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DEVELOPING MULTIPLE USES FOR *MUCUNA*. EXPERIENCES OF THE SEDENTARY FARMING SYSTEMS PROJECT IN TRANSITIONAL ZONE OF GHANA

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SUMMARY

An on-station experiment was conducted in Sunyani district, Brong Ahafo region, Ghana, to assess how *Mucuna* seed meal could replace fish meal in pig diets. Mottled-seeded *Mucuna* variety (*M. pruriens* var. *deeringiana*) was used in this study. Ten castrated piglets of six weeks in age were divided into two groups of five piglets each for the experiment. The first group was fed with a ration containing fish meal as protein source and the second group was fed with a ration where a part of fish meal had been replaced by *Mucuna* seed meal. Both rations were balanced to satisfy the nutrient requirements of growing piglets. All the animals were fed twice daily for eight weeks and weight gain was recorded at 14, 28 and 42 days.

To process the *Mucuna* seed, they were first soaked in water for 48 hours (the water was changed every 12 hours) to reduce the content of the main anti-nutritional substance, L-Dopa. The seeds were then dried, pounded in a mortar into a meal and mixed with the other feed components. Piglets in the control group that received a fish meal-based diet had a live weight gain of 64.3 and 142.9 g day^{-1}, at the second and sixth week, respectively, which was 4 times greater than that of the group receiving ration with *Mucuna*. This was interpreted to mean that the nutritional quality of *Mucuna* was much poorer than that of fishmeal. Recommendations for future work include studies to evaluate the nutritive value and digestibility of *Mucuna* seed meal and different *Mucuna* varieties.

Key words: *Mucuna pruriens*, L-Dopa, fish meal, crude protein, pigs, nutrition.

INTRODUCTION

The degradation and irreversible destruction of soils have reached alarming proportions and every year, 5-7 million ha of agricultural land is lost worldwide (Steiner, 1996). To maintain and improve soil fertility over time, the incorporation of leguminous cover crops in farming systems has been advocated (Osei-Bonsu and Buckles, 1993). Inclusion of these legumes into the farming systems has been shown to contribute nutrients to the soil through nitrogen fixation and through recycling of residues which also contribute organic matter into the soil (Anthofer, 1999). They also play an important role in weed suppression and soil conservation.

In 1997, the Sedentary Farming Systems Project (SFSP), which is a project of the Ministry of Food and Agriculture supported by German Development Cooperation (GTZ) and German Development Service (DED), started promoting the use of cover crops (*Mucuna, Lablab purpureus, Canavalia ensiformis* and *Pueraria* spp.) to suppress weeds and increase soil fertility in the Brong Ahafo Region of south west Ghana. The region has a population of about 2 million people with approximately 73% of the population living in the rural areas. Farming is the major economic activity. The average annual rainfall of 1500 mm falls in a bi-modal pattern. Agricultural production in the region is mainly based on traditional farming practices, including slash-and-burn cultivation. Most farming households rear livestock including sheep, goats, pigs and cattle. Livestock is generally not closely integrated into the farming system (Zschekel *et al*., 1997).

Increasing pressure on land is leading to shorter fallow periods, and soil fertility can no longer be regenerated naturally. This has led to a gradual destruction of the natural resource base, declining soil fertility and yields, and hence, reduced farm income. The integration of the leguminous cover crops into the existing farming systems in Brong Ahafo to address these problems has been very successful because of the high agronomic benefits achieved from the use of these legumes (Loos *et al.,* 2001). Of the four legumes introduced, *Mucuna pruriens* was found the most promising (Loos *et al.,* 2001).

Five years after the initiation of the activities, the project started seeking ways to utilize the *Mucuna* seed that was being produced by farmers for livestock

feeding. The crude protein content of *Mucuna* seeds ranges between 23 and 35% and is similar to that of other beans like cowpeas and soybeans (Kay, 1979). It could, therefore, replace some of the expensive fish meal in livestock feeds. However, consumption of *Mucuna* is limited by the presence of a toxic substance, known as L-Dopa, which can cause diarrhoea, vomiting and nervous disorders when ingested (Osei-Bonsu and Buckles, 1993). L-Dopa can be partially removed by soaking *Mucuna* seeds in water (Berhe, 2001). Berhe (2001) reported success when evaluating *Mucuna* beans as a feed for monogastrics.

In order to confirm the potential of *Mucuna* beans as a feed for pigs, a trial was conducted to evaluate the performance of pigs fed on a diet containing *Mucuna* seed meal compared to one containing fish meal as protein source. The trial was carried out on the Don Bosco, a private farm in Sunyani district.

MATERIAL AND METHODS

Sunyani district, where the study was conducted, lies at 7˚36'N and 28'2˚31'W. It is located between 229 and 376 meters above sea level (SDA, 1995). The rainfall pattern is bi-modal with two rainy seasons between late March to July and between September to October/November. Annual precipitation is around 1300mm (Holland, 1995).

Two groups of 5 castrated piglets of the locally available breed "Large white" were used in the study. The piglets had an initial weight of approximately 10 kg and were each housed in a cemented pen of 6 m^2. The test group received a daily feed consisting of a mixture of 2.0% fish meal and 9.6% *Mucuna* beans as protein sources, while the control group received a ration with only fish meal. The feeds were mixed based on nutritive value to satisfy the nutrient requirements for growing pigs (10-40 kg). (These values, obtained from Prof. Amstrong Donkor of the University of Science and Technology, Animal Science Department, Kumasi, were: 3,300 kcal kg^{-1} of digestible energy, 160 g kg^{-1} of crude protein, 10.0 g kg^{-1} of lysine, 5.0 g kg^{-1} of methionine / cystine, 7.0 g kg^{-1} of calcium, 6.0 g kg^{-1} of phosphorus, and 5.0 g kg^{-1} of sodium chloride.) The ingredients of the diets in the trial are presented in Table 1 for the control group and in Table 2 for the test group. Mottled *Mucuna* type (*Mucuna pruriens*, var. *deeringiana*) was chosen because farmers reported it produces higher seed yield than the others, such as the black-seeded (var. *utilis*) or white-seeded (var. *cochinchinensis*) types.

Soaking of *Mucuna* beans to decrease their L-Dopa content started two days before beans were fed to the test group. After every 12 hours the water was changed to create an osmotic gradient for the water-soluble L-dopa to move from the seeds into the water. Before supplying the soaked beans to the animals, they were pounded with a mortar and pestle so that they could mix thoroughly. Feeding of both groups was done twice per day, in the morning and the evening, and the animals were weighed at 14, 28 and 42 days. The feeding trial was carried out for 8 weeks. No weighing was done at the end of the experiment because of management problems.

RESULTS AND DISCUSSION

Palatability of the soaked *Mucuna* beans seemed good. The test group refused only small amounts of *Mucuna*, which mainly consisted of seeds coats. Both groups gained weight during the test period. Within a group, variability in weight gain was quite large, presumably due to heterogeneity of the animals in the study. Average daily weight gain was higher at 14 days for all groups compared with 28 days, irrespective of the ration given, but this later increased at 42 days in both groups (Figure 1). Signs of disorders resulting from L-Dopa in the *Mucuna* seed meal were not observed.

The weight gains of 64 and 142 g, at respectively 2 and 6 weeks, of the control group was about four times higher than those of the test group (14 and 36 g, respectively) (Figure 2 and Table 3). This may indicate that *Mucuna*'s nutritive value is poorer than was assumed (diets were formulated based on *Mucuna* containing 30% crude protein) and higher amount of *Mucuna* should have been included in the diet. The *Mucuna* beans could also be deficient in some essential amino acids, which, if known, could have been corrected with supplements. In addition, in the study, whole seeds were soaked because pounding unsoaked beans would have been too labour-intensive. Removal of L-Dopa from the whole bean may not have been effective. Studies on water extraction of L-Dopa by Teixeira *et al*. (this volume) indicate that at room temperature only the smallest 1mm particle size resulted in a safe level (0.1%). This level was reached within approximately 55 hours (2.5 days) of soaking in a minimum of 40/1 parts water/bean. The L-Dopa in the diet could have contributed to the poor live weight gains recorded for the piglets fed *Mucuna*-based diet.

An economic comparison of the test- and the control group showed a decrease of feed cost of approximately 34% when *Mucuna* beans are valued free (during the trial period, market price of *Mucuna* beans was ¢1000 kg^{-1}; 1 USD = ¢8000). However, economic analysis revealed that using *Mucuna* beans as a partial substitute to fish meal might not be profitable due to the poor weight gains with *Mucuna* diets. To break even, weight gains in *Mucuna* diet should not be more than 10% less than weight gains with fish meal diets and *Mucuna* beans should not be priced.

Table 1. Ingredients of the pig feed in the control treatment without *Mucuna*.

Ingredient	% DM in diet	Quantity per day (g)	Digestible energy (MJ kg^{-1})	Crude protein (g kg^{-1})	Calcium (g kg^{-1})	Phosphorus (g kg^{-1})	Sodium Chloride (g kg^{-1})
Maize granulated	61.8	780.0	2.306	61.8	0.7	1.7	0.1
Rice bran	26.2	330.0	688	39.7	0.3	5.0	0.1
Fish meal	7.2	91.0	202	51.4	4.1	2.2	0.1
Oyster shells	0.4	5.5	0	0	5.3	0.0	0.0
Palm kernel meal	4.0	50.0	113	7.7	0.2	0.2	0.0
Table salt	0.5	4.7	0	0	0.0	0.0	4.7
Total	100	1,261	3.309	160.4	10	9.2	5.0

Table 2. Ingredients of the pig feed in the test diet containing *Mucuna*.

Ingredient	% DM in diet	Quantity (g d^{-1})	Digest. Energy (MJ kg^{-1})	Crude protein (g kg^{-1})	Calcium (g kg^{-1})	Phosphorus (g kg^{-1})	Sodium Chloride (g kg^{-1})
Maize granulated	56.2	700.0	2.070	55.5	0.1	1.6	0.1
Rice bran	27.3	340.0	709	40.9	0.3	5.1	0.1
Fish meal	2.0	25.0	55	14.1	1.1	0.6	0.0
Mucuna beans (soaked)	9.6	120.0	347	42.8	0.2	0.6	0.1
Oyster shells	0.4	5.5	0	0.0	5.3	0.0	0.0
Palm kernel meal	4.0	50.0	113	7.7	0.2	0.2	0.0
Table salt	0.4	4.7	0	0.0	0.0	0.0	4.7
Total	100	1,245.2	3.294	160.8	7.2	8.1	5.0

Table 3. Average daily weight gain (range) at 2 and 6 weeks of pigs feeding on diet containing *Mucuna* and on a control diet without *Mucuna*.

Group	Average weight gain (range) (g d^{-1})	
	2 weeks	6 weeks
Mucuna diet	14.3 (0.0-35.7)	35.7 (-18.0-35.7).
Control diet	64.3 (-35.7-142.7)	142.9 (107.1-178.6)

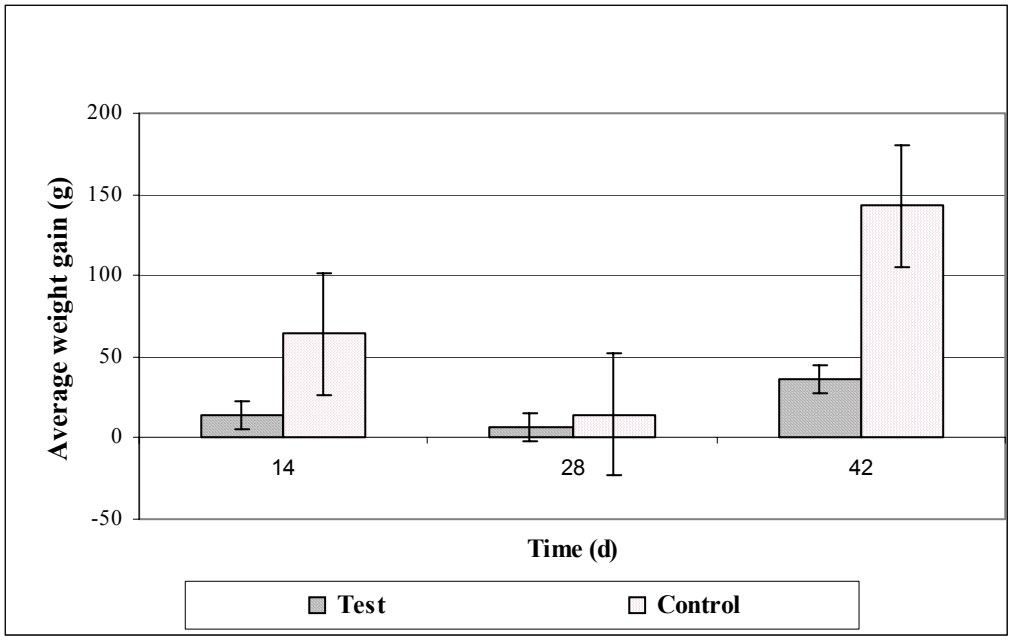

Figure 1. Weight of pigs with test diet containing *Mucuna* and with a no-*Mucuna* control diet at 14, 28, and 42 days of experiment.

CONCLUSIONS AND THE WAY FORWARD

In this study *Mucuna* seed meal did not appear to be a suitable substitute for fish meal as a protein source in piglet rations. The liveweight gains of pigs fed diets containing *Mucuna* were only 22% and 25% of the liveweight gains recorded for piglets fed fish meal based diets in the second and sixth week of the study, respectively. However, because of the high crude protein content in *Mucuna* seeds and because farmers in the Brong Ahafo region are already growing *Mucuna* for soil fertility maintenance and for smothering weeds, it is recommended that further research be done to develop suitable processing methods for *Mucuna*-based pig feeds. The areas to be addressed during the testing should include:

- Evaluation of the nutritive value and digestibility of *Mucuna* and utilization of nutrients by different animals.
- Assessment of the nutritive value (crude protein) of different *Mucuna* varieties.

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