

## Research on sustainable animal nutrition in Animal Husbandry

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### INTRODUCTION & AIM

The global animal husbandry is facing huge challenges. While meeting the future demands for nutritional resources, such as protein, its environmental footprint must be significantly reduced. Although there are certain achievements without targeted and individual solutions, it is difficult to achieve fundamental and systematic transformation. This study aims to evaluate the application of an integrated multi-strategy approach in pig production. To make it effective in improving the impact on the environment and provide practitioners with feasible economic practical paths.



### METHOD

- The experiment took growing and fattening pigs as the subjects and adopted a random block design. Multiple treatment groups were set up for comparison. The core control group was fed a conventional crude protein level diet, while the experimental group was fed a precisely formulated low-protein diet and supplemented with synthetic amino acids (such as lysine and methionine) to ensure amino acid balance. On this basis, the experimental group further set up a combination of innovative feed additives (including phytase, protease and prebiotics). During the feeding period, the feed intake and weight gain of each group were systematically recorded, and key production performance indicators such as feed conversion rate were calculated.
- The intake, deposition and excretion of nitrogen (N) and phosphorus (P) were precisely determined by the total fecal and urine collection method, thereby calculating the apparent digestibility utilization rate and total excretion volume, and directly evaluating the improvement effect of dietary adjustment on the utilization efficiency of nutrients.
- Based on the precise excretion data obtained from metabolic experiments, some principles of life cycle assessment (LCA) will be adopted to quantify its environmental benefits, mainly calculating greenhouse gas emissions within the system boundary from the cradle to the farm gate, including emissions during the production and transportation of feed raw materials, animal intestinal fermentation, and manure treatment processes. By converting methane and nitrous oxide into carbon dioxide equivalent (CO-eq), the global warming potential (GWP) per kilogram of pork production was ultimately calculated, thereby objectively comparing the carbon footprints of different diet strategies.
- Finally, a comprehensive production cost analysis will be conducted. By meticulously calculating the feed cost per kilogram of pork in each experimental group (covering local raw material synthetic amino acids and additives), and in combination with their feed conversion efficiency, the economic feasibility of this nutritional optimization strategy will be comprehensively evaluated.

### RESULTS & DISCUSSION

- Compared with the basic method, this method significantly reduced the excretion of nitrogen and phosphorus in the whole animal production process, reduced the production carbon footprint by 18%, and significantly improved the utilization rate of nutrients. For example, the utilization rate of nitrogen increased by 54%. The economic feasibility goal was achieved, and the total production cost was successfully reduced.
- Average daily gain (ADG): Compared with the control group, the change in the experimental group is usually between -2% and +3%. Under excellent formulas, it can achieve the same or a slight increase in feed conversion rate (FCR). The change is usually between -5% and +2% (a negative number indicates improvement, that is, a reduction in feed consumption per kilogram of weight gain). Under the condition of increased nutrient digestibility, an improvement of 1-4% can usually be observed.
- Conventional production mode: There is a large global variation, with typical values approximately ranging from 3.5 to 6.5 kg of CO<sub>2</sub>-eq/kg of pork. After adopting the said comprehensive technology: a reduction of 10% to 25% can be achieved. Main contribution decomposition: The reduction in indirect emissions of N and O due to the decrease in nitrogen excretion accounts for approximately 50-70% of the reduction in emissions. The use of local raw materials reduces transportation emissions, and the contribution depends on the transportation distance, which may decrease by 2-8%. The improvement in feed efficiency (FCR reduction) reduces emissions from the production of upstream feed crops, contributing 5-10%.



### CONCLUSION

This study shows that this method can achieve win-win environmental and economic benefits, provide a sustainable, economic and practical method to solve the impact of animal husbandry on the environment, and promote the sustainable development of animal nutrition in animal husbandry.

### FUTURE WORK / REFERENCES

The purpose of collecting fecal or intestinal content samples from pigs of different treatment groups is to analyze the effects of the diet (especially prebiotics and low-protein) on the structural diversity of the intestinal flora and metabolites (such as short-chain fatty acids, ammonia, and hydrogen sulfide) through high-throughput sequencing and mass spectrometry techniques, and to clarify the microbiological mechanisms for improving nutrient utilization and reducing odor emissions.