Fermented sweetpotato vines for more efficient pig raising in Vietnam

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Abstract

The increasing demand for meat in Hanoi, Vietnam, requires pig-raising to become more efficient. Sweetpotato vines are an important feed for pigs, but labor requirements for preparation are heavy, and storage is difficult. Already Vietnamese farmers, mostly women, spend up to two hours every day chopping sweetpotato vines to feed their one or two pigs, and as the numbers of pigs increases, feed preparation time increases also. Moreover, large amounts of vines need to be processed and stored for use in the off-season.

In the Red River Delta area near Hanoi, two on-farm trials were carried to see if using fermented sweetpotato vines could reduce women's labor and feed processing costs, and improve pig growth efficiency. Twelve different mixtures of sweetpotato vines, corn and cassava meals, rice bran, sun-dried chicken manure and salt were fermented, and the results were analysed for nutritional value. Vines fermented with chicken manure had significantly higher crude protein, dry matter and ash contents, and lower units costs of each nutrient, than did the other fermentation products. None of the preparations were found to contain aflatoxin or Salmonella. *E. coli*, although present in the original samples, disappeared after 14–21 days of fermentation.

The subsequent three-month on-farm feeding trial compared fresh sweetpotato vines, vines fermented with cassava meal, and vines fermented with sun-dried chicken manure and cassava meal in terms of pig growth and economic efficiency. Pigs fed the preparation containing chicken manure achieved statistically higher growth rates than those fed fresh vines; neither of these feeds was significantly different from the vines fermented with cassava meal only in terms of feed efficiency. The chicken manure preparation was also significantly cheaper (cost per kg of weight gain) than the other two preparations.

Introduction

In recent years, as incomes in Asia have risen, meat has become a much more important part of the diet, particularly in urban centers (Pezo et al, 2000). In Hanoi, Vietnam, meat production increased from 31,000 t in 1997 to 33,000 t in 1999**,** but this production meets only 50% of the total demand of the city: the rest must come from neighboring provinces and rural areas (Tinh, 2000). Meat demand is expected to increase to 87,000 t by 2005

and to 119,600 t by 2010, with 80% of the production coming from peri-urban farmers (Anh, 2000). Meat production in Vietnam is often constrained by shortages of feed (local or imported). The profitability of current pig-raising practices is low, and better feed, and hence enhanced growth efficiency, are necessary for pig farmers to increase profits. Low profitability presents a serious constraint to pig farmers because pigs often provide the only source of cash income.

Sweetpotato is a valuable pig feed: the roots provide energy and the leaves protein, and both can be used fresh, dried or fermented into silage (Woolfe, 1992). It is a common feed for pigs, and other livestock, in many countries in Asia, including China, India, a few eastern islands of Indonesia (Bali and West Papua), Korea, Philippines, Papua New Guinea, Taiwan, Uganda and Vietnam. In China, for example, which produces 85% of the world production of sweetpotato, a large part of the crop goes to feed animals, mainly pigs (Scott, 1991; Y Wang, CIP-Beijing, personal communication). In Vietnam, feeding sweetpotatoes to pigs is common in the north and central parts of the country.

The main constraints to using sweetpotato vines as pig feed are labor and storage. Regardless of how they are fed to the animals, the vines must first be chopped into small pieces—daunting and time-consuming task, mainly undertaken by women. If the vines are fed fresh, the women must allocate time each day for this task, even during the busy field season. Silage offers a potential alternative to overcome this constraint: sweetpotato vine silage has been a common livestock feed during winter (Sutoh et al, 1973) whenever seasonal lack of feed for livestock may limit productivity (Brown and Chavalimu, 1985). Use of vine silage overcomes both main constraints: the women are able to process the vines during the off-season when labor is more abundant, and store the silage for use when feed is limited. Moreover, there is also the economic advantage of ensiling/storing vines: to process and store the sweetpotato vines during the harvest season when vines are cheap and feed them to pigs during off-season when vines are expensive.

Ensiling may also increase nutritional value and feed efficiency if it involves a fermentation process which converts nitrogen into protein. This paper describes a fermentation trial to compare the nutritional value (particularly crude protein content) of 12 fermented mixtures of sweetpotato vines with various combinations of additives. Results showed that fermenting sweetpotato vines with chicken manure increased crude protein content. However, because high crude protein content does not necessarily guarantee better quality feed (Gerpacio et al, 1967), a subsequent on-farm pig-feeding trial was conducted to test the hypothesis that sweetpotato vines fermented with chicken manure gives better pig growth and economic efficiency.

Materials and methods

The fermentation trial consisted of 12 treatments—(Table 1) sweetpotato vines with combinations of corn meal, cassava meal, rice bran, and sun-dried chicken manure, all locally available and affordable material. All materials were prepared (weighed, chopped, pre-wilted, mixed and put into labelled doubleaerobic plastic bags) on-farm in a village in Ha Tay Province in the Red River Delta, by the farmers. Each treatment consisted of

three replications for each scheduled analysis—at14, 30, 60 and 90 days after fermentation started; hence a total of 12 samples for each treatment, or 144 samples in total. The samples remained on farm until the scheduled date for analysis when they were transported to the laboratory of National Institute of Animal Veterinarian or National Institute of Animal Husbandry in Hanoi to be analyzed. Chemical analysis pH and dry matter, crude protein, ether extract, crude fibre and ash contents. Microbiological tests for aflatoxin, *Salmonella* and *E.coli* were performed on vines fermented with various types of chicken manure, to ensure feed safety[1]. Costs of the nutrients were calculated to determine the economic efficiency.

The on-farm feeding trial was conducted in the same village. Five households were selected, each with six pigs (a total of 30 pigs). In each household, two pigs were assigned to each of three treatments (i.e., two replications per treatment):

- fresh or unfermented vines
- vines fermented with cassava meal (equivalent to treatment 5 of the previous trial: 93.5 % SP vine + 6 % of cassava meal + 0.5 % of salt)
- vines fermented with chicken manure and cassava meal (equivalent to treatment 6 of the previous trial: 83.5 % SP vine + 10 % chicken manure + 6 % cassava meal + 0.5 % of salt)

Treatment 5 and Treatment 6 of previous trial were selected for the feed trial due to the abundance of cassava roots in this area.

The base feed was common to all three treatments and it consisted of rice bran, corn meal, cassava meal, fish meal and soy bean[2]. The percentage of each ingredient was formulated based on the weight of the pigs: the bigger the pig, the lower percentage of protein and higher percentage of starch (Table 2). The daily recommended daily ration of this base feed also varied with pig weight: the bigger the pigs, the more ration (i.e., kg of feed) per day (Table 3).

Efforts were made to ensure there was no significant difference in the weight of the piglets in each treatment of the feeding trial in order not to bias the results (Table 4).

The trial lasted three months between 29 January and 30 April 2000 (93 days). The pigs were weighed four times: on the first day, after one month, after two months, and on the last day. The amount and the price of feed were recorded to calculate the costs of total feed and per kilo of weight gain.

Results and discussion

At 30 days after fermentation, the pH of all the treatments met the basic requirement of the acidity level (pH 3.7) for livestock (Ruiz et al. 1981) (Table 5). The pH of the

[1] This is to check feed safety when fermentation uses any type of chicken manure.

[2] Rice bran, corn meal, and cassava meal are commonly used for all farmers as pig feed. Fish meal and soy bean are less common in the rural area, but more commonly used by peri-urban farmers who raise pigs for the urban centers.

treatments with chicken manure were significantly higher than the ones without, AND HAD already attained the required level after only 14 days of fermentation. In terms of pH, therefore, the treatments with chicken manure are better feed than fresh vines or fermented vines without chicken manure.

Dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF), and ash showed no significant difference over time (at 14, 30, 60, and 90 days of fermentation). However, these parameters did differ significantly across treatments, especially between treatments with and without chicken manure (Table 6): DM, CP and ash contents of the treatments with chicken manure were all significantly higher than those of the treatments without. More importantly, the nutrient costs (especially of CP and ash) of the treatments with chicken manure were significantly lower than those of the treatments without (Table 7).

Microbiological tests vines fermented with various types chicken manure showed no aflatoxin or *Salmonella* in freshly dried chicken manure**.** *E. coli* was found when freshly dried, but was no longer detectable after 21 days of fermentation. The chicken manure used in this trial was purchased from a chicken farm near the trial village and the low price of the manure resulted in the low cost of crude protein and ash content in the fermented mix. In practice, farmers may collect and use manure from their own chickens. Therefore other types of chicken manure were also subjected to microbiological tests in this study. Sun dried manure from Kabir dual-purpose broilers and Tam Hoang layers, which are commonly raised by farmers, showed no aflatoxin or *Salmonella*: *E.coli* was a little more persistent in the fermented mixuture, but was no longer detectable after 21 days of fermentation.

In the feeding trial, the daily weight gain of the pigs over 93 days showed no significant difference between the fresh vine and non-chicken-manure fermentation (Table 4). Growth of pigs on the chicken manure treatment, however, was significantly greater than of pigs fed fresh vines. Even though the daily weight gain of pigs on the two fermented treatments was not significant, because of the large SD resulted from highly uneven weight of the pigs, the difference (554 versus 488 g) is quite substantial.

The chicken manure treatment achieved the highest feed and dry matter conversion rates (i.e., lowest feed or DM input for per kilo of weight gain), and consequently the lowest feed cost for per unit of weight gain (Table 8). The farmgate prices of live pigs in the Red River Delta area have been fluctuating between 9000 and 10,000 VND/kg, so farmers would suffer a loss by feeding fresh vine and would make only a small profit by feeding the non-chicken-manure treatment. The chicken manure treatment, however, would provide farmers with a substantial profit, as well as the highest weight gain

Conclusions

The fermentation is a simple process that requires little investment or equipment or investment. Chicken manure is readily available and cheap because only small quantities are required. The only equipment needed is a set of scales for weighing the ingredients,

and bags for storing the ferment. Thus, this fermentation method can easily be adopted, or even adapted, by farmers to improve pig growth and increase profit. During the extension meeting held soon after the trial, 40women showed great interest and enthusiastically copied the fermentation formula and the daily feeding formulation without any prompt from the extension staff.

During the extension meeting, the women voiced their concern about the formulation of the daily diet for pigs: not all crops included in the formulation are available year round, even though all are used as pig feed at different times of the year; and farmers cannot afford to buy fish meal or soy beans every day, however small the amount required. Sofarmers may not be able to follow the complete feed formulation. But the trial shows that, holding the base feed stable, vines fermented with chicken manure should yield higher daily weight gain with lower cost of weight gain than feeding fresh vines or vines fermented with cassava meal. In other words, replacing fresh vines with chicken manure-fermented vines will lead to improved growth, but the extent of which depends on the base feed.

These results may be disseminated widely to pig farmers in north and central Vietnam where sweetpotato vines are an important component of the pig feed. Policy should be made to encourage the Department of Agricultural and Rural Development of the district and commune levels to disseminate the information and demonstrate the processing and feeding method to farmers. Instead of encouraging the use of commercial protein supplement which is mainly imported, the policy should create favorable conditions for farmers to experiment with using locally available materials to increase the necessary protein for pig feed.

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