FEEDING MUSCOVY DUCKS ON LOCALLY AVAILABLE AGRO-INDUSTRIAL BY-PRODUCTS AND FEED RESOURCES

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ABSTRACT

The development of low cost farm-made feeds for Muscovy ducks, based on increased use of agro-industrial by-products will be crucial in encouraging Muscovy duck production in Papua New Guinea (PNG). Agro-industrial by-products such as; copra meal, rice bran, wheat millrun and palm kernel expeller meal are available locally in large quantities. As part of the National Agricultural Research Institute's efforts to develop effective feeding systems for Muscovy ducks, two Muscovy duck feeding trials using agro-industrial by-products were conducted in 2004 at the National Agricultural Research Institute's Labu Livestock Station. The first trial assessed the growth of male Muscovy ducks on commercial broiler feed (Lae Feed Mills) and a test diet of agro-industrial by-products (rice bran, wheat millrun and palm kernel expeller meal) over seven days during their period of rapid growth. The second trial assessed the growth of male Muscovy duck on commercial broiler feed (Lae Feed Mills) and two test diets (local maize diet and copra diet). In the first study, it was found there was no difference ($p>0.05$) in weight gain between the commercial feed (698 ± 33(SE) grams) and the test diet (677 ± 78(SE) grams). In the second study, the ducks on commercial broiler pellets had higher ($p<0.05$) weight gain and feed intake than the two test diets during the same period; however, there was no difference ($p>0.05$) in feed intake between the copra diet and commercial feed. Even though the commercial feed has better feed conversion ratio (FCR) than copra and maize diets, the two test diets were cheaper ($p<0.05$) to produce a kilogram of weight gain. These results showed that these locally available feed resources and agro-industrial by-products can be effectively used to make cheaper farm-made poultry diets. The use of these locally available feed resources will encourage Muscovy duck farming and promote economic development and food security.

Keywords: *Muscovy ducks, agro-industrial by-products, local feed resources, duck feeding*

INTRODUCTION

The popular duck breed in Papua New Guinea (PNG) is the Muscovy duck, which has been successfully adopted into PNG farming systems since the 1970s (Abdelsamie, 1979; Bilong, 1981; Ignatius and Quartermain, 2002). Usually Muscovy ducks are kept under an extensive system of free-ranging and supplementary feeding with fruits, cooked tubers and kitchen leftovers. However the trend is now changing as more farmers are now keeping Muscovy ducks in confinement with commercial poultry feeds for the local live duck market (Ignatius and Quartermain, 2002). These commercial poultry feeds which are formulated from imported grains (maize, sorghum, soybean, etc.) are quite expensive and are of high nutrient density. Ignatius and Quartermain (2002) have highlighted the need to develop suitable feeding systems based on increased use of agro-industrial by-products. Many people are interested in farming Muscovy ducks, but since they consume more feed than chickens for the same weight gain, it is uneconomical to feed this high nutrient density feeds to Muscovy ducks (Ignatius and Quartermain, 2002). The making of farm-made feeds is not a common practice by livestock farmers in PNG and some attempts are now being made by National Agricultural Research Institute (NARI), Department of Agriculture and Livestock (DAL) and the National Fisheries Authority (NFA) to develop the capacity of poultry and fish farmers to formulate and prepare on-farm feeds using locally available feed materials (Booth, *et al.* 2007). In order to improve duck feeding systems, optimized use of these resources in farm-made diets should be encouraged and promoted.

Agro-industrial by-products such as copra meal, wheat millrun, palm kernel expeller meal, brewer's grain, rice bran and pyrethrum marc are available in large quantities and can be utilized by poultry farmers to make poultry feeds. Even low quality fishmeal is now readily available from fish canneries and tuna loining plants that were es-

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tablished recently. Currently, some of these agro-industrial by-products, especially wheat millrun, fishmeal and copra meal, are used in limited quantities in pig and poultry feeds. However, with the increasing cost of commercial poultry feeds and the opportunities to use low intensity feeds, optimal amounts of these agro-industrial by-products can be utilized cheaply in commercial pelleted feeds or farm-made feeds. Some of the agro-industrial by-products and feed resources available locally in Morobe Province are copra meal, wheat millrun, fishmeal, Markham maize, poultry offal meal, meat and bone meal. Palm kernel meal was sourced from West New Britain Province while a significant quantity is also available from Oro Province. Copra meal in Morobe Province is accessed from Madang and East New Britain Provinces.

The study by Ignatius and Quartermain (2002) was one of the initial efforts by NARI to develop effective feeding systems for Muscovy ducks. This study found that, even though Muscovy ducks on high nutrient density grain-based diets have better growth than those on low nutrient density feed (agro-industrial by-product diet), low nutrient density feeds can be as good as the high density feeds in terms of the cost of a kilogram of weight gain. The two diets that they compared were commercially manufactured feeds for broiler chickens and rabbits. Their study did not confirm the hypothesis that the commercial low density feed was cheaper and was as good as the high density feed. However, it may be cheaper to produce an on-farm feed using the agro-industrial by-products (copra meal and wheat millrun) that were used in the commercial low-density feed tested by Ignatius and Quartermain (2002). The subsequent trials that followed were based on evaluating the grain-based commercial feeds with agro-industrial by-product based farm-made feeds.

The use of farm-made feeds in livestock production is a common practice in most Asian countries and the use of farm-made feeds is known to optimise production and maximise profits for poultry and fish farmers in South-East Asia (Dong, 2005). It is anticipated that the development of farm-made feeds using local feed resources would be cheaper and therefore minimise cost of production and encourage Muscovy duck production in rural and peri-urban areas of PNG. The diets prepared in the following studies were made as simple as possible for farmers to adopt; if it is possible for them to source the ingredients.

MATERIALS AND METHODS

The study was undertaken at the NARI Labu Livestock Research Station of the Sir Alkan Tololo Research Centre, which is located near Lae in the wet-lowland areas of PNG. This Station is situated at latitude 06° 40' South and longitude 146° 54'East. It receives an average annual rainfall of about 2900 mm (Ignatius and Quartermain, 2002).

Only male Muscovy ducks were used in these two studies to test the treatment diets because of obvious sexual dimorphism in growth between male and female Muscovy ducks. All the diets were fed *ad libitum*, with the commercial feed (Lae Feed Mill) in pelleted form and the on-farm diets in mash form. The first trial had a completely randomised design (CRD) with two treatments: the commercial broiler finisher feed from Lae Feed Mills and a farm-made diet of 40% rice bran, 20% wheat millrun, 14% palm kernel expeller meal, 20% soybean plus salt (0.3%), limestone (1.1%), broiler premix (0.4%), methionine (1%), DCP (2%), vegetable oil (1%) and choline chloride (0.2%). Since the commercial broiler feed is about 20% crude protein (CP) and 12 MJ/kg of metabolizable energy, the on-farm diet was calculated to give an estimated 20% CP and 12 MJ/kg. Ducklings of about 5 weeks (35 - 40 days) of age weighing 1,333± 244 (SD) grams were used for this study over a seven days feeding period (between days 35 and 50). Eighteen birds were housed in six separate pens with three birds in each pen (1 m x 1 m) and each bird was tagged to measure individual weights. The study took only seven days during the period of rapid growth (Leclercq and Carville, 1986) and weight measurements were taken only on the first day (Day 0) and the last day (Day 7). There was an adaptation period of two days on the test diets prior to the trial. Feed intake was not recorded since the feeds were offered in mash form and the feed container height was low, so it was practically difficult to measure left over feed due to feed wastage and contamination with faeces.

The second trial also had a CRD with three treatments and five replicates. The three treatments were the commercial broiler feed (Lae Feed Mills), a copra meal diet and a maize diet. Using Evans (1997), the copra diet crude protein (CP) and energy (DE) were estimated at 25% CP and 12 MJ/kg DE while the maize diet was estimated at 16% CP and 13 MJ/kg DE. The crude fibre (CF) levels were also estimated to be 9% for the copra diet and 4% for the maize diet. The experiment was conducted over 10 weeks and the ducks were fed *ad libitum* commercial broiler starter (22% CP) for 3 weeks before they were

randomly allocated into respective treatment groups and fed commercial broiler finisher (20% CP), copra meal diet (25% CP) and the maize diet (16% CP). The farm-made diets were made as simple as possible with local maize diet having 80% maize, broiler premix (0.5%), fishmeal (15%) and fish oil (4.5%). The copra diet had 80% copra meal, broiler premix (0.5%), fishmeal (15%) and fish oil (4.5%). Copra oil can be a viable substitute for fish oil due to the fact that fish oil may not be readily available but it was considered because it was very cheap (Kina 5 per 200 L drum).

Thirty male ducks were used in the study and they were allocated, two each into a small pen of 1 m x 1 m. There were three treatments and each treatment was replicated five times, giving a total of 10 ducks per treatment. Duck weights were measured weekly while feed intake was measured daily since larger containers reduced feed wastage and contamination by faeces. Feed intake estimates were made possible by drying the waste feeds and separating the faeces as much as possible. Weight gain was measured per duck and averaged, while feed intake was measured on a pen basis (Table 2) (two ducklings per pen). The Feed Conversion Ratio (FCR) and the unit cost of feed (cost/kg) were also calculated. The unit cost of feed was calculated based on a retail price of Kina 1.25 per kilogram for commercial broiler feed and an estimated ingredient cost of Kina 0.96 and Kina 0.84 respectively per kilogram for copra and maize diets. Weight gain and feed intake for each treatment diet were analysed on a pen basis (2 ducks per pen). The cost of each ingredient used in the diets was also taken into account with the commercial broiler finisher feed to calculate the cost of a kilogram of weight gain (Cost/kg gain).

RESULTS

In the first trial, it was found that there was no significant difference ($p > 0.05$) in the weight gain between ducks fed the commercial feed and the farm-made feed (Table 1). The growth rates were also similar; 97g/day and 100g/day for commercial feed and test diet respectively, during the feeding period when the Muscovy ducks are expected to have rapid growth.

Table 1: Mean weight (grams) and weight gain of the ducklings on the commercial and farm-made diets (Trial 1).

Feed	Initial weights (g)	Final weights (g)	Weight gain (g)
Test diet (± SE)	1289.6 ± 83.4	1987.4 ± 95.1	697.9 ± 33.2
Commercial feed (± SE)	1376.6 ± 81.7	2053.9 ± 124.0	677.3 ± 78.0
Significance ($p < 0.05$)	NS	NS	NS

The two parameters measured in the second trial were daily feed intake and weekly weights. Weekly weights were used to show the difference in the effect of treatment diets over the trial period. Accordingly, male ducks on the commercial broiler diet were heavier than those on the maize and copra diets, while those on the copra diet were heavier than those on the maize diet (Figure 1 and Table 2). The weight gain of ducks on the commercial broiler feed was significantly better ($p<0.05$) than those on the copra and maize diets, while the copra diet had better gains than the maize diet (Table 2). Ducks on commercial feed had significantly greater feed intake ($p<0.05$) than those on the maize diet but there was no difference ($p> 0.05$) in feed intake between the copra diet and the commercial feed.

The FCR was significantly ($p<0.05$) better for the commercial broiler feed than for the maize diet and copra diet but the copra diet ($p<0.05$) was significantly better than the maize diet (Table 3). In terms of the cost of producing a kilogram of weight gain, the maize diet and the copra diet were cheaper ($p<0.05$) than the commercial feed (Table 3).

DISCUSSION AND CONCLUSION

The results of these studies show that agro-industrial by-products and local maize can be effectively used to grow Muscovy ducks economically. Since there was no difference in weight gain between the test diet and commercial feed in the first trial, we can conclude that this particular test diet is as good as the commercial broiler diet. The daily gain in the two diets (97g/day vs 100g/day) appears higher than what was reported by Leclercq and Carville (1986) (80g/day), however this relates to the age difference of the ducks used in the trial.

In the second trial, the commercial broiler feed had better weight gain compared to the two test diets (local maize and copra diet) but in terms of feed intake, both the commercial feed and the copra diet are higher than the maize diet.. The FCR for the commercial feed is better than the two test diets; however, the agro-industrial by-product based diets are cheaper than the commercial broiler feed. Generally, the feed intake of the ducks corresponds to the energy level of the feed and ducks will eat more of a lower intensity feed to meet their energy requirements as shown by Ignatius and Quartermain (2002). The ducks on the copra diet and the maize diet have lower feed intake than those on broiler feed because they might have slightly higher energy levels (~12 MJ/kg and 13 MJ/kg). The results of the FCR may be related to the protein level. The copra diet is

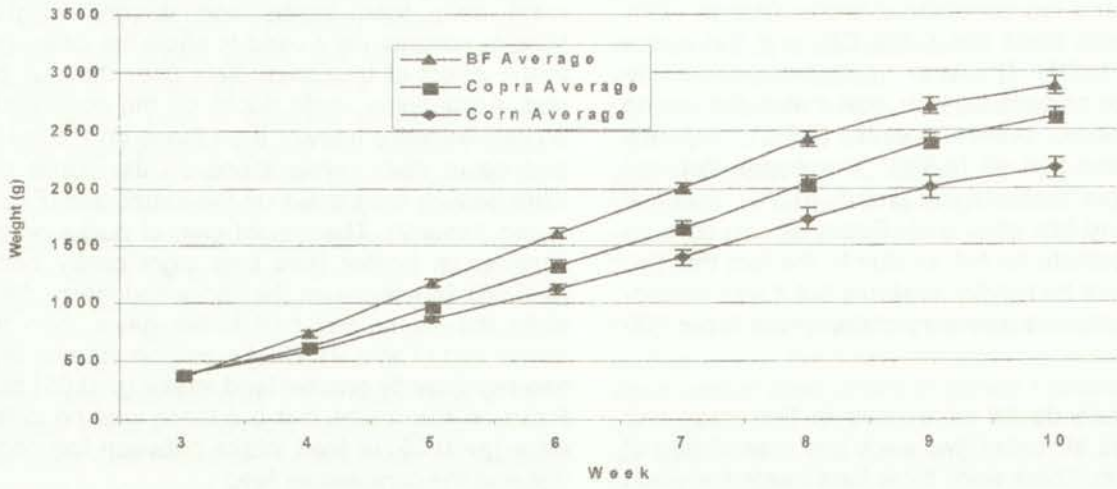

Figure 1: Weekly weights of male ducklings on broiler finisher (BF), copra meal and Markham maize diet (Trial 2).

Table 2: Weight gain (g) and feed intake (g) of Muscovy ducklings (Trial 2)

Diets	Weight gain (±SE)	Feed intake (±SE)
Commercial feed	2,504.3 ± 82.8[a]	15,843.2 ± 804.3[a]
Copra diet	2,228.2 ± 68.7[b]	15,167.8 ± 426.5[a]
Maize diet	1,787.2 ± 78.0[c]	13,341.6 ± 500.0[b]
Lsd (p = 0.05)	108.5	848.1

Means with the same superscript are not statistically different at 5% level of significance

Table 3: FCR and feed cost (Kina) per kg of weight gain of the of Muscovy ducklings on the diets (Trial 2).

Diets	FCR (±SE)	Cost/kg gain
Commercial feed	3.16 ± 0.09[a]	3.95 ± 0.11[a]
Copra diet	3.41 ± 0.08[b]	3.27 ± 0.08[b]
Maize diet	3.76 ± 0.20[c]	3.16 ± 0.17[b]
Lsd (p = 0.05)	0.2	0.18

Means with the same superscripts are not statistically different at 5% level of significance

comparable to the commercial feed because their protein levels are 25% CP and 20% CP. A poor FCR is achieved by the maize diet due to lower protein level (16%). Even though the copra diet had much higher protein level (25% CP) compared to the broiler feed (20% CP) given the same energy levels (12 MJ/kg) for both diets, the protein and energy ratio may be unbalanced.

The use of effective feeding systems is crucial for the development of the smallholder livestock industry. However in PNG, livestock farmers either rely on commercial feeds or foraging (free-ranging system) to provide food for their livestock. The practice of making farm-made feeds that are nutritionally sound or comparable to commercial feeds is uncommon in PNG. This practice is uncommon in PNG because of the very limited information about feeding values of these local feed resources, lack of information about feed formulation and preparation, and availability of feed making equipments such as hand grinders, hammer mills, feed mixers and feed pelleters to produce farm-made feeds. Recent attempts by the Australian Centre for International Agricultural Research (ACIAR) to support poultry feed research and development capacity in NARI and fish feed research and development in (National Fisheries Authority) NFA, (Department of Agriculture and Livestock) DAL and its stakeholders (Booth, *et al.* 2007) is quite significant for the development of the smallholder livestock indus-

try. The much needed information about feeding values of locally available feed resources, feed formulation and preparation (poultry and fish) is now available in NARI, NFA and DAL while the private sector (Project Support Service Limited) is now engaged in providing feed making equipments for making, on-farm feeds. The studies by Dong (2005) in Vietnam shows that agro-industrial by-products or other local feeds resources can be effectively used in duck feeds to maximised production. These agro-industrial by-products can be good protein substitutes, such as the use of soy waste, brewery waste and ensiled prawn waste in farm-made duck feeds in Vietnam (Dong, 2005) or energy substitutes in lower intensity feeds. Agro-industrial by-products can be used to develop low intensity (high fibre, and lower nutrient density) feeds, which are cheaper and comparable to high nutrient density feeds (Ignatius and Quartermain, 2002). Feed cost can also be dramatically reduced by the addition of agro-industrial by-products like copra meal to commercial feeds at 40% level (Pandi, 2005).

The diet in the first trial consisted of commonly used commeroial feed ingredients and agro-industrial by-products (rice bran, wheat mill run and palm kernel meal) while the second trial consisted of ingredients that can be put together on-farm by smallholder Muscovy duck farmers. Now that the information and technology for production of farm-made feeds are available in the country, research and extension efforts should now focus on evaluating locally available feed resources for feeding Muscovy ducks, especially with the use of farm-made feeds. Further studies are also needed to define the energy and protein requirements of Muscovy ducks under lowlands, highlands or even high altitude areas in order to develop proper duck rations for duck farmers in PNG. With these experiences in the use of agro-industrial by-products as protein substitutes, energy substitutes and the development of lower intensity feeds, Muscovy duck farmers should be encouraged to develop farm-made feeds using locally available feeds resources and by-products of agro-processing industries. The use of these agro-industrial by-products and locally available feeds resources will encourage Muscovy duck production and promote economic development and food security for rural and peri-urban communities in PNG.

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REFERENCES

ABDELSAMIE, R. E (unpublished) Protein and Energy Requirements of Muscovy ducks under PNG environment. Department of Primary Industry, Port Moresby.

ABDELSAMIE, R. E (1979) Performance of ducks under semi-intensive management in Papua New Guinea. Papua New Guinea Agricultural Journal 30 (4): 43 - 51

BAKAU, B. J. K AND TOM, M (1996) The yawa banana: a potential feed for livestock. Live stock Development Note: No. 5. Harvest 18: 3 – 4.

BILONG, G (1981) A study on the Performance of Muscovy ducks on sweet potato (*Ipomoea batatas* L. Lam) feeding. B. Sc. Agric. Hons. Thesis, UPNG.

BOOTH, M; ALLAN, G; WANI, J AND HEAS MAN, H. (2007) Aquaculture and Poultry Feed Manufacturing Workshop. Report on an Aquaculture and Poultry Feed Manufacturing Workshop held at the Coffee Research Institute, Aiyura, Papua New Guinea, 6 – 8 December, 2006.

DONG, N, T, K (2005) Evaluation of Agro-Industrial By-Products as Protein Sources for Duck Production in the Mekong Delta of Vietnam. Doctoral Thesis, Swedish University of Agricultural Sciences. Uppsala 2005

EVANS, M (1997) Nutrient composition of feed stuffs for pigs and poultry. Department of Primary Industries, Queensland. Information Series Q185001.

IGNATIUS, S AND QUARTERMAIN, A.R (2002) Evaluating high and low nutrient density feed for the finishing stages of Muscovy broiler ducks. Papua New Guinea Journal of Agriculture, Forestry and Fisheries. 45 (1 & 2): 53 – 57.

LECLERCQ, B AND DE CARVILLE, H (1986) Growth and Body Composition of Muscovy ducks. In: Duck Production Science and World Practice. Farrel, D. J. and Stapleton, P. (Ed.) University of New England. pp.102 – 109.

PANDI, J (2005) Addition of copra meal to commercial feed for broiler chicken production. Papua New Guinea Journal of Agriculture, Forestry and Fisheries. 48 (1 & 2): 3 – 6.