Tel: (84-4) 8276906 Fax: (84-4) 8276554 Email: hau@hn.vnn.vn Website: www.hau1.edu.vn

Utilization of agricultural by-products in pig feeding, its effect on nitrogen digestibility, nitrogen excretion and nitrogen losses from slurry during storage

Nguyen Ba Mui and Dang Thai Hai

Hanoi University of Agriculturure, Vietnam

1. INTRODUCTION

- Pig production is not only a major protein source for human consumption but the manure from it is also important in supplying organic fertilizer.
- Traditionally, pigs are fed rice bran, cassava. While amount agricultural by-product such as beer by-product, pineapple pulps are also feed source for pig.
- It is well established that an increased supply for fermentable substrate to the microbes results in increased metabolic activity of the large intestinal microflora of pigs (Morgan and Wittemore, 1988; Schulze et al, 1993).

- There is increasing evidence that excretion of nitrogen can be shifted from urine to faeces when fermentable carbohydrate are available for microbial fermentation in the large intestine (Schulze, 1993)
- In our research was to make one’s choice for feed ingredients in traditional feed of households for intensive pig production, these alternatives could be the local agricultural by-products which contain high concentration of fermentable carbohydrate it may possible to improve both pig performance and manure quality, contribute reduce environmental pollution.

2. MATERIALS AND METHODS

Animal and housing

- A experiment was carried out on 12 commercial crossbred barrows (Vietnamese Mongcai x Lagre white), with initial BW of 70.5 kg were randomly allotted to one of three diets (table 1).
- From 65 kg onwards the animals were kept in groups and were fed treatment diets. When the animals reached 70 kg body weight, they were housed individually in a controlled room in metabolism cages that allowed the separated collection of urine and faeces.
- The 21-day experimental period consisted of a 12-day adaptation period to allow the pigs to become accustomed to the cages and to the new diet and 9-day period during which urine and faeces were collected.

Table 1. Ingredient composition of the experimental diets (g/kg diet)

Ingredients (as fed basic)	Tapioca	Rice bran	Pineapple pulp
Rice	230.0	230.0	230.0
Tapioca	511.0	341.5	342.5
Cane molasses	25.0	25.0	25.0
Groundnut extracted	125.0	125.0	125.0
Fish meal	78.0	48.0	42.0
Rice bran		200.0	
Pineapple pulp			200.0
Chalk	11.0	11.0	11.0
$CaHPO_4$	4.5	4.5	4.5
$KHCO_3$	2.5	2.0	7.0
Salt	3.0	3.0	3.0
Premix	10.0	10.0	10.0

Diets and feeding

- The control diet was composed with rice and tapiocas basal energy sources.
- In the other two diets, tapioca was exchanged with the same amount (200 g/kg diet) of rice bran or pineapple pulp.
- Thus, the diets were similar, except for the contents of NSP-rich by-products and pineapple pulps.
- The diet based on pineapple pulp had the highest NSP content (18.92%), followed by the diets based on rice bran (12.88%) and the tapioca (6.95%) (table 2).

Table 2: Chemical composition of experimental diets

Composition (as fed basic)	Tapioca	Rice bran	Pineapple pulp
NE, (kcal/kg)	2310	2316	2205
Crude protein (%)	12.70	12.48	12.06
Crude fat (%)	2.57	4.58	3.18
NSP (%)	6.95	12.88	18.92
Cellulose (%)	2.47	3.02	5.38
NDF (%)	2.61	4.82	7.05
ADF (%)	1.24	3.27	5.18
Lignin (%)	0.62	1.03	1.21
Water (%)	13.79	14.02	14.15
Crude ash (%)	4.93	5.45	4.92
Starch (%)	55.29	50.45	43.47
Sugar (%)	3.77	0.14	3.3
Phosphorus (%)	0.43	0.63	0.47
Sodium (%)	0.19	0.15	0.20
Calcium (%)	0.91	1.12	0.84
Potassium (%)	0.80	0.85	0.79
Chloride (%)	0.39	0.36	0.28
Magesium (%)	0.12	0.25	0.15
Copper (ppm)	3.6	3.0	3.2
dEB (meq/100g)	18.50	18.84	18.75

Chemical analysis

- All samples were analyzed in duplicate.
- The diets and excreta were analyzed for DM, ash, crude fiber, crude fat and total N according to AOAC (1990).
- Urinary urea was determined by Neumann and Ziegenhorn (1977).
- Neutral detergent fiber (NDF) and acid detergent fiber were analyzed as described by Huisman (1990).
- The pH was measured by pH met Hanna directly submerged in the urine, in diluted faeces (mixed with distilled water in a ratio 1:4) and in the slurry

- The urine and faeces collected in the first 4 days were used for determining the nitrogen balance
- Urine and faeces were collected twice a day, their pH was measured directly after collection, and they were then mixed to slurry in a plastic bucket
- The buckets were kept for a further 30 days in the same room.
- After storaging, the slurry was mixed and sampled for chemical analysis.
- The slurry was weighed at the beginning and the end of the storage period. The differences in total nitrogen of slurry at the start and the end of this 30-day storage period were used to calculate the nitrogen losses from slurry

3. RESULTS AND DISCUSSION

- 3.1 Nitrogen intake and nitrogen excretion
- No health problems occurred during the experimental period. Table 3 shows that the animal daily BW gain, nitrogen intake, nitrogen excretion and nitrogen retension of the pigs on the different diets
- The nitrogen intake of the tapioca based diet was higher than the pineapple pulp diet ($p<0.05$). This can be explained by the crude protein content of the tapioca based diet had higher than the pineapple pulp diet.
- Total nitrogen excretion was effected by the diets. Pigs fed the tapioca and rice bran based diets had a higher in total nitrogen excretion ($p<0.05$).

Table 3: Weight gain, nitrogen intake, nitrogen excretion and retention of pig fed different diets

Variables	Tapioca	Rice bran	Pineapple Pulp	P[1]
Number of pigs	4	4	4	
Initial BW[2] (kg)	70.5	71.2	70.7	NS
Final BW[3] (kg)	79.7	81.1	80.4	NS
Weight gain (g/day)	657	707	692	NS
N intake (g/day)	38.2[a]	36.6[ac]	34.7[bc]	*
Faecal N (g/day)	4.32[a]	6.05[b]	8.12[c]	***
Urinary N (g/day)	18.18[a]	15.55[b]	11.08[c]	***
Total N excretion (g/day)	22.5[a]	21.6[a]	19.2[b]	*
Urinary N: faecal N	4.21[a]	2.57[b]	1.36[c]	***
Apparent N digestibility (%)	88.7[a]	83.5[b]	76.6[c]	**
N retention, % of intake	41.0[a]	40.9[a]	44.7[b]	*

3.2 Amount, pH and composition of urine and faeces

- The pigs fed the pineapple pulp based diet produced less urine than in the pigs fed the rice bran and tapioca based diets ($p<0.001$).
- So addition of fiber to the diet caused a major increase in the volume of water passing into and out of the large intestine.
- Total nitrogen concentration of faces and urine were lowest in the pineapple pulp based diet, and were the same in the tapioca and rice bran based diets ($p<0.01$)

Table 4: Amount, pH and composition of faeces and urine from pigs fed different diets

Component	Tapioca (n=4)	Rice Bran (n=4)	Pineapple Pulp (n=4)	P[1]
Amount (g/day):				
Urine	4247[a]	3783[a]	3028[b]	***
Faeces	422[a]	622[b]	879[c]	***
Total N (g/kg):				
Urine	4.28[a]	4.11[a]	3.56[b]	**
Faeces	10.24[a]	9.73[a]	8.23[b]	**
pH:				
Urine	7.62	7.51	7.45	NS
Faeces	7.95[a]	7.73[a]	7.18[b]	**
Faecal CF (g/kg)	66.8[a]	72.8[b]	76.6[b]	**
Urin. urea (mmol/l)	136.7[a]	117.5[b]	102.3[b]	***
Tot. urinary urea (mmol/day)	580.5[a]	444.5[b]	309.8[c]	***

3.3 The chemical composition of slurry and nitrogen loss from slurry during storage

- The dry matter content of slurry was highest in pigs fed the pineapple pulp based diet and lowest in the tapioca based diet ($p<0.01$).
- The dry matter content of slurry increased during storage, causing by water evaporated. Total nitrogen concentration of the slurry at d 1 was not significantly different between diets ($p>0.05$)

Table 5: Composition of slurry at d 1 and d 30 and N loss from slurry during storage

Components	Tapioca (n=4)	Rice Bran (n=4)	Pineapple Pulp (n=4)	P
Day 1				
Amount[1], kg	22.34	21.02	19.53	NS
DM, g/kg	77.72[a.]	84.7[a]	96.8[b]	**
Total N, g/kg	5.37	5.51	5.62	NS
pH	794[a]	7.82[a]	7.21[b]	**
Day 30				
Amount[1], kg	15.19	14.65	13.86	NS
DM, g/kg	106.31[a]	120.15[b]	138.63[c]	***
Total N, g/kg	6.62[a]	7.18[b]	7.41[b]	**
pH	7.85[a]	7.79[a]	7.12[b]	***
N loss (%)[2]	16.20[a]	9.21[b]	6.32[c]	***

4. CONCLUSION

- Including non-starch polysaccharides rich by-products in the diet of pigs shifts nitrogen excretion from the volatilisable form in urine to the less accessible protein form in the faeces.
- Non-starch polysaccharides also lower the pH of slurry, consequently there are clearly reduced nitrogen losses from slurry during storage.
- Such an approach may be an economical way of improving the quality of fertilizer from pig farming and of reducing the environmental impact of pig production.

Some pictures


Thank you
for your attention !!!