FEED RESOURCE AVAILABILITY AND UTILIZATION IN SMALLHOLDER PIG FARMS IN SRI LANKA

V. Ravindran, H. W. Cyril, P. Nadesalingam[1] and D. D. Gunawardene[2]

Postgraduate Institute of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Summary

Data on available feed resources, feeding practices and nutrient adequacy of rations under small farm conditions in Sri Lanka were obtained in a baseline survey involving 104 pig farms. The results showed that a wide range of non-conventional feedstuffs are used for pig feeding under typical small farm conditions and that dietary protein quality is a major factor limiting productivity. Following the survey, two on-farm trials were conducted to evaluate cheaper, alternative feeding strategies. In trial 1, a test diet was formulated using several non-conventional feedstuffs and compared with a commercial feed that is normally fed in the farms. In trial 2, the possibility of improving growth rates by amino acid supplementation was evaluated. The results demonstrated that feed costs can be considerably lowered through these packages. Some problems inherent to on-farm livestock trials are highlighted.

(**Key Words** : Feed Resources, Feeding Practices, Survey, Small Farms, Pigs, On-farm Trials)

Introduction

In the tropics, pig farming is primarily a small holders concern. Biological productivity variables of pigs under these conditions have been reported (Eusebio, 1980). While the reproductive parameters are generally comparable to those achieved under temperate climates, the growth performance has always been inferior. Though the poor growth rate of pigs in tropical small farms is attributed mainly to their poor nutritional status, limited published information is available on the feeding methods which are practiced. Accordingly, a survey was conducted to obtain data on feed resources, feeding practices and nutrient adequacy of the rations in small farms in Sri Lanka. Understanding of these aspects is critical for efficient use of available feed sources and to any future development strategies to improve small-farm pig farming. Following the survey, two on-farm trials were conducted to evaluate the possibility of increasing pig productivity through alternative feeding strategies. The objective was to develop and test a nutritionally adequate, cheaper diet that will offer an alternative to the expensive commercial feed.

Materials and Methods

Baseline survey

The study was conducted in the 'pig belt' area around the capital city of Colombo, where more than 75% of the pig population is concentrated. The baseline survey was used to select the farmers for the on-farm trials. The multiple-visit, questionnaire-type survey covered a total of 104 smallholder pig farms. The herd size ranged from 14-55, with an average herd strength of 36. All animals were of exotic type, consisting primarily of Large White, Landrace and crossbreds. Data collected *inter alia* included: type of feed resources, availability, amounts fed, any limitations, feeding methods, use of supplements/ premixes and farmer attitudes.

Major feed resources were identified based on the data obtained during the initial visit. Representative samples of the materials were collected during subsequent visits and, analysed for dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE) and ash. In addition, feed intake and feeding patterns of growing pigs were monitored in six selected farms over a period of eight weeks to obtain reliable data of nutrient adequacy. Estimates of lysine (LYS), methionine (MET), cystine (CYS) and digestible energy (DE) contents of the

Address reprint requests to Dr. V. Ravindran, Department of Animal Science, University of Sydney, Camden, NSW 2570, Australia.

[1]Department of Molecular Biology, University of Guelph, Guelph, Ontario, Canada N1G 2W1.

[2]Planning Unit, Department of Animal Production and Health, Getambe, Peradeniya, Sri Lanka.

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ingredients were obtained from available literature, and average nutrient intakes in these farms were calculated. Calculated nutrient intakes were compared with those recommended by NRC (1988) for growing pigs of the same liveweight class.

On-farm trials

Trial 1

Following the survey, four farmers who used commercial feed for pig feeding were selected for on-farm investigations to test a new diet that was formulated based on several locally available new feed resources. The selected farmers had a sound technical know-how of pig farming and showed a strong aptitude necessary to carry out the responsibilities of the research component. All farmers had Large White × Landrace crossbred animals.

During this time, the responsibilities of the two parties were discussed and agreed upon. The quantities of fish meal and skim milk powder needed for the feed formulation were supplied by the project as an incentive. This was necessary since the quality of these feedstuffs available in local markets is highly variable. In return, the farmers agreed to allow the use of farm facilities, including labour. They also agreed to collect the new feed resources (breadfruit, sweet potato vines, ipil ipil leaves and poultry litter) and process them into a meal form. The leaf meals and the poultry litter were processed as described elsewhere (Rajaguru et al., 1978; Ravindran et al., 1986; Ravindran and Wijesiri, 1988). It was also agreed that any losses on the test diet, such as loss in weight gain, will be covered by the project.

The farm size and type of housing made the application of more than two dietary treatments per farm virtually impossible. Consequently only two treatments were imposed, namely a control and a test diet. The commercial feed, that was commonly used for feeding pigs in the farms, served as the control. The test diet was formulated using several non-conventional feed resources (table 1) and was 28% cheaper than the commercial feed.

Within each farm, 16 growing pigs (average age, 85 days; average body weight, 12.4 kg) were assigned across litter-mates to four pens. Two pens of four pigs each was then randomly assigned to each diet. Pigs were limit-fed twice daily. The feed allowance was determined by the replicate group consuming the least during a 30-min feeding period at the start of each week. Feeding levels were then held constant until the following week. Water was available at all times. Records of daily feed intake were maintained and the body weights were determined at monthly intervals. The set-up of the trial, estimation of feed allowance and the monthly weighings of the animals were done under the supervision of the researcher; otherwise, the trials were entirely farmer-managed.

TABLE 1. PERCENTAGE COMPOSITION OF THE TEST DIET USED IN TRIAL 1

Ingredient	%
Sorghum	10.0
Rice polishings	36.5
Breadfruit meal	10.0
Coconut meal	15.0
Sweet potato vine meal	5.0
Ipil ipil leaf meal	5.0
Poultry litter	10.0
Skim milk powder[a]	4.0
Fish meal	4.0
Vitamin-mineral premix	0.25
Salt	0.25

Analytical values

	Control	Test diet
Crude protein, %[b]	17.8	18.0
Crude fibre, %[b]	7.1	9.0

[a] Discarded as unsuitable for human use.
[b] Analysed values.

Prior to the on-farm trials, the new diet was pre-tested at the University Research Station in a feeding trial involving 32 growing pigs (average age, 80 days; average weight, 18.9 kg). There were four replicate groups of four pigs each for each diet. The trial lasted eight weeks. The conduct of the trial was similar to that described for the on-farm trial, except that the weight gains were recorded at fortnightly intervals.

It was intended that the on-farm trials will last until the animals reach an average market weight of 75 kg. However, two farmers discontinued cooperation after two months citing personal and practical difficulties. Thus the studies were discontinued at that point.

Trial 2

Since the survey results indicated that inadequate amino acid intake may be a major reason for the poor growth performance, it was decided to conduct another on -farm feeding trial on two selected farms to investigate whether the growth can be improved by supplementation of synthetic amino acids (lysine and methionine). Two dietary treatments were employed: (1) control (ration that was normally fed in the farm; combination of swill and several bulky-type feedstuffs), and (2) control + 0.2%

MET + 0.2% LYS. The cost of amino acid supplements was covered by the research project.

Within each farm, eight barrows (average age, 70 days; average weight, 13.2 kg) were selected from two litters and randomly allocated to two pens across littermates. Pens were then randomly assigned to one of the treatments. Each farm was considered a replicate. Diets were offered *ad libitum* once daily and feed refusals were recorded. Feed samples were collected every week for the determination of DM contents. Body weights were taken at fortnightly intervals. The trial lasted eight weeks.

Data analysis

Data from Trial 1 was analysed according to Snedecor and Cochran (1967) using the procedures of the Statistical Analysis System (SAS, 1985). Feed per gain was computed on a pen basis.

Results and Discussion

It is often assumed that the use of by-product feedstuffs for livestock feeding at the farm level is negligible. While this assumption may be true for other species of farm animals, the survey results showed that a wide range of non-conventional feed resources are being used for pig feeding under small farm conditions in Sri Lanka. Composition of the feedingstuffs, with the exception of swill, are presented in table 2. A variety of pasture and fodder grasses were cut and offered in most farms, but no attempt was made to analyse them realizing

TABLE 2. COMPOSITION OF FEED RESOURCES USED IN SMALLHOLDER PIG FARMS IN SRI LANKA

Feedstuff	DM (%)	CP	CF	EE	Ash	NFE
		(as % dry matter)				
Major feedstuffs[a]						
Cassava(*Manihot esculenta*) roots, peeled	26	2.3	2.8	0.8	1.8	92.3
Sweet potato(*Ipomea batatas*), tubers	24	5.8	2.6	1.2	3.6	86.8
Rice(*Oryza sativa*) bran	88	11.6	15.9	10.8	15.1	46.6
Breadfruit(*Artocarpus altilis*), unripe	26	6.0	6.2	1.2	3.9	82.7
Jakfruit(*Artocarpus heterophyllus*), unripe	28	8.2	8.9	2.7	4.0	76.2
Banana(*Musa sapientum*) pseudostem	11	8.5	27.2	3.2	20.4	40.7
Coconut(*Cocos nucifera*) meal	90	20.6	14.4	10.8	8.4	45.8
Sweet potato, vines	19	12.1	22.0	4.3	10.4	51.2
Poultry litter, layer house	68	21.6	18.5	2.4	16.9	40.6
Poultry offals	32	60.9	–	21.8	8.6	8.7
Fish offals	54	28.9	–	13.1	13.9	44.1
Minor feedstuffs[b]						
Pineapple(*Anonas cosmos*) fruit waste	24	4.4	15.1	1.9	6.1	72.5
Papaw(*Carica papaya*) leaves	21	29.5	14.6	8.8	12.4	34.7
Water hyacinth(*Eichhornia crassipes*), whole plant	7	12.6	19.8	3.9	12.8	50.9
Kankun(*Ipomea aquatica*), whole plant	11	24.1	12.7	3.4	13.5	46.3
Banana leaves	19	8.6	21.4	4.9	14.0	51.1
Banana fruit peels	45	2.8	3.9	0.7	2.2	86.4
Cabbage(*Brassica oleracea*), leaf waste	21	6.8	4.9	1.3	3.3	83.7
Carrot(*Daucus carota*), refuse with tops	40	2.6	11.4	2.4	3.5	80.1
Poultry manure, dried	84	28.1	14.6	2.1	14.6	40.6
Hatchery wastes	25	41.5	–	19.5	32.8	6.2
Rice, broken[c]	85	7.6	3.1	2.5	3.8	79.2
Skim milk powder[c]	90	31.8	–	1.8	8.3	58.1
Dried fish, salted, refuse[c]	81	19.4	–	3.9	15.7	61.0

[a] Feedstuffs that are used on a regular basis.
[b] Feedstuffs that are used irregularly.
[c] Discarded as unsuitable for human use.

the extreme variabilities that may be expected.

Swill was the most widely used feedingstuff. Some form of swill feeding was practiced in over 80% of the farms. The quality of swill was highly variable depending on the source. The average % composition (and ranges) of 22 samples of swill are as follows: DM, 19.8 (15.2-25.6); CP, 13.1 (6.1-21.2); CF, 12.4 (8.6-19.3); EE, 14.6 (7.1 -23.9) and ash, 8.5 (6.2-11.0). Swill from the tourist hotels generally had the highest CP and lowest CF contents, whereas the reverse was true for swill collected from local markets. About 55% of the farmers cooked the swill prior to feeding.

Feeding practices varied widely. No general characterization can be provided of the amounts fed and the quality of rations. Most farmers practiced *ad libitum* feeding of combination of energy-type bulky feeds (table 2) and swill, and variable amounts of protein-type feeds (table 2) were given depending on availability. The feeding method, though not well planned, is similar to the modified Lehmann method described by Devendra (1976). Feeding of commercial concentrates was not common due to their high cost. About 20% of the farmers practiced feeding of limited amounts of concentrates and, 42% of the farmers used a mixture of rice bran and coconut meal for supplementary feeding. Vitamin / mineral supplements were used only in 24% of the farms.

The feed intake data showed that adequate amounts of feed are offered to fattening pigs under smallholder farms in Sri Lanka (table 3). The data also revealed that the intakes of DE and CP can be considered somewhat adequate, the intakes being only about 5% lower than the nutrient requirements (NRC, 1988) for growing pigs. Intakes of LYS and MET + CYS however, were 23-28% lower than the recommended requirements. Thus poor protein quality, rather than quantity, appears to be the major limiting factor contributing to the poor growth performance of pigs under small farm conditions in the tropics. During the eight-week monitoring period, the daily gain of growing pigs were found to be only .32 kg/ day (range, .26-44 kg/day). It is obvious that, under these conditions of marginal nutrition, on-farm productivity of pigs could substantially be increased if farmers would consistently supplement the pig diets with superior protein sources and possibly minerals.

TABLE 3. NUTRITIONAL STATUS OF GROWING PIGS (20-35 kg) IN SIX SELECTED FARMS

	Average intake per day	Recommended intake per day[a]	Remarks
Feed intake (g)[b]	1,810	1,700	Adequate
Crude protein (g)[b]	242	256	6% lower
Digestible energy (Kcal)[c]	5,490	5,730	5% lower
Lysine (g)[c]	8.1	11.2	28% lower
Methionine + Cystine (g)[c]	5.5	7.3	23% lower

[a] Projected based on NRC (1988).
[b] Determined values.
[c] Calculated values.

The results of trial 1 demonstrated that it is possible to formulate pig diets based on non-conventional feedstuffs and obtain acceptable production standards (table 4). The performance of pigs were similar between the control and test diets at the reseach station as well as on-farm. The feed cost per unit weight gain was considerably lowered by feeding the test diet. The results of trial 2 are summarised in table 5. Daily gains were improved by 33 % and feed cost / kg gain was lowered by 17% through the use of supplemental amino acids. This finding confirmed the original hypothesis that poor protein quality of rations is a major factor contributing to the low growth rates of pigs in small farms in the tropics. Despite the small number of observations, it was felt that the data generated were reasonably reliable due to the continuous monitoring of the on-farm trials.

TABLE 4. PERFORMANCE OF GROWING PIGS FED ON A NEW TEST DIET - RESULTS OF TRIAL 1[a]

	On-Research Station			On-Farm		
	Control	Test diet	SEM	Control	Test diet	SEM
Avg. daily gain (kg)	.372	.381	.05	.283	.294	.14
Feed / gain	2.72	2.66	.08	3.25	3.13	.19
Feed cost per kg gain, SLR[b]	21.12	14.90	–	25.31	17.67	–

[a] Within a location, performance data statistically not significant ($p > 0.05$).
[b] 1.00 US$ = Sri Lankan Rupees 49.50.

TABLE 5. RESPONSE OF GROWING PIGS FED TRADITIONAL SWILL-BASED RATIONS TO LYS AND MET SUPPLEMENTS-RESULTS OF TRIAL 2 (70-126 DAYS)

Parameter	Control	Control + AA supplements
Avg initial weight (kg)	13.3	13.2
Avg final weight (kg)	30.9	39.4
Avg daily gain (kg)	0.314	0.468
Avg feed DM intake (kg)	104.5	109.8
Feed DM/gain	5.94	4.19
Feed cost/kg gain, SLR[a]	24.94	20.65

[a] U.S. Dollars 1.00 = Sri Lankan Rupees 49.50.

Due to practical difficulties, farms were used as replicates in trial 2. Such choice of farms as replicates limits precision and, therefore, the likelihood of detecting statistically significant effects. Under these conditions, it is justifiable to put emphasis on average treatment effects and overlook the statistical aspects. Data from Trial 2 was not subjected to any statistical analysis. Loss of percision however, is compensated by its simplicity to and increased understanding by the farmer. The high risk of wrong inferences from such approach however, should be recognised.

In both trials, variability in bodyweight gains within farms was found to be as large as among farms. Owing to the small number of observations per farm, performance of individual animals had a large effect on farm averages and on the differences among farms. It should be recognised that high biological variability will always be a major limitation in pig experiments under small farm conditions because of differences in the genetic make-up of animals and in managerial skills.

It is generally conceded that there exists a technological gap between the performance levels achieved under research station conditions and those obtained under farm conditions (Mosher, 1986). This gap may be accentuated in the case of small farmers in developing countries and this has been demonstrated by Brannon et al. (1979) in on-farm pig trials in Thailand. They found that the response of pigs for a new ration on-farm was considerably lower than that achieved at the research station, though relatively better responses were noted in farms employing better husbandry practices. In the present study, the growth rate of pigs under farm conditions was only 20-25% lower than that was obtained at the research station level. The descrepancy between our data and the Thai data appears to be related to the managerial skills of the farmers. The Sri Lankan farmers, in general, were educated and had a better understanding of improved management practices.

Under small farm conditions, the difficulty of using balanced diets is obvious owing to the cost-factor and to the problem of procuring supplies of quality ingredients. The results stress the need to ensure adequate protein quality, as otherwise amino acid imbalances are likely to depress growth performance. The present studies also show that improvements in productivity can be obtained through the use of amino acid supplementation and use of judicious combinations of available feed resources. It can be speculated that concern over everrising feed costs will continue to pressure livestock farmers into utilizing more and more by-product feedstuffs in the future. To accelerate the adoption of such feeding packages, the enormous amounts of research station data available on non-conventional feedstuffs need to be evaluated through widespread on-farm testing (Devendra, 1988).

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