NC STATE
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DELIVERING EDUCATION AND TECHNOLOGY THAT ENRICHES THE LIVES, LAND, AND ECONOMY OF NORTH CAROLINIANS

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IN THIS ISSUE

Using Frass from Black Soldier Fly Larvae in Nursery Pig Diets

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Image courtesy of the National Pork Board, Des Moines, Iowa.

Introduction

Frass is the residual coproduct from black soldier fly larvae (BSFL) processing and could serve as a sustainable, functional, and economically attractive feed additive in U.S. swine diets. This product contains larval exoskeletons, unprocessed larvae, unconsumed substrate, larvae digesta and residual organic matter. The nutrient composition of frass can vary significantly depending on the substrate they are grown on, but frass produced from BSFL reared in commercial production will contain approximately 23% crude protein, 8% crude fat, 2.6% calcium, and 1.0% phosphorus. The fiber and ash content can be relatively high at 10 and 11%, respectively, which may limit the amount that can be fed to young pigs. In addition to its nutrient contributions, frass contains bioactive compounds such as lauric acid, chitin, and antimicrobial peptides, which may support immune function and gut health in young animals. Frass is currently approved in the US for feeding to swine under AAFCO definition 74.7.

Although frass has shown promising results in aquaculture and ruminants, including improved growth and disease resilience, its efficacy in swine diets remains largely unknown. We have previously reported that frass supplemented at 6% improved growth performance of newly weaned pigs during the early nursery stage, but no impact was observed during the later stages. In the present study, we evaluated the impact of increasing inclusion levels of frass in diets with high levels of soybean meal (replacing specialty protein sources) compared to positive control diets with low levels of soybean meal. Thus, this study evaluated the impact of graded levels of a proprietary source of BSFL frass (EnviroFeed®, EnviroFlight, LLC) on the growth performance and serum chemistry of nursery pigs fed increased levels of soybean meal.

Materials and methods

We used 160 nursery pigs that were weaned at approximately 21 days old with an average body weight of 6.5 kg in a 6-week nursery study. Pigs were randomly assigned accounting for sex and initial body weight to 4 dietary treatments using 40 pens with 4 pigs per pen. Experimental diets were fed in 3 phases throughout the nursery period and consisted of:

1) a positive control diet (PC) with 20, 25, and 30% soybean meal for Phase 1 to 3, respectively.
2) a negative control diet (NC) with 25, 30, and 35% soybean meal for Phase 1 to 3, respectively.
3) a negative control diet with 3% supplemental frass (NC+3%).
4) a negative control diet with 6% supplemental frass (NC+6%).

The increased level of soybean meal in the NC diet replaced a portion of specialty protein sources (plasma protein and enzyme-treated SBM) for Phase 1 and 2, whereas frass supplementation to the NC diet primarily replaced corn, crystalline amino acids, monocalcium phosphate, and limestone for Phase 1 to 3. Frass used in the present study was analyzed to contain 30.6% crude protein, 8.0% crude fat, 32.3% NDF, 1.26% Ca, and 0.96% P.

Pigs were weighed on a weekly basis and the amount of feed consumed (measured as feed disappearance) was determined for the same time points. On days 4, 7, and 14, individual fecal samples were obtained using fecal loops and were evaluated on a scale of 1 to 5 representing hard, normal, soft, watery soft, and watery liquid feces, respectively. Scores of 1 to 3 were indicative of no diarrhea and scores of 4 to 5 indicated diarrhea.

Results

Increasing SBM in Phase 1 diets (NC vs. PC) reduced average daily feed intake (328 vs. 364 g/d; P=0.042; Figure 1), but there were no other significant effects of increased soybean meal inclusion on body weight or feed intake or feed efficiency (Figure 2 and 3).

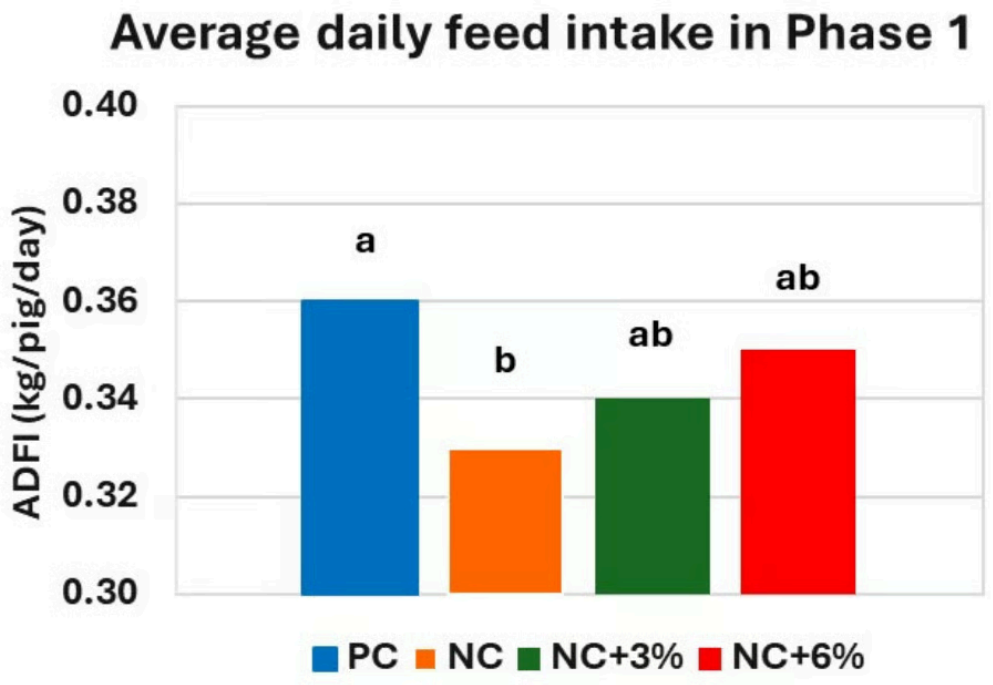

Figure 1. Average daily feed intake in Phase 1

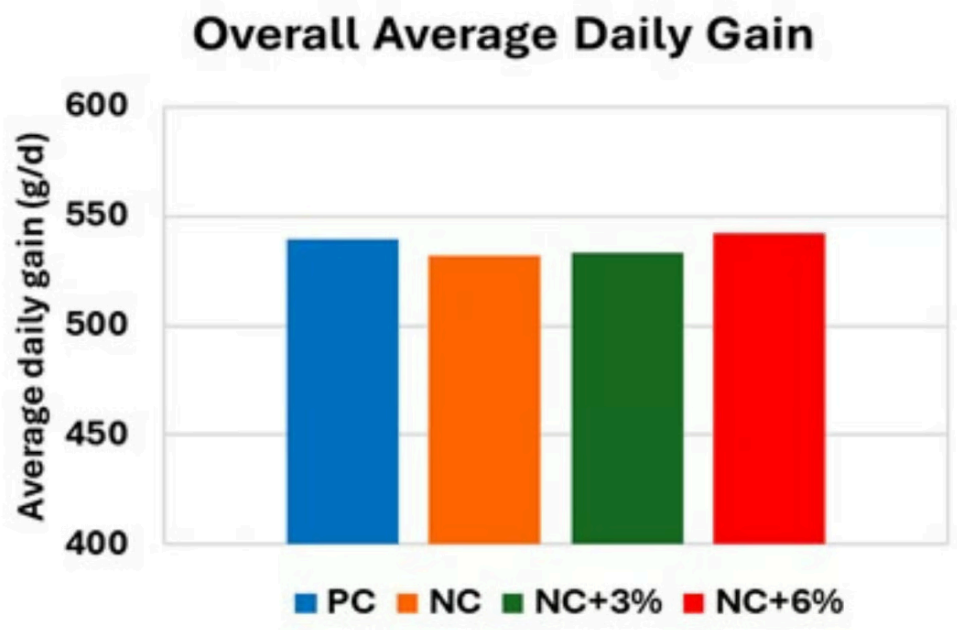

Figure 2. Overall average daily gain

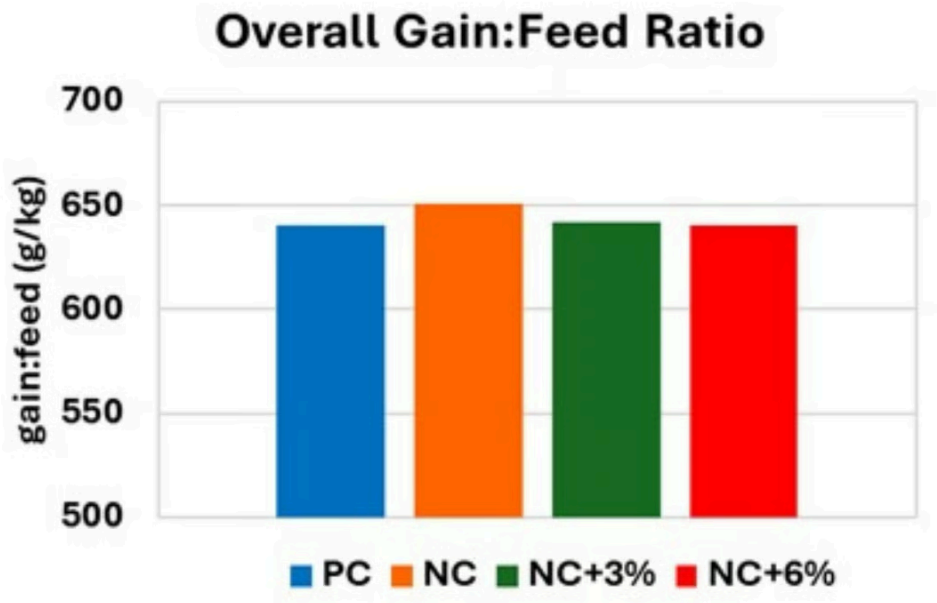

Figure 3. Overall gain:feed ratio

Dietary inclusion of frass to the negative control diets had no impact on growth performance. Diarrhea incidence was 31.3, 70.6, and 61.9% for days 4, 7, and 14, respectively and was not affected by dietary treatments. Serum chemistry parameters, including markers of liver and kidney function, electrolytes, and metabolic indicators,

remained within normal physiological ranges and showed no treatment-related differences.

Similarly, serum cytokine concentrations were generally unaffected by dietary treatments suggesting that frass did not strongly alter immune function.

When evaluating the cost of Phase 1 diets, increased dietary levels of soybean meal resulted in a reduced cost per ton of feed, mainly because the inclusion rate of specialty protein sources decreased. Inclusion of frass with an assumed cost of $400 per ton slightly increased diet cost compared to the NC diet, but the cost was lower than the PC diet. These results indicate that frass can be incorporated into diets for nursery pigs without negatively affecting performance or health and that frass can provide a cost-saving benefit by reducing diet costs of the standard control diet.

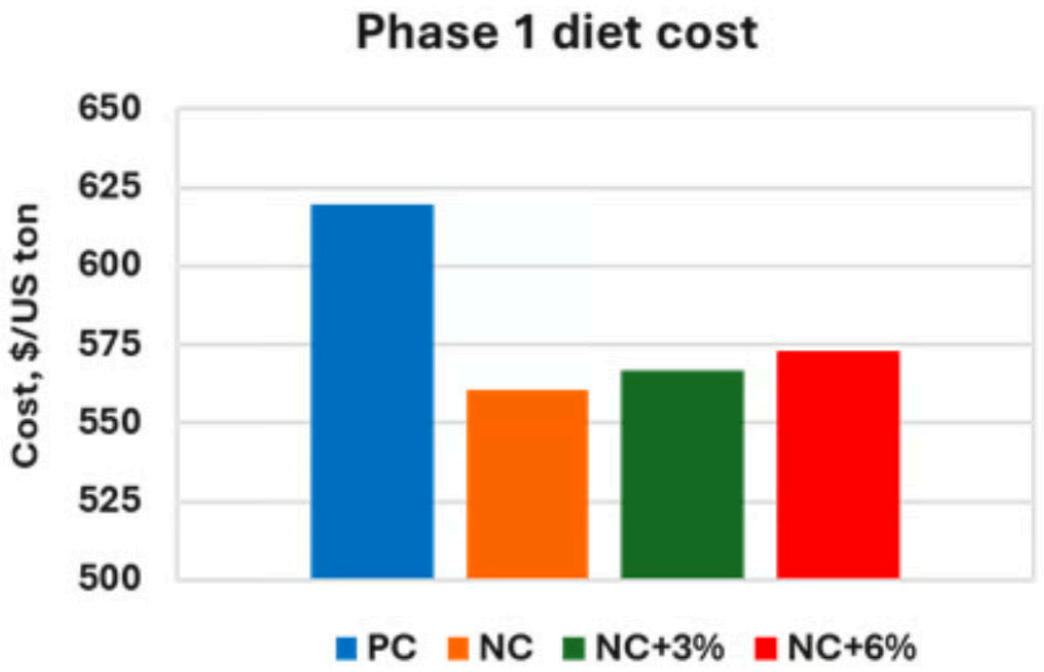

Figure 4. Cost of Phase 1 diets

Effect of Antioxidant Supplementation on Productivity Under Different Thermal Conditions

As we approach the summer months, heat stress always becomes a topic of discussion across the swine industry. Particularly, producers and researchers alike want to know how they can address the adverse effects of heat stress on growth performance and animal welfare. To investigate the effect of dietary antioxidants on mitigating the negative impacts of heat stress, the following research study was conducted[1].

Materials and Methods

Researchers conducted two experiments involving 128 crossbred pigs at approximately 13 weeks of age Pigs were housed individually and were grouped by thermal conditions, thermoneutral (21.2 °C) or heat-stressed (30.9 °C), and by dietary treatment. The dietary treatments consisted of 1) a control diet; 2) control + 100 IU/L of D-α-tocopherol provided in water; 3) control + 200 IU/kg of DL-α-tocopheryl-acetate provided in feed; 4) control + 400 mg/kg of a botanical extract provided in feed. The study lasted 28 days during which growth performance, oxidative stress markers, and intestinal health parameters were monitored.

Key Findings

Pigs exposed to heat stress exhibited significant reductions in growth parameters including final body weight (-7.4 kg), average daily gain (-26.7%), and average daily feed intake (-25.4%). Vitamin E supplementation, both in water and in feed, increased serum and liver vitamin E concentrations, however, antioxidant supplementation did not alleviate the negative effects of heat stress on growth performance. Heat stress did induce increased oxidative stress, and vitamin E supplementation did have a positive influence on inflammatory markers in the intestinal mucosa in heat stressed pigs, indicating a possible anti-inflammatory effect.

Conclusions

Although vitamin E supplementation enhanced antioxidant status in pigs and exhibited some anti-inflammatory properties, it did not mitigate the negative impacts of heat stress on growth performance in pigs. These findings suggest that antioxidant supplementation alone may be insufficient to mitigate the impact of heat stress, highlighting the need for comprehensive strategies combining nutritional, environmental, and management interventions to improve resilience to heat stress.

For further details, you can access the full study here.

[1]Silva-Guillen, Y. V., Arellano, C., Wiegert, J., Boyd, R. D., Martínez, G. E., & van Heugten, E. (2024). Supplementation of vitamin E or a botanical extract as antioxidants to improve growth performance and health of growing pigs housed under thermoneutral or heat-stressed conditions. *Journal of Animal Science and Biotechnology*, 15, Article 27. https://doi.org/10.1186/s4010

Upcoming Events

PQA Advisor Training Dates

9 am - Monday, June 9th

Duplin County Center

Please contact Dr. Mark Knauer (mtknauer@ncsu.edu) to register.

2025 ASAS-CSAS Annual Meeting

July 6th - 10th

Diplomat Beach Resort in Hollywood, FL

Carolina Feed Industry Association Summer Meeting

August 19th - 21st

Lumina at Wrightsville Beach, NC

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