FATS AND PROTEINS RESEARCH FOUNDATION, INC.

Director's Digest

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FAT IN SWINE DIETS

INTRODUCTION

The primary contribution of fat for swine is that it serves as a concentrated source of energy-yielding ingredients. The response of pigs to dietary fat additions largely depends on the animal's food intake level. The digestibility of the fat source and the efficiency of utilizations of the fat for maintenance of body functions, growth (muscle and fat tissue) and milk production.

Most fats are well digested by the pig except for the first one to two weeks after weaning. The digestibility of a specific feed fat largely depends on the ratio of unsaturated to saturated fatty acids in the total diet (Stahly, 1985). If the unsaturated to saturated ratio of fatty acids exceed 1.5 to 1, digestibility of fat is high. The unsaturated to saturated ratio in common feedstuffs range form .9 (pure beef tallow) to 6.0 (vegetable oils). Corn based diets normally exceed 1.5 to 1 ratio if a saturated fat is used, but the fat in the total diet will have a ratio of approximately 2.5 to 3.25 to 1 if a moderately (1.5 to 1) unsaturated fat is added. Therefore, the digestibility of a particular supplemental fat source in pigs is dependent on the fatty acid composition (unsaturated/saturated fatty acid ratio) of the fat in the total diet. In diets based on low fat feedstuffs such as wheat (1.7% fat) or dried skim milk (.8% fat), the fatty acid composition of the saturated fat source may become important. The digestibility of fat, particularly saturated fats, also is reduced to a limited extent by inclusion of fibrous feedstuffs and high levels of calcium and magnesium in the diet.

Below are the NRC 1988 listing of Energy Composition of Selected fats and oils.

	ME (Kcal/kg)
Animal	
Lard	7750
Poultry Fat	7975
Moderately Saturated Tallow	7895
Plant	
Corn Oil	7350
Soybean Oil	7280

FAT IN YOUNG PIG DIETS

Considerable changes have occurred in nutritional programs for nursery pigs in the past few years. A common problem in pigs weaned at 3 to 4 weeks of age has been a "post-weaning check" that often results in pigs losing weight during the first week after weaning. Pigs weaned at 21 to 28 days of age allowed to consume a grain-soybean meal diet will have a low feed intake with a considerable drop in energy intake during the first few days post-weaning. Nursery pigs have shown a preference for a diet with supplemental fat. A starter diet with 3% added fat improved daily gain and feed efficiency in pigs weaned at 3 weeks of age (Speer et at 1975). Other research at Ohio State (Mahan and Maxson, 1984) has shown that relatively high (7.5%) levels of dietary fat can be effectively utilized by the 21 day old weanling pig, regardless of weaning weight. These results suggest that young pigs prefer a diet that contains some fat and apparently utilizes this energy quite well for growth.

As mentioned earlier, pigs appear to utilize the energy from a fat supplemented diet less efficiently than the energy from a diet without supplemented fat during the first two weeks post-weaning. However, the young pig appears to utilize the energy from both diets with equal efficiency for the 0-5 week peroid. (Pettigrew, 1989). In young pig rations it is advisable to maintain a constant protein:energy ratio when adding supplemental fat. The fat should have a low free fatty acid (less than 6%), less than 1% M.I.U. and stabilized with an appropriate anti-oxidant and have a bland odor versus pungent denoting a high initial peroxide value or the inclusion of by-products of vegetable oil refining.

GROWING - FINISHING PIGS

There have been many experiments over the past twenty years where the effects of adding fat to growing-finishing swine diets on average daily gain, feed/gain ratio and carcass merit have been studied in some form or another.

The reports are somewhat inconsistant regarding the effects of added fat on average daily gain, especially at levels less than 5% added fat. Some producers have reported significant improvement in average daily gain with levels of 3% added fat and maintaining the calorie:protein ratio, but (Moser, 1977) in a review of over twenty studies concluded that a significant increase in average daily gain may not be observed until the added fat level is, approximately 5% or more.

The most striking and consistent response to supplemental fat is in feed efficiency. In reviewing over 90 papers Pettigrew (1989) found there were no instances of poorer gain : feed ratio with fat. The response is large (9-13%), economically important, and not as greatly affected by maintaining a constant protein : energy ratio as in the studies on average daily gains.

In hyperthermal stress, a diet containing fat aids by reducing food intake and minimizes the increase of body temperature due to metabolism; therefore, the animal remains more comfortable and improved performance should occur. The decreased heat increment of the fat supplement diet results in a greater percentage of the diet being available for tissue synthesis maintained at or above thermal neutrality.

Stahly and Cromwell (1979) have shown that the pig's response to supplemental dietary fat is greater in thermoneutral or hot environments than in the cold(Table 1):

TABLE 1

The effect of dietary fat additions on the relative performance of pigs housed in a cold (10 C), thermoneutral (22.5 C) or hot (35 C) environment.

Temperature (C)	10			22.5			35		
Added Fat (%)	0	5	Change	0	5	Change	0	5	Change
Daily ME intake	114	112	-2	100	103	+3	72	77	+5
Daily Gain	99	98	-1	100	109	+9	66	75	+9
ME intake/gain	116	116	0	100	94	-6	114	106	-8
Carcass backfat	93	97	+4	100	106	+6	8	92	+7

Stahly, 1984; data from Stahly and Cromwell , 1979.

thermal stress that cause decreased feed intake. The weakness cause unnecessary baby pig losses, thin and early culling of sows and loss productivity in finished hogs. An understanding of caloric sources and how these different sources can best be utilized in ration formulation is important for feed nutritionists and livestock producers. Lipid calories can be more valuable than carbohydrate calories in some diets and feeding situations.

Newborn pigs are relatively weak at birth when compared to the young of many other species. Their metabolic energy reserves will permit survival for only two days. A low density of body hair and only 2% body fat provided little insulation while body heat loss is rapid. Consequently, glycogen, blood and cellular energy decrease to a critical low level by 24 to 48 hours of age. Newborn pigs are totally dependent on the milk from the sow and a good life supporting environment by two days of age. Any cold stress , low milk intake or littermate competition can rapidly deteriorate the weaker pigs.

The percentage of lipids in the sow's colastrum and milk is consistently increased by the feeding of high dietary lipids during late gestation. (Seerley 1974). Data from feeding fat to sows in late gestation indicate no adverse influences and some data illustrate possible metabolic changes that aid piglets. The energy reserves and thus survival of the neonatal pig are influenced by the sow's dietary energy source, independent of the level of energy fed. Changes that may improve survival rates with 2-3 week feeding of supplemental fat in late gestations , are ; increased birth weight, increased blood glucose at birth, slower disappearance of blood glucose during starvation and slower disappearance of liver glycogen.

Pettigrew (1981) reported that supplemental fat in the sow's diet during late gestation piglet's carcass fat stores, increases milk production and the fat concentration of colastrum. This increase in colastral and milk fat increased the survival rate (.3 pig per litter) among the piglets if the herd survival rate is low (less than 80%) and the sow consumes approximately 1,000 g. (2-3 lbs.) of fat before farrowing. Large swine producers in U. S. report from .4 to one extra pig per litter when feeding 5% supplemental fat two to three weeks before farrowing and during lactation. Research at Georgia (Coffey, 1981) illustrate that longer term (35 days) feeding of lipids at the 5% added level has some advantages versus shorter term (5 days) feeding at 10% of the diet.

FEEDING THE PROLIFIC SOW DURING LACTATION

During the past 10 years greater emphasis has been placed on selecting sow lines based on their level of prolificacy in contrast to their "meat" characteristics. Because the type as well as level of productivity of these prolific sow lines differ from their predecessors, their nutrient needs also are different.

The prolificacy of the sow is measured in her ability to (1) wean large litters of acceptable weight and (2) rebreed rapidly and consistently. As mentioned previously, the survival and weight gain of the sow's offspring are strongly influenced by the energy reserves of the pig at birth and the amount of colostrum and milk that it receives. These parameters are dependent on the amount and type of nutrients available from the diet and endogenous dependent on the amount and type of nutrients available from the diet and endogenous body reserves of the sow. In turn, the adequacy of the nutrient reserves in the sow's body influences the subsequent conception rate and lifetime productivity of the sow.

The energy requirement of the sow during lactation is related to her body size and body reserves at the beginning of lactation, the number of pigs nursing, her milking ability, food intake capacity and other facts such as ambient temperature. Today's high producing sow will maintain high levels of milk production while consuming low amounts of energy. Sows simply supply the balance of nutrients needed to sustain a high level of milk production by using body stores of fat and protein.

Swine producers are constantly interested in new ideas or methods of feeding the lactating sow. The feeding program for the lactating sow needs to be designed to bring out the genetic potential of the sow under various environmental conditions. The two nutrients often discussed are the fat and/or fiber levels in lactating sow diets.

Results of past research indicates the productivity of the lactating sow decreased as temperature increased about the thermal comfort zone (7 °to 25°C). In a hot environment, deep body temperature and respiration rate increase, feed intake decreased and milk production is reduced. The researchers suggest that the reduced feed intake apparently is an attempt by the sow to lower the thermal heat load resulting from digestion and metabolism of nutrients.

The amount of heat produced in the body from the digestion and metabolism of dietary fat is less than produced from starch and fiber. Therefore, on this basis, calories may be used more efficiently for milk production when obtained from fat than when derived from starch or fiber.

The high nutrient demand experienced by sows nursing large litters increases and incidence of the "thin-sow" syndrome. This problem is further complicated by the fact that the more prolific sow lines may have smaller body fat stores initially than their meat-type counterparts. A large loss of body reserves, particularly fat stores, in the sow may delay the animals return to estrus or result in a state of anestrous. It is know that the low body fat stores result in lower circulating insulin levels in the female. Low insulin levels are thought to alter estrogen and LH release in the sow, potentially resulting in a noncycling (anestrous) sow.

Feeding a 5% supplemental fat diet during lactation will assist in furnishing sufficient energy for prolific sows so they can maintain good cody condition as well as improve their milk flow and fat content of milk. The percentage of lipids in the sow's milk is consistently increased by the feeding of 5% fat during lactation. Milk from the initiation of farrowing to about 5 to 7 days generally increases in lipid content. Apparently sows metabolize lipids from adipose cells for the milk. Consequently, they become thinner and lose weight. Moser and Boyd (1978) indicated that milk yield was increased by lipid feeding in a range of 8 to 18%. University of Georgia trials on milk yield show approximately 31% increase on day 14 of lactation, according to M. T. Coffey (1981). This increase in milk yield and fat content of the milk is responsible for producers reporting more uniform litters at weaning and heavier weaning weights.

Kirkwood et al. (1988) demonstrated that lactating sows consuming high energy vs control diets (1.69 vs 1.49 Mcal DE / lb) had greater litter size at the second and subsequent farrowings. The high energy diets contained 5.0% added fat and the control diets were similar to normal grain-soybean meal diets. It was concluded that the energy intake of the sow during lactation influenced subsequent reproductive performance.

Recent attention has been drawn to the "second parity slump" seen on many swine farms and in some research trials. Inadequate energy consumption and excessive weight loss in first litter sows have been implicated as causes for the reduction in the number of pigs born in the second parity. The problem may be abated for first litter sows by encouraging energy intake during the weaning to remating period.

It is suggested we use the same fat specifications for sows as outlined for growing-finishing swine.

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