The role of feed in sustainable pork production: How feeding programs affect environmental impacts of pork production - Part 2

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Key Points:

- This week's page is a follow-up to last week's on the background of the impact of livestock feed on the environment. In this week's page, we will share the results of experiments to determine the environmental impacts of grower-finisher feeding.
- The environmental impacts of four precision formulated swine feeding programs were determined.
- Results indicated that overall, the four feeding programs all have performed well in terms of growth performance while reducing environmental impact.

Last week's page (part 1) introduced how different feed programs can affect the environmental impact of swine production. This week's page (part 2) continues the topic with summaries of a series of studies conducted to determine the nitrogen (N) and phosphorus (P) utilization efficiency and environmental impact of different grower-finisher feeding programs. Four feeding programs containing variable amounts of soybean meal as the primary protein source, with and without 30% distiller dried grains with solubles (DDGS), crystalline amino acids, and phytase were assessed. Precision diet formulation approaches were used to achieve optimal growth performance and carcass composition. Precision diet formulation was based on using dynamically determined net energy, digestible amino acid and phosphorus nutrient loading values for the sources of corn, soybean meal and DDGS being fed. Diets within each of the following 4-phase feeding programs consisted of: 1) Corn and soybean meal (CSBM), 2) Low protein corn and soybean meal diets supplemented with crystalline amino acids (LP), 3) Corn and soybean meal diets with 30% DDGS, 4) Corn DDGS diets supplemented with crystalline isoleucine, valine, and tryptophan (DDGS+IVT).

The first study was conducted to determine the effects of the feeding program on growth performance and carcass characteristics. A total of 288 pigs (initial body weight, or BW, of 80 lb.) were fed for 12 weeks, scanned to obtain backfat and loin muscle area measurements before shipping, and hot carcass weights were obtained for individual pigs. No differences were observed in average daily gain and feed intake, but pigs fed CSBM had greater ($P < 0.05$) final BW than those fed LP and DDGS, and greater ($p < 0.05$) gain efficiency than pigs fed LP. However, supplementing crystalline isoleucine, valine, and tryptophan in diets containing high levels of DDGS improved final body weight of pigs compared to feeding the DDGS diets without these dietary amino acid adjustments. No differences were observed for hot carcass weight, carcass yield, or carcass fat-free lean percentage among pigs fed any of the four feeding programs. Therefore, these results indicate that CSBM and DDGS+IVT feeding programs provided the greatest gain efficiency but provided no advantages for carcass lean percentage compared with the other feeding programs.

The second study was conducted to determine the effects of feeding the phase 2 grower diets used in each of the 4 feeding programs evaluated in the first study, on nitrogen and phosphorous balance. A total of 32 barrows (initial BW = 130 lb.) were housed in metabolism crates at the University of Minnesota Southern Research and Outreach Center (Waseca, MN) for a 12-day metabolism study. Pigs fed the CSBM diet had a greater ($p < 0.05$) amount of N retained than pigs fed the other diets, but also had a greater ($p < 0.05$) amount of urinary N excretion and blood urea N than pigs fed the LP and DDGS+IVT diets. Pigs fed the LP diet tended ($p < 0.10$) to have the highest N utilization efficiency but the lowest ($p < 0.05$) percentage P retained as a percentage of P intake among diets.

Using the growth performance and carcass composition data from the previous experiments, the Life Cycle Assessment (LCA) of the environmental impacts of producing 1000 kg (2,205 lbs) of pork carcass weight from each feeding program was determined using the Opteinics™ software (BASF, Lampertheim, Germany). Life cycle assessment is a systematic analysis to quantify the environmental impacts of inputs and outputs of products during the entire life cycle. The results showed that the CSBM feeding program had the least impact on climate change (GHG emissions), marine eutrophication, freshwater eutrophication, and fossil resource use, while the LP feeding program had the least impact on acidification, terrestrial eutrophication, and water use among the four feeding programs evaluated. The DDGS and DDGS+IVT feeding programs had the lowest impact on land use.

These results indicate that while all these feeding programs were superior to the other feeding programs in one or more of the environmental impact measures, none of them were superior in all criteria. However, the CSBM feeding program provided optimal growth performance and carcass composition of growing-finishing pigs while simultaneously reducing impacts on climate change, eutrophication potential, and fossil resource use compared with the other feeding programs evaluated. Results from this study demonstrate how the use of LCA data for assessing various environmental impacts of feed ingredients, diets, and feeding programs can provide important information that enables pork producers to choose feeding programs that meet specific sustainability goals.

Moving forward, sustainable swine feeding programs must be based on using multi-objective feed formulation that puts constraints on high-priority LCA environmental impact measures that involve N and P utilization efficiency, GHG emissions, water consumption, and land use, in additional to meeting nutritional requirements to optimize pig performance and carcass composition at a reasonable cost. This will require integration with real-time determination of nutrient loading values of actual sources of feed ingredients used in feed formulation and precision feeding practices to "get the right feed to the right pigs at the right time".