INFLUENCE OF NUTRITIONAL TECHNOLOGY ON WATER AND PERFORMANCE INDICATORS OF PIG PRODUCTION

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1 INTRODUCTION

There are several nutritional technologies that reduce chemical output by animals. Increasing Nitrogen, Phosphorus and micro mineral utilization by pigs improves environment quality, by reducing local nutrient importation from other regions and better use of non renewable natural sources (Dourmad and Jondreville., 2007). Besides, Shaw et al. (2006) stated that studies on water utilization by swine are very complex, since they are affected by animal behavior, the environment inside facilities and nutritional management.

Water is the nutrient required by pigs in greatest amount. Its consumption is influenced by several factors but type of diet is by far the most important. Therefore, a well formulated diet will demand less water consumption and hence promote rational use of water sources. This diet will also provide environmental and economic benefits, because it will generate less waste, reducing environmental risks to surface and ground water, soil and air. It will also reduce management and treatment costs.

The use of environmentally friendly nutritionally strategies will reduce the potential impact of pig manure in water, soil and air. The research involving nutrition and environment require continuous monitoring, multidisciplinary and systemic approach (Prince, 2000).

This systemic approach is usually not considered when decisions are taken. This can be observed, for example, in studies related to swine production costs. Usually, environmental costs are not taken in account in swine production. This cannot be accepted for an activity that is routinely questioned about its environmental performance. Therefore, a diet planned to consider environmental technologies in its formulation, may have higher cost but have a positive impact on reducing the environmental hazards. Consequently, they reduce environmental management costs.

Knowledge about relationship between pig nutrition, water consumption and waste production is essential for an activity that has been questioned for its sustainability. The establishment of indicators that express these relationships will assist decision-making by actors in the production chain, and provide social evaluation of this activity.

The objective of this study was to propose water and performance indicators to growing-finishing pigs, and evaluating the effect of nutritional technologies on indicators.

2 MATERIALS AND METHODS

The experiment was conducted at Embrapa Swine and Poultry swine production facilities during 17 weeks (119 days).

Eighty barrows, Landrace x Large White crossbred with MS60 syntetic boars, with average initial weight of 30 kg average age of 77 days were allotted in a randomized block design. The experiment was divided in four phases: 30 to 50, 50 to 70, 70 to 100 and 100 to 130 kg. The experimental unit (replicate) consisted of a pen with four animals.

The treatments were:

T1 - Diet with high level of crude protein, minimum amino acid supplementation, and without the inclusion of phytase and organic minerals;

T2 - Diet based on T1, with reduced level of crude protein by supplementation of lysine, methionine, threonine and tryptophan, with ideal protein of all essential amino acids, and without the inclusion of phytase and organic minerals;

T3 - Diet based on T1, with the inclusion of phytase and reduction of Calcium and Phosphorus;

T4 - Diet based on T1, with the supplementation of microminerals (Cu, Zn and Mn) on the basis of 44% organic and 56% inorganic minerals;

T5 - Diet based on T1, but combining all supplemantations of T2, T3 and T4.

All diets were isocaloric and formulated based on digestible amino acids using the concept of ideal protein. Basic ingredients were corn, soybean meal and oil, without the inclusion of animal by-products. Brazilian Poultry and Pigs Requirements (Rostagno et al., 2005) were the reference for nutritional requirements of animals to formulate diets.

In the diets of Treatments 4 and 5 the contents of copper, zinc and manganese were supplemented with inorganic and organic minerals at a rate of 56% and 44%, representing the reduction of 10% in the total amount of supplemented minerals compared to T1.

Diets were mashed type and phytase was added following commercial recommendations regarding reduction in supplemented Phosphorus and Calcium.

Each pen had one 50 L water tank placed above the animals. Daily, the volume of the tank was refilled. Therefore, the difference between gallon capacity and the volume refilled indicated the water intake into the pen. The tank was connected to a drinker designed to reduce losses as much as possible. Before and after the daily replacement, water temperature was measured using a thermometer with mercury bulb.

Weekly, total waste produced was collected in each pen. After collection, the manure was weighed. The division of the total waste by the number of pigs in each pen generated the result of kg of waste produced per animal.

The chosen indicators to measure performance, waste production and water use were: IND1 - water consumption and waste production (L/kg); IND2 - water consumption and weight gain (L/kg); Ind3 - water consumption and feed consumption (L/kg).

Variables were analyzed using various procedures of SAS (2002) and the general model included main effects of blocks and treatments. Univariate and multivariate analysis techniques were employed.

3 RESULTS AND DISCUSSION

Average water temperature before replacement was 23.33^{0}C and after of 23.34^{0}C. Among treatments, the average temperature ranged from 22.97^{0}C to 23.02^{0}C. Considering that ideal temperature to drinking is 20.00^{0}C, it was observed that the mean value was slightly above the ideal, but there was no statistically significant difference between the water temperature before and after replacement among treatments.

Figures 1, 2, and 3 show IND1, water consumption and waste production (L/kg); IND2, water consumption and weight gain (L/kg); IND3, water consumption and feed consumption (L/kg), respectively.

Treatment 5 had the highest ratio between water consumption and waste production (2.72) while Treatments T2 (2.22) and T3 (2.25) had the lowest ratio. It was expected that the largest ratio occurred in T1 because this diet had any of the chosen nutritional technologies. The largest ratios occurred in treatments containing organic minerals. Higher ratios has a direct impact on the environmental cost of pig production, because volume is one of the main parameters used in the design of storage and waste treatment systems.

T2 and T3 had a positive effect in reducing the need for labor to cleaning pens, cost of environmental management, reducing the potential pollution, especially that related to surface and groundwater; need for agricultural area when the use of manure as fertilizer.

The ratio between water consumption and weight gain increased with the age. In the first week the average of treatments was 3.7 L/kg and in the last week was 6.3 L/kg. This increase is related to animal physiology, since older animals are less efficient to convert nutrients in meat. Water is the main nutrient in a livestock. If it is used with lower efficiency it decreases water availability to farms and environment. Therefore, the decision on the best slaughtering weight cannot be limited only by market needs, but also consider the environmental impacts that this decision could have. The actual trend is to increase animal concentration in farms and regions, slaughtering animals at heavier weights, which will demand higher water availability.

The lowest average water intake was observed in T5 (5.0 L/kg) and the highest in T1 (6.0 L/kg). The difference of 1 L/kg between these treatments is significant when we consider the difference during experimental period. The animals were housed with an average weight of 30 kg and slaughtered at an average weight of 130 kg, weight gain during the period was 100 kg. Multiplying this value by the difference between T5 and T1, each animal under T1 drank 100 liters more than the ones in T5. If we project this difference to an industrial farm the impact will be huge to conservation of water sources.

Treatments with organic minerals had the lowest ratio between water consumption and weight gain, showing that this technology can be used when farmers aim improving water efficiency.

The ratio between water consumption and weight gain can be used as an indicator of environmental performance and water efficiency. Therefore, it is necessary that the practice of measuring water consumption be internalized in the daily of farm.

Traditionally, farmers and profissionals use the ratio of 2 to 3 L of water per kilogram of feed.. The results showed that treatments did not differ significantly and that the average ratio ranged from 2.13 L/kg (T1) to 1.74 L/kg (T5). The use of all technologies on the same diet provided a lower consumption of water per kilogram of feed. Despite the low difference between the maximum and minimum average (390 ml), when we project this difference to the current scale of production, the difference will be significant.

Animal nutrition should be understood as an important factor on the generation of production wastes. Therefore, any practice or technologies that improve the utilization of nutrients should be evaluated in theirs productive, economical and environmental factors. Today, the economical evaluation is the main criteria to take decisions in swine production, which can lead to important environmental liabilities.

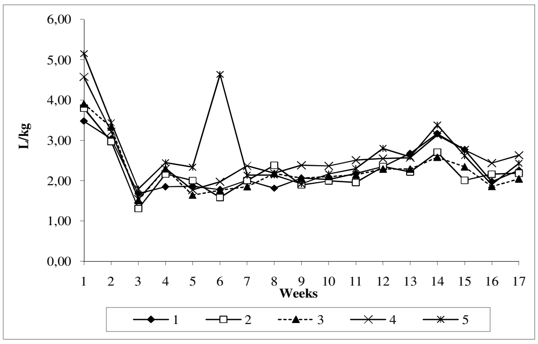

FIGURE 1 **Relation between water consumption and waste production (L/kg).**

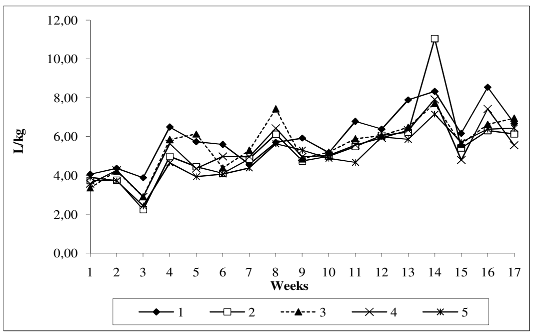

FIGURE 2 **Relation between water consumption and weight gain (L/kg).**

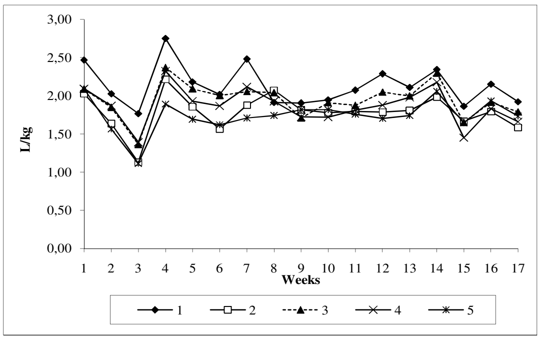

FIGURE 3 **Relation between water consumption and feed consumption (L/kg).**

4 CONCLUSIONS

Nutritional technologies provided a positive impact on the efficient use of water by animals.

Research should be conducted to evaluate the responses for other swine categories. It should also be made an analysis of cost of production that considers the cost of diets, the value of water sources, and the cost of waste management.

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