36 h were. Further results over 9 mo with 383 pigs resulted in loss of only four pigs, two of which had congenital deficiencies, and two that apparently had no colostrum intake.

Lecce (1969) reported details of a system for rearing colostrum-free piglets in an automatic feeding device, and extended the study to 170 piglets farrowed in 44 litters obtained from seven herds (Lecce, 1971). Survival and performance of three groups were compared: low birth weight (disadvantaged and judged as unlikely to survive; some were lethargic and dehydrated), a control group and an attendant-farrowed group. The diet consisted of unpasteurized cows’ milk to which iron, zinc and cod liver oil were added. Total solids were increased to 24% by addition of spray-dried, non-fat milk solids. Survival for the three groups were 83, 100 and 100%, respectively. Survivors in the disadvantaged group increased their initial weight by 3.5 times by d 14 compared with 3.1 for controls. Inanition was responsible for death losses in the disadvantaged group.

Protein and energy needs for colostrum-free pigs reared artificially were reported by Lecce and Coalson (1973). A diet of 21% protein (casein)-40% lactose resulted in performance near that of the diet used for the 1971 study noted previously. Responses to other combinations are reported. Pettigrew and Harmon (1974) reported a possible effect of source of milk proteins on prevalence of scouring in pigs weaned at 2 to 3 d; results indicate lower incidence of scouring and higher weight gains from replacement of dry skim milk by a combination of sodium caseinate and sweet dried-whey. For colostrum-free pigs reared to 4 wk of age, Young and Underdahl (1953), successfully used a diet consisting of one whole egg per .95 liter of whole milk fed with a mineral solution.

Jones (1986) summarized his research with artificial feeding by use of various automatic feeders for pigs removed from the sow at ages ranging from d 2 to d 21. The diet formula contained 18% protein, 15% fat, 56.1% carbohydrate and 1.5% minerals and vitamins. Feeding at hourly intervals gave results superior to feeding at 2- or 3-h intervals. Laboratory studies showed similar responses by pigs weaned at 6, 9 or 20 d of age; field reports included favorable results from weaning at d 2; feed conversion efficiency on dry matter basis ranged from .7 to 1.1. For 10 sows farrowed at a time, the author estimated that this system will increase sow productivity by two pigs per sow per year.

England and Keeler (1965) reported no differences in milk intake, growth rate or feed efficiency of pigs of various birth weights when tested from equal beginning weights instead of equal ages. Boaz and Elsley (1962) and England and Chapman (1962) reported no effect of within-litter differences in weaning weight on postweaning gains based on initial weights of 27 kg without regard to age. England (1963) concluded from data on 255 pigs that prenatal growth rates and size-influenced postnatal growth rates do not affect carcass traits. George and England (1973) reported similar reproduction and litter trait performances by gilts of different birth weights. It thus appears that low birth weight is not a deterrent to effective and efficient performance for pigs that are provided an environment which enables them to survive and express their innate potentials.

Literature Cited


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