UTILIZATION OF NON-CONVENTIONAL FEED RESOURCES IN POULTRY PRODUCTION: RESULTS OF ON-FARM TRIALS

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Summary

Though a variety of non-conventional feedstuffs have been successfully evaluated in research stations in Asian countries, there had been little adoption of these technologies at the small farm level. The methodology and results of three separate on-farm trials evaluating the possible use of some non-conventional feedstuffs in broiler diets under small farm conditions in Sri Lanka are reported in this paper. In all trials, the commercial mash, that is normally used in the farms, served as the control. In trials 1 and 2, 5 and 10% cassava leaf meal, respectively, was substituted (w/w) for the commercial mash and fed to broilers for six weeks. In trial 3, several non-conventional feedstuffs (cassava leaf meal, rubber seed meal, ipil ipil leaf meal and dried poultry manure) were substituted (w/w) for the commercial mash at levels of 15-20%. The results demonstrated that these non-conventional feed resources can be used in broiler diets under small farm conditions, with no adverse effects on performance. The salient features of on-farm animal research are highlighted.
(**Key Words** :Non-conventional feedstuffs, Broilers, On-farm trials)

Introduction

In most Asian countries, the focus of livestock development policies and research efforts had been on ruminant species like cattle, buffaloes, goats and sheep. Though the non-ruminants, poultry and pigs, contribute substantially to the livestock economy, they remain largely neglected on the argument that these industries are advanced and have assumed industrial proportions. This is despite the fact that poultry and pig production in most Asian countries are operated predominantly by smallholders.

In Sri Lanka, the rapid expansion of the poultry industry in less than a decade (1980-1990) is characterized by the emergence of smallholder farms. The major factors that have contributed to this expansion are genetics, nutrition and disease control. The new technology has helped to cut production costs drastically by improving the feed efficiency from 3.5 in 1980 to 2.2 in 1990 and reducing the growth span from 90 to 42 days.

During the past two decades, a wide range of new feed resources have been successfully evaluated in research stations in Sri Lanka (Ravindran et al., 1993); but there had been little or no adoption of these technologies at the farm level. Recommendations from the research stations need to be tested on-farm because such testing represents conventional wisdom as to appropriate technologies (Devendra, 1988). They allow a more realistic evaluation of the innovation, while stimulating new avenues for applied research that are appropriate to small farmers. In view of the priority given to the development of ruminants in Asia, on-farm animal research in the past have focussed more on these species (Devendra, 1987). On-farm trials involving poultry and pigs are almost non-existent.

The present paper describes the methodology and results of on-farm trials evaluating the use of several non-conventional feed resources in broiler diets under smallholder conditions in Sri Lanka. The intention of these trials was to demonstrate the possible use of relatively cheaper, locally available by-products by proportionately reducing the expensive concentrate feeds.

Materials and Methods

Baseline survey

The initiation of on-farm research was facilitated by a survey of baseline information on specific aspects of broiler production systems and productivity. The survey covered 34 broiler farms distributed in the Udunuwara

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district which is located in the central hills of Sri Lanka. The choice of Udunuwara district as the project area was due primarily to its easy accessibility from the university. The close monitoring required for on-farm trials makes proximity an important consideration in area selection.

The questionnaire was designed and pre-tested before being finalized. It was composed of a shortlist of topic themes covering both qualitative and quantitative aspects such as location, flock size, housing, feeding, disease management, marketing and farmer attitudes. The local veterinary surgeons were used as contacts in farmer selection and interviews.

On-farm trials

Selection of farmers

Following the survey, several farmers indicated interest in getting involved in the on-farm trials. Although selection of several farms would have had the advantage of wider coverage, it places considerable demand on resources especially on researchers' time. For this reason, it was decided to concentrate only on two farms. The two farmers selected for participation were invariably individuals who had a sound technical know-how and showed a strong commitment to perform trials as advised by the researcher. Following selection, the research objectives and methodology were discussed with the farmers.

During this time, the responsibilities of the two parties were identified and agreed upon. The day-old chicks were provided free of cost as an incentive. In return, the farmers willingly allowed use of farm facilities, including labour. They also agreed to collect the new feedstuffs (cassava leaves, ipil-ipil leaves and poultry manure), transport, dry and get them ground in a meal form in the local mills. The leaf meals were prepared using procedures described previously (Ravindran et al., 1986; Ravindran and Wijesiri, 1988). Poultry manure was collected from layers maintained in cages and dried in the sun. Any losses due to test diets during the trial, such as mortality and loss of weight gain, were agreed to be covered by the project.

Experimental design

Although employing several treatments would have increased the information generated by the investigation, the size of broiler operations did not permit this; thus it was not possible to employ more than two dietary treatments. The number of replicates per treatment was restricted to two for the same reason.

Trial 1

The first trial was conducted at three locations - the two farm sites and the university research staion. Given the poor access of farmers to good quality feed ingredients and the sensitivity of broilers to nutritional fluctuations, it was considered impractical to recommend on-farm mixing of balanced diets. For simplicity, the commercial broiler mash, that is commonly used by the farmers, was employed as the control. A broiler starter mash was fed during 0-3 weeks and a broiler finisher mash during 4-6 weeks. In the test ration, 5% cassava leaf meal (CLM) was substituted (w/w basis) for the commercial mash.

Day-old, unsexed broiler chicks, obtained from the same hatch from a commercial hatchery, were used in all three locations. At each of the farm, 120 chicks were randomly divided into four pens of 30 chicks each and each dietary treatment was then assigned randomly to two pens of floor brooders. Feed and water were available *ad libitum* at all times. The trial was almost entirely farmer-managed. Group weights were recorded on day 1 and at weekly intervals by the farmers under the supervision of the researcher. They also mixed the test ration and maintained records of feed consumption and mortality. On day 42, all birds were killed to determine the carcass recovery percentage.

At the university research station, 120 chicks were randomly divided into 12 groups and each treatment was then randomly allocated to six pens of battery brooders. The methodology and conduct of the trial were otherwise similar to those at the farm level.

Trial 2

This trial was also conducted at the two farm sites and the university research stations. The objective was to evaluate the possibility of including 10% CLM in broiler diets. Because of the encouraging results in Trial 1, the farmers themselves were interested in testing the use of higher levels of CLM. The design and conduct were similar to those of Trial 1, except that the test ration was formulated by substituting (w/w basis) 10% CLM for the commercial feed. Since calculations showed that sulphur-containing amino acids may be deficient in this ration, 0.2% DL-methionine was added as a supplement.

Trial 3

In this trial, in addition to CLM, low levels of several other non-conventional feed resources were substituted (w/w basis) for the commercial mash. These non-conventional feedstuffs have been successfully evaluated in poultry diets and the results have been reviewed (Ravindran and Blair, 1991, 1992, 1993). The composition of the test

ration thus formulated is given in table 1. The object of including other feedstuffs was to further lower the feed cost. This trial was conducted only in one farm, since the other farmer was forced out of business by this time owing to increasing feed prices and an unstable broilermeat market. The design and conduct of the trial were similar to the earlier trials.

Prior to the on-farm trial, the test ration was evaluated at the university research station in a feeding trial involving 120 broiler chicks. There were six replicates of 10 chicks per treatment.

TABLE 1. PERCENTAGE COMPOSITION OF EXPERIMENTAL DIETS USED IN TRIAL 3

Ingredient	Broiler Starter		Broiler Finisher	
	Control	Test diet	Control	Test diet
Commercial feed	100	84.8	100	79.8
Cassava leaf meal	–	10.0	–	10.0
Rubber seed meal	–	2.5	–	4.0
Dried poultry manure	–	2.5	–	3.5
Ipil ipil leaf meal	–	–	–	2.5
DL-methionine	–	0.2	–	0.2
Analysed composition(%)				
Crude protein	20.8	21.4	18.1	18.8
Crude fibre	5.8	6.9	5.7	7.3

Data analysis

The data was statistically analysed using the analysis of variance procedure (SAS, 1985). Calculations of costs and returns were also made. The emphasis however, was placed on the economic analysis to demonstrate the cost benefits of using the new feedstuffs. Prices of CLM and other non-conventional feed resources were established taking into consideration of the various costs associated with obtaining them. These included labour cost for collection, transport and processing, and the cost of grinding.

Results

Survey results

All 'all-in, all-out' system of broiler production was practiced by 88% of the farmers. A typical broiler farm in the area housed 200-300 broiler chickens and marketed 1,000-1,500 per year. About 76% of the producers had broiler farming as a source of supplementary income. In most farms, the daily activities were managed by the farmers' family. Extra labour however, was hired for the slaughter of birds. Most farmers (80%) slaughtered the broilers on-farm and sold on a carcass weight basis directly to retail outlets in sorrounding towns. The balance (20%) sold the birds on a liveweight basis usually to middle-men. Twenty nine percent of the farms had their own freezer facilities; these farmers were able to store and obtain a better price for the meat.

Most farmers had resonably good knowledge of broiler husbandry practices. This was also reflected by the broiler performance in the farms, which was comparable to accepted standards (table 2). Mortality was less than 5% in all, but three, farms. Typical broiler houses were of semi-permanent type, constructed using local materials. Deep litter houses were common. The recommended floor space allowances were followed to create ideal conditions for fattening. Two farms had a double-deck type of housing with the objective of saving on space. All farmers purchased day-old chicks from franchise hatcheries and fed them on compounded commercial feeds.

TABLE 2. SOME PRODUCTION CHARACTERISTICS OF BROILER CHICKENS UNDER FARM CONDITIONS IN CENTRAL SRI LANKA

Parameter	Size of Farm[a]		
	< 1000	1000-2000	> 2000
No of farms	8	21	5
Average market weight (kg)	1.59 (1.5-1.7)[b]	1.68 (1.6-1.8)	1.66 (1.6-1.8)
Average market age (days)	46 (42-48)	43 (42-45)	43 (42-46)
Average feed/gain	2.58 (2.4-3.0)	2.41 (2.2-2.9)	2.47 (2.3-2.7)
Average carcass recovery (%)	72 (70-74)	72 (70-75)	71 (70-72)

[a] Number of birds marketed per year.
[b] Values in parantheses refer to range of values that were reported.

The survey revealed high cost of feed to be the major factor lowering the profit margins. Feed cost accounted for approximately 70-80% of the total cost of broiler production. Thus it was only natural that the farmers were interested in possible ways of reducing the feed cost. Of the alternatives available, use of locally available, cheaper non-conventional feedstuffs offers an acceptable, short-term strategy. Several such feedstuffs were available in the area, but not used for poultry feeding. The main reasons

cited for not using these materials relate to the lack of knowledge about their feeding value, irregularity in supply and the possible presence of 'harmful' factors.

On-farm evaluation

The compositional data of the non-conventional feed resources, used in the investigation, is presented in table 3. Results of Trial 1 are summarized in table 4. Inclusion of 5% CLM in the commercial diet had no adverse effects on weight gain, feed/gain or carcass recovery of broilers in either of the farms or in the university research station. Feed intake tended ($P < 0.10$) to be higher on CLM-diets in Farm 1 and in the research station. Inclusion of CLM lowered the feed cost per kg carcass gain at all three locations. The higher feed intake and feed/gain values observed for birds fed on the control diet in farm 2, compared to other locations, were probably reflective of some feed wastage; presence of rodents was suspected in this farm.

TABLE 3. AVERAGE COMPOSITION OF NEW FEED RESOURCES USED IN THE ON-FARM TRIALS (DRY MATTER BASIS)

Parameter	Cassava leaf meal	Ipil ipil leaf meal	Dried poultry manure	Rubber seed meal
Crude protein (%)	21.3 (19.8-22.4)[a]	24.6	28.9	26.1
Crude fibre (%)	19.8 (18.7-21.3)	14.8	12.1	9.5
Crude fat (%)	5.4	4.1	3.0	9.8
Ash (%)	8.5	8.6	14.9	4.7
Nitrogen-free extracts (%)	45.0	48.9	41.1	49.9
Metabolizable energy (kcal/kg)[b]	1.84	1.06	1.42	2.35

[a] Values in parantheses refer to ranges determined for the different samples used in the on-farm trials.
[b] Determined values (Ravindran, unpublished data).

TABLE 4. PERFORMANCE OF BROILERS (1-42 DAYS) AS INFLUENCED BY THE INCLUSION OF 5% CLM-RESULTS OF ON-FARM TRIAL 1

	Farm 1			Farm 2			University Research Station		
	Control	Test diet	SEM	Control	Test diet	SEM	Control	Test diet	SEM
Average weight gain (kg)	1.71	1.76	0.12	1.62	1.60	0.17	1.68	1.75	0.11
Average feed intake (kg)	3.78	3.98	0.31	4.09	4.02	0.27	3.88	4.06	0.34
Feed/gain	2.21	2.26	0.04	2.52	2.51	0.08	2.31	2.32	0.05
Carcass recovery (%)	72.4	72.2	2.1	73.1	72.6	3.2	71.8	71.0	2.4
Feed cost/kg carcass gain (SLR[a])	35.66	35.48	–	40.07	39.02	–	37.62	37.17	–

[a] 1.00 US$ = 49.50 Sri Lankan Rupees.

In Trial 2, inclusion of 10% CLM had no adverse effects on weight gain and carcass recovery in any of the three locations (table 5). In Farm 1 and the university, feed/gain was increased ($P < 0.05$) on the test diet; however, feed cost per kg carcass gain was unaffected by the inclusion of CLM. In Farm 2, feed intake ($P < 0.05$) and feed/gain ($P < 0.09$) were depressed in broilers fed the test diet. The use of CLM however, considerably lowered the feed cost per unit carcass gain in this farm.

In Trial 3, where the inclusion of 15-20% non-conventional feedstuffs was evaluated, weight gain was unaffected in the university, but tended to depress ($P < 0.08$) on-farm (table 6). At both locations, feed/gain of broilers on the test diet was increased ($P < 0.05$); feed cost per unit carcass gain however, was slightly lowered.

Discussion

Relevance of non-conventional feedstuff research in developing countries rests largely on its potential and applicability to address the needs of small farmers who are the major livestock producers. On-farm research becomes an important tool in this context for demonstrating feed formula packages that are simple, practical and within farmers' capacity to implement.

The conduct of on-farm animal research in developing countries is often difficult because conditions on small farms are highly variable and difficult to control, and consequently the methodologies tend to be much less precise than those employed in research stations. However, in the on-farm research reported herein, the trials were designed and executed somewhat like

TABLE 5. PERFORMANCE OF BROILERS (1-42 DAYS) AS INFLUENCED BY THE INCLUSION OF 10% CLM-RESULTS OF ON-FARM TRIAL 2

	Farm 1			Farm 2			University Research Station		
	Control	Test diet	SEM	Control	Test diet	SEM	Control	Test diet	SEM
Average weight gain (kg)	1.74	1.68	0.16	1.54	1.46	.22	1.64	1.61	0.13
Average feed intake (kg)	3.90	3.88	0.23	3.68[x]	3.42[y]	.18	3.77	3.83	0.22
Feed/gain	2.24[x]	2.31[y]	0.04	2.39	2.34	.05	2.30[x]	2.38[y]	0.04
Carcass recovery (%)	73.0	72.3	2.7	72.1	72.5	2.2	71.9	71.2	2.9
Feed cost/kg carcass gain, (SLR[a])	35.37	35.39	–	38.40	36.94	–	37.01	37.12	–

[a] 1.00 US$ = 49.50 Sri Lankan Rupees.
[x, y] Within a location, means in the same row follwed by different superscripts are significantly ($P < 0.05$) different.

TABLE 6. PERFORMANCE OF BROILERS (1-42 DAYS) AS INFLUENCED BY THE INCLUSION OF 15-20% NON-CONVENTIONAL FEED RESOURCES-RESULTS OF ON-FARM TRIAL 3

	Farm 1			University Research Station[a]		
	Control	Test diet	SEM	Control	Test diet	SEM
Average weight gain (kg)	1.78	1.66	0.14	1.69	1.65	0.16
Average feed intake (kg)	4.02	3.97	0.19	3.95	4.11	0.17
Feed/gain	2.26[x]	2.39[y]	0.07	2.34[x]	2.49[y]	0.06
Carcass recovery (%)	72.6	71.8	3.1	71.6	71.1	2.2
Feed cost/kg carcass gain (SLR[b])	37.03	36.64	–	38.85	38.64	–

[a] The new diet was pre-tested at the University research station and then evaluated on-farm.
[b] 1.00 US$ = 49.50 Sri Lankan Rupees.
[x, y] Within a location, means in the same row followed by different superscripts are significantly ($P < 0.05$) different.

conventional research-station trials with randomization and replications. The limited number of replications, that were employed, obviously may not have generated precise data for statistical analysis. But from the farmers' point of view, this lowered excessive complexity and improved their elicitation of the response to the test diets. A simple design was easy for them to understand and, provided a better assessment of the relevance and acceptability of new feed resources.

In contrast to the results generally reported for on-farm research with ruminants (Amir and Knipscheer, 1987), the variability observed for the performance of broliers in the present study was low as indicated by the low standard error values associated with the mean values for the various parameters. This was largely due to the low biological variability of improved strains of broilers and is also reflective of good husbandry practices in these farms. Compared to ruminants, on-farm research with poultry is easy to conduct owing to their small size, total confinement and short productive cycle.

In transferring any technology to the farmer, it is important to ensure that the reponse is likely to be the same on the farm as it was on the research station. Studies on this topic, particularly in relation to animal production, have been few, but one in Australia with layers (Davidson and Martin, 1965) found that farmers may achieve 80% of the egg production that was reported under research station conditions. In a study with pigs from Thailand (Brannon et al., 1979) however, the farm level performance of fatteners on a new ration was only half that was observed at the research station. Interestingly, in the present study, the on-farm performance of broilers were comparable to those obtained at the research station level.

A major benefit of on-farm research is that it takes into consideration of socio-economic contraints at the farm level and the important role of the family unit in managing livestock. The farmers' perception is greatly enhanced when the innovation can be seen under his own farm conditions. Furthermore, by closely participating in the conduct of research, they were able to make their own appraisal. Overall, the farmers were satisfied with the

results. From the researcher's point of view, the investigation provided insight to the problems of practical feeding under small farm conditions and of the conditions of the farm family.

It is not expected that the present studies will make a significant impact on the poultry feeding systems in the area. However, with the use of non-conventional feedstuffs proven cost-effective, the farmers involved in the project are likely to continue their use. Ideally the on-farm trials should have been carried out in several farms to increase the demonstration effect and possible adoption by other farmers in the area. This was not possible in the present investigation owing to manpower and funding constraints.

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