Nitrogen and phosphorus excretions from Luong Phuong chickens fed different typical diets

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During the year 2010, SUSANE researcher group has carried out a study with focus on nitrogen and phosphorus excretion from chicken fed different typical diets in Vietnam. In this newsletter preliminary result of their study is presented.

Implication

There was no difference in growth rate between chickens fed the standard diet formulated according to PHILSAN's recommendation (2003) and chicks fed commercial diet. Although total N and P intake of chicken used the PHILSAN feed formulation was higher than that of chicks fed the commercial diets, chicken fed the diet formulated according to PHILSAN's recommendation (2003) were excreting less nitrogen and phosphorus than chickens fed the commercial diets if expressed as ratio of excretion to intake.

Introduction

In Vietnam there is an increasing focus on livestock production causing pollution of the environment due to loss of plant nutrient pollution. The plant nutrients run off and leaching to fresh water recipients may cause increased production of plants in rivers and lakes and thus reduce the potential production of fish, shellfish and shrimps. Therefore, livestock farmers and authorities need to be better in predicting the amount of plant nutrients produced, so that the right production rate of livestock and use of the manure can be assessed. In chicken production very little is known about the amount of manure excreted by chickens fed standard diets and there is a need of better knowledge about the right feeding ratio. This may cause excess excretion of poultry due to the inefficiency of feed utilization.

Thus, a better knowledge base about excretion related to feeding may contribute to a better feeding, better manure management and less pollution. The risk of pollution from chicken production can be solved by implementation of two major strategies, which are i) dietary modification to improve the utilization of nitrogen and phosphorus, and ii)

industrial disposal of excreta through manure treatment such as composting, anaerobic digestion and direct combustion. This study focused on strategy i) for the purpose of reducing plant nutrient excess the experiments were conducted to increase the knowledge base about nitrogen and phosphorus excretion from Luong Phuong chickens fed different typical diets in Vietnam.

Results

Three diets were used in this study: i) diet was formulated to meet all nutrition requirements for chickens in the experimental periods according to PHILSAN's recommendation (2003) (diet 1), ii) diet was obtained by mixing commercial protein concentrate with broken rice, rice bran and maize according to manufacturer's recommendation (diet 2) iii) diet was commercial feed (diet 3). For more information see annex 1.

Table 2. Feed intake, excreta output, live weight gain and FCR of chicken fed with different diets (n = 6)

Item	Diet 1	Diet 2	Diet 3
DM feed intake (g/chick/day)	49.7	45.8	48.1
Daily weight gain (g/chick/day)	21.3	17.80	22.7
FCR (g/kg weigh gain)	2.34	2.58	2.13
Fresh excreta output	87.5	85.7	93.5
DM excreta output	14.3	12.7	12.3

FCR is feed conversion ratio

DM: Is the dry matter of the feed or excreta, measured by drying the feed or excreta.

The dry matter (DM) feed intake and live weight gains in chickens fed diet 2 were lower than those in chicks fed diet 1 or diet 3 (Table 2). Feed conversion ratio (FCR) of chickens fed diet 2 was significantly higher than that of chicks fed diet 1 and diet 3.

Fresh excreta output ranged from 85.7 to 93.5 g chick^{-1}day^{-1} and no difference was observed between treatments. However, daily DM excreta output of every chick fed diet 1 was 14.33 g that was higher than that of chick fed with two other diets.

Table 3. Nutrient intake and excretion, nutrient excretion and retention in percentage of intake (as dry matter)

Item	Diet 1	Diet 2	Diet 3
Total intake (g/chick/60 days)			
Nitrogen	147	90.3	97.5
Phosphorus	63.7	53.9	49.0
Daily intake (g/chick/day)			
Nitrogen	2.46	1.51	1.63
Phosphorus	1.06	0.90	0.82
Total excretion (g/chick/60 days)			
Nitrogen	55.8	46.4	43.7
Phosphorus	29.6	32.7	29.5
Daily excretion (g/chick/day)			
Nitrogen	0.93	0.77	0.73
Phosphorus	0.49	0.55	0.49
Daily retention (g/chick/day)			
Nitrogen	1.53	0.73	0.90
Phosphorus	0.57	0.35	0.33
Excretion/intake (%)			
Nitrogen	37.8	51.3	44.8
Phosphorus	46.5	60.8	60.1
Retention/intake (%)			
Nitrogen	62.2	48.7	55.2
Phosphorus	53.5	39.3	39.9
Excretion/retention (%)			
Nitrogen	60.9	106	81.5
Phosphorus	87.2	156	151

The results also indicated that there was the effect of differences in diets on nitrogen and phosphorus intake, excretion and retention in broilers (Table 3). The chicken fed diet 2 (combined local feed and commercial feed) did not increase weight at the same rate as the chickens fed diet 1 and 3. Further the chicken fed diet 2 excreted less DM, nitrogen and phosphorous.

The total excretion of nitrogen in chicks fed diet 1, 2 and 3 were 55.8, 46.4 and 43.7 g chicken^{-1} per 60 days, respectively. The average nitrogen intake and nitrogen excretion from chickens fed diet 1 were 2.46 and 0.93 g chick^{-1} per day, respectively. Meanwhile, the lower values were observed in diet 2 (1.51 and 0.77 g chick^{-1} per day) and in diet 3 (1.63 and 0.73 g chick^{-1} per day).

The total excretion of phosphorus was 29.6, 32.7 and 29.5 g chicken^{-1} per 60 days in chicks fed diet 1, 2 and 3. Most important was that phosphorus intake and phosphorus retention from chicks fed diet 1 were higher than those of in chicks fed diet 2 and diet 3. During 60 days of experiment, the daily total phosphorus excretion in diet 2 was 32.7 g per chick, that was significant higher than in diet 1 (29.6 g per chick) and diet 3 (29.5 per chick).

Nitrogen and phosphorus excretion as percent to intake, nitrogen and phosphorus excretion as percent to retention in chicks fed diet 1 (37.8% and 46.5%) were lower than that in groups fed diet 2 (51.3% and 60.8%) or diet 3 (44.8% and 60.1%). Nitrogen excretion as percent to intake and to retention in diet 1 was 37.8% and 60.9%, respectively. Meanwhile, phosphorus excretion as percent to intake and to retention was 46.5% and 87.1%, respectively, for chicks fed diet 1.

Thus, although the chicken fed diet 2 showed the greatest weight gain as related to feed intake these chickens at the same time excreted more nitrogen and phosphorous than the chickens fed diet 1 and 3. This indicates that the diet 2 have not been adjusted well to the chickens need so that both production is lower than one could expect and excretion is higher.

Annex 1: Experimental design

Seventy two (1-day-old) male and female Luong Phuong chickens were allocated equally and randomly to 18 metabolism cages with 2 males and 2 females per cage. Three diets were allocated randomly to the cages of birds, such that there were six cages each of four birds per diet (24 birds per diet). Three diets were used in this study: i) diet was formulated to meet all nutrition requirements for chickens in the experimental periods according to PHILSAN's recommendation (2003) (diet 1), ii) diet was obtained by mixing commercial protein concentrate with broken rice, rice bran and maize according to manufacturer's recommendation (diet 2) iii) diet was commercial feed (diet 3) The crude protein, phosphorous and gross energy of test diets was presented in Table 1.

Table 1. Nutrition composition of experimental diets (as dry matter)

Diets	Chicken age (day)	Crude protein (%)	Phosphorus (%)	Gross energy (kcal/kg)
Diet 1	1-15	25.5	1.49	4446
	16-30	22.8	1.72	4501
	31-60	21.5	1.48	4520
Diet 2	1-21	22.4	2.00	4483
	22-42	20.9	1.94	4516
	43-60	19.4	1.96	4537
Diet 3	1-21	22.4	1.46	4662
	22-60	20.8	1.75	4608

Feed and water were supplied *ad libitum* during 60 days of experiment. During experiment period, intake and excreta from chickens in each cage were recorded daily. Excreta of chickens in each cage was collected quantitatively twice per day and stored at -20^{o}C. At the end of each period of experiment, excreta samples of 4 chickens in each cage were defrosted and homogenized. After that, sub-sample was taken and stored at -20^{o}C until analyses.