Journal of Animal and Veterinary Advances 2 (12): 666-670, 2003

Perspectives on the Commercial Broiler Industry in Samoa: Constraints and Opportunities

A. O. Ajuyah and C. Okere
The University of The South Pacific, School of Agriculture, Alafua Campus,
Private mail bag, Samoa

Abstract: The broiler industry in Samoa is rudimentary mainly as a result of high dependence on imported feed and feed ingredients. However, the most significant observations from replacing one or two imported feed ingredients with coconut byproducts was the inverse relationship between levels of inclusion, the cost of broiler meat and performance traits such as growth rate and feed conversion ratio (FCR). This is because coconut by-products have highly variable composition such as residual fat (70-175 g kg^{-1}), gross energy (3679 - 5108 kcal kg^{-1}) and fibre (90-302 g kg^{-1}). In-addition the lysine content is very low (4.3 g kg^{-1}) compared to soybean (35.4 g kg^{-1}) and fish (54.4 g kg^{-1}) meals. Dietary intake of copra products based diets is further compounded by rancidity and palatability problems from free fatty acids. Consequently in Samoa it might not be feasible or economical for broiler producers to strive for very high productivity using local feed ingredients.

Key words: Samoa, south pacific region, broiler industry, local feed resources and performance traits

Introduction

Samoa is a small island country in the South Pacific region, with a total land area of approximately 2,934 km^2 and population of 164,217 people (Tamate, 2001). Poultry production is an important segment of the livestock industry in Samoa, however it's growth and expansion is dependent on the reduction of the current over reliance on imported complete feed or feed ingredients from overseas (Ajuyah *et al.*, 2001). This over reliance has contributed to the demise of the broiler industry in Samoa, because feed accounts for approximately 65-75% of the total cost of producing broiler meat.

However, there are abundant local feed ingredients in Samoa that could be used in feed formulation for broiler chickens if their physical characteristics, chemical composition and limiting factors are properly understood. Consequently in the past two decades research has been conducted at the University of The South Pacific's School of Agriculture to evaluate the constraints and opportunities of local feed ingredients in poultry feed formulation (Ochetim, 1987a,b; Ochetim, 1992; Ajuyah and Toomata 1996 and Ajuyah and Tofinga 2002). In recent years there is renewed interest to revamp the livestock industry as a result of high demand for quality livestock meat products and need for food security, especially with spiraling import food bills. The major objectives of this paper is therefore to review past feed research in relation to current constraints and opportunities for the poultry industry in Samoa as panacea for future growth and development, and also identify future nutritional strategies to reduce dependence on imported feed ingredients.

Types and Composition of Local Feed Ingredients: Local feed ingredients in Samoa includes coconut by-products, brewers grain, breadfruit (*Artocarpus altilis*, Park), bananas, pawpaw, cassava, fish waste (mainly bones and gut contents), seashell, seaweed, poultry litter, and water hyacinth. However, the two most abundant and of practical significance are brewers grains and coconut by products, which includes coconut oil (CO), desiccated coconut meal (DCM), copra meal (CM) or cake (CC) and grated coconut meat (GCM). The average yearly output of CM and DCM is about 7600 and 560 tons respectively (Ajuyah, 1999 unpublished). Most of the coconut by-products and brewers grain are either fed to cattle, goats and pigs because of their physical characteristic (wet and mash), or used for compost manure production and excess disposed in streams and rivers.

The proximate composition of the major feed ingredients are presented in Tables 1, 2 and 3 respectively. The ingredients are broadly classified into 3 groups, namely, (i) energy supplements (ii) protein supplements (iii) energy and protein supplements. Energy supplements have crude protein levels of less than 180 g kg^{-1} and include CO, DCM, cassava and breadfruit. Protein supplements have crude protein levels of more than 180 g kg^{-1} and includes, cassava leaves, bread fruit leaves and fish waste. While energy and protein supplements have crude protein and energy levels of more than 180 g kg^{-1} and 3600 kcal kg^{-1} respectively, and includes CM, DCM and brewers grain. Coconut by-products are the cheapest and most abundant local ingredients in Samoa and their chemical composition is dependent on methods of preparation and efficiency of extraction of coconut oil or coconut cream. Consequently, gross energy and crude protein values that ranged from 3679 - 5108 kcal kg^{-1} and 180 - 205 g kg^{-1} respectively has been reported for copra meal (Ochetim, 1988b; Hite and Ajuyah, 1995 and Aregheore, 2002).

Table 1: Proximate chemical composition of energy supplements

Feed ingredients	Chemical composition (g kg^{-1}) Dry Matter	Crude Protein	Fat	Fibre	Ash	Gross Energy kcal kg^{-1}	Ref
Coconut oil	-	-	-	-	-	NA	
Cassava root	331	24	9.5	20	40	3901	1
Bread fruit (fresh)	208	35	15	46	28	3871	2
Desiccated coconut meal	945	56.9	455	295	11	5064	3

References 1 = Hite and Ajuyah, (1995); 2 = Aregheore, (2001); 3 = School of Agriculture laboratory (2003), NA = not available.

Table 2: Proximate chemical composition of protein supplements

Feed ingredients	Chemical composition (g kg^{-1}) Dry Matter	Crude Protein	Fat	Fibre	Ash	Gross Energy kcal kg^{-1}	Ref
Cassava leaves	890	255	13	65	67	2318	1
Bread fruit leaves (fresh)	206	187	40	227	137	3560	2
Fish waste	953	613	164	6	50.5	4949	3

References 1 = Ochetim, (1987); 2 = Aregheore, (2001); 3 = School of Agriculture laboratory (2003); GE for cassava leaves from Ochetim (1988, unpublished)

Table 3: Proximate chemical composition of energy and protein supplements

Feed ingredients	Chemical composition (g kg^{-1}) Dry Matter	Crude Protein	Fat	Fibre	Ash	Gross Energy kcal kg^{-1}	Ref
Copra meal	901	205	70	107	65	4200	1
Copra meal	900	188	175	302	40	5108	2
Copra meal	900	180	75	90	53	3679	3
Desiccated coconut meal	806	188	168	312	48	4372	4
Brewers grain	916	245	29	135	66	3702	5
Brewers grain	912	209	51	148	41	3850	1

References 1 = Ochetim, (1988b); 2 = Hite and Ajuyah, (1995); 3 = Aregheore, (2002); 4 = Aregheore and Tunabuna, (2001); 5 = School of Agriculture laboratory (2003).

Table 4: Local ingredients, inclusion levels and responses of broiler chickens

[1]Feed Ingredients	Inclusion level %	Selected performance traits	Significance	Reference
Copra cake	33,44,55	Growth rate, FCR	*	1
Copra meal	22	Growth rate, FCR	ns	2
Grated coconut meat	100	Growth rate, FCR	*	3
Cassava	40	Growth rate, FCR	ns	1
[6]Cassava	100	Growth rate, FCR	*	4
Bread fruit	40	Growth rate, FCR	ns	1

1 = Ochetim, (1987a); 2 = Ajuyah and Toomata (1996); 3 = Ochetim, (1988a); 4 = Ajuyah and Tofinga (2001). [1]Feed ingredients replaced maize and [6]Cassava replaced 100% sorghum. ns = not significant and * = ($P<0.05$).

Concerns on the use of high levels (>20%) of copra meal, grated coconut meat and desiccated coconut meal in poultry diets includes low metabolizable energy (copra meal), high energy (grated coconut meat and desiccated coconut meal), low lysine, high fibre or non-sugar polysaccharide (NSP), rancidity and palatability problems from free fatty acids as a result of high level of residual fat. Regarding cassava major limitations include high water and poor quality protein content, powdery texture of the meal, hydrogen cyanide content, long production cycle (9 to 18 months), and limited storage of the fresh tuber (4 to 5 days).

The Use of Local Feed Ingredients in Broiler Diets: The

Table 5: Local ingredients, inclusion levels and responses of broiler chickens

Feed Ingredients	Inclusion level	Selected %	Significance performance traits	References
Cassava + leaf	50	Growth rate, FCR	ns	1
Cassava + leaf	100	Growth rate, FCR	*	1
Cassava + leaf + oil	100	Growth rate, FCR	ns	1
Copra cake + rumen liquor (20:3)	33	Growth rate, FCR	ns	2
Cassava + bread fruit (1:1)	40	Growth rate, FCR	ns	3

1 = Ochetim, (1992); 2 = Ochetim, (1987b); 3 = Ochetim, (1987a). [1]Feed ingredients replaced maize. ns = not significant and * = (P<0.05)

Table 6: Amino acid composition (g kg^{-1}) of copra, soya bean and fish meals

Essential for Poultry (g kg^{-1})	Copra[1] meal	Soy-bean[2] meal	Fish meal[2]	Requirement (Broiler 0-6 wks)[2]
Protein	188	485	604	240
Arginine	2.1	36.9	39.7	13
Histidine	3.8	18	42	5.4
Isoleucine	6.9	22	30.2	12
Leucine	11.9	39.3	52.3	20
Lysine	4.3	35.4	54.4	12
Methionine	3	6.6	22.2	5.5
Phenylalanine	8	26	26.1	8.7
Threonine	5.9	19.3	30.6	7
Tryptophan	-	6.7	6.8	2
Valine	10	23	32	12.2
Glycine	9.1	21	42	13 (+serine)
Total	65	254.2	378.3	110.8
Non-essential for Poultry (%)	**Copra meal**	**Soy-bean meal**	**Fish meal**	**Requirement (Broiler 0-6 wks)**
Alanine	0.85	2.01	3.82	-
Aspartic acid	1.5	5.22	5.93	-
Glutamic acid	3.57	8.48	8.89	-
Hydroxy proline	-	-	-	
Proline	-	2.44	2.74	-
Serine	0.83	2.50	2.88	1.30 (+glycine)
Tyrosine	0.37	1.84	2.24	1.62 (+phenylalanine)
Cystine	0.33	0.70	0.56	0.75 (+methionine)
Total	7.45	23.19	26.76	3.67

Sources: [1]Analysis done at Poultry Research Foundation Laboratory, Camden, Australia. [2]Monogastric Animal Nutrition Principles and Practice by J.M. Olomu. Jachem Publication

major and bulkiest ingredients in broiler feeds are energy and protein supplements (85-95%) which traditionally is from maize or sorghum and soybean meal. Consequently most nutritional studies in Samoa where based on partial or total replacement of maize and soybean meal with local ingredients (Table 4). Ochetim, (1987a) in an earlier study with broiler chickens reported that cassava and breadfruit could replace 40% of maize with no adverse effects on growth rate and feed conversion ratio (FCR). In another study using copra meal Ajuyah and Toomata (1996) reported broilers could tolerate up to 22% with no adverse effects on selected performance traits. In contrast when cassava completely replaced sorghum, Ajuyah and Tofinga (2001) observed signification reduction in performance traits and feed cost. A similar observation was made when maize was replaced with more than 33% of copra meal (Ochetim, 1987b; Ochetim, 1988a).

The most significant observations from replacing one or two imported feed ingredients with local ingredients was the inverse relationship between levels of inclusion, the cost of producing broiler meat and performance traits. Consequently additional studies were conducted to explore methods of improving growth performances at higher levels of dietary inclusion of local ingredients (Table 5). Some of the novel methods include the fermentation of rumen liquor with copra cake and the complementary effects of cassava + leaf + coconut oil. Both of which improved the growth performances of broiler chickens at 33 and 100% inclusion levels respectively (Ochetim, 1987b, Ochetim, 1992).

The poor responses of broiler chickens to the high copra meal diets was attributed principally to it's poor protein quality. The protein is low in essential amino acids (65 g kg^{-1}) when related to the requirements for 0-6 weeks broiler chickens (110.8 g kg^{-1}) and concentration in soybean and fishmeals at 254.2 and 378.3 g kg^{-1} respectively (Table 6). Consequently it is not nutritionally feasible to formulate a balance diet based on copra meal as primary protein source.

Based on local feed ingredient a typical diet for broiler chickens in Samoa is shown in Table 7 (Ajuyah and Tofinga, 2001).

Table 7: Ingredient composition of broiler diets (g kg^{-1})

Ingredients	Control	Cassava
Ground Sorghum	536	-
Ground Cassava	-	536
Soybean meal	330	330
Fish meal	20	20
Animal tallow	70	70
DiCal Phosphate	20	20
Limestone	10	10
[1]Broiler premix	5	5
Salt	3	3
Lysine	3	3
DL-Methionine	2	2
Choline Chloride	1	1
Calculated Analysis		
Energy ME, kcal kg^{-1}	3159.0	3082.0
Dry Matter (%)	90.05	90.59
Crude Protein (%)	20.1	17.0
Calcium (%)	0.98	1.14
Total Phosphorus (%)	0.77	0.65
Lysine (%)	1.45	1.36
Methionine& Cystine(%)	0.90	0.70

[1]Broiler premix supplied the following nutrients per kilogram of diet. Vitamin A 1500IU, vitamin D 200ICU, vitamin E 10IU, vitamin K 0.5mg, riboflavin 3.6mg, pantothenic acid 10mg, niacin 27mg, vitamin B_{12} 0.009 mg, choline 1300mg, biotin 0.15mg, folacin 0.55mg, thiamin 1.8mg, pyridoxine 3.0mg, magnesium 600mg, manganese 60mg, zinc 40mg, iron 80mg, copper 8.0mg, iodine, 0.35mg and selenium. 0.15mg.

Constraints and Opportunities: Mitigating factors to the growth of the broiler industry in Samoa include lack of good source of protein, variability in energy contents of same ingredient and high fibre and water content, and therefore require further processing. In-addition the cultivation of cereals as energy feed source for poultry in Samoa is not feasible because of it is staple for humans and limited land resources. It is therefore impossible to formulate a diet based on 100% local ingredients. The cumulative effect is that locally produced poultry products are more expensive than their imported counterparts. However opportunities exist in terms of high demands for poultry products and future research should focus on developing organic poultry products and promoting "freshness" or "wholesomeness" of locally grown products. However, since most byproducts are high in water content liquid feeding might be the most viable option if the problems of fermentation from high temperature could be overcome (Farrell, 1999)

Conclusion

In general using high levels of local feed resources in poultry diets reduced growth rate and feed efficiency with a general reduction in feed cost (Ochetim, 1988a). However, in the short term it might be important to match poultry production to available resources for it might not been economical to strive for unrealistically high production expectation.

References

Ajuyah, A.O. and A. Toomata, 1996. Growth Performance and Economic Evaluation of Broiler Chickens Fed a High Copra Meal based diet with and without Exogenous Feed Enzyme. Institute for Research Extension and Training in Agri. of the University of The South Pacific. Annual Res. Report pp: 1-3.

Ajuyah, A.O., S.H. Mael and T. Tabuaciri, 2001. Current Feeds, Constraints and Feeding Technique for Pig and Poultry Small Holders in the South Pacific Region: Scope for Improvement. *In* Regional Training Workshop for Pig and Poultry Small Holder Farmers. 24th-28th September 2001, Samoa, Ed. A.O. Ajuyah.

Ajuyah, A.O. and M. Tofinga, 2002. Performance and Economic Evaluation of Broiler Chickens Fed Two Cultivars of Cassava. J. Agri., Forestry and Fisheries. 45(1and 2):

Aregheore, E.M., 2001. Traditional Staple Foods and Some Feed Stuffs of the Pacific Islands: their chemistry, biochemistry and nutrient composition. IRETA publication.

Aregheore, E.M. and T. Tunabuna, 2001. Utilization of diets containing increasing levels of dried desiccated coconut waste meal (DCWM) by growing crossbred Anglo-Nubian goats in Samoa. Asian-Australasian. J. Anim. Sci., 14: 316-320.

Aregheore, E.M., 2002. Copra meal. Unpublished data.

Farrell, D. (1999). Seminar presentation at the School of Agriculture of The University of The South Pacific, Apia Samoa 4th,March 1999.

Hite, R. and A.O. Ajuyah, 1996. Chemical Evaluation of Local Feed Ingredients for Pig and Poultry Production in Solomon Islands. Institute for Research Extension and Training in Agriculture of The University of The South Pacific Annual Res. Report, pp: 4-16.

Ochetim, S., 1992. The Substitutability of Maize with Cassava and Leaf Meal Mixture in Broiler Diets. J. of South Pacific Agri., 1:29-33.

Ochetim, S., 1987a. Copra Cake in Diets of Broiler Chickens: I Effects of Levels of Cake on Nutritional and Economic Performances. Alafua Agricultural Bulletin, 12:19-24

Ochetim, S., 1987a. Efficacy of Some Alternative Sources to Maize in Diets of Broiler Chickens in the South Pacific Region Alafua Agricultural Bulletin, 12:13-17.

Ochetim, S., 1988b. Alafua Agricultural Bulletin, 13:35-37.

Ochetim, S., 1988a. Grated Coconut Meat as an Energy Source for Broiler Chickens Alafua Agricultural Bulletin, 13: 9-12.

Ochetim, S., 1987b. Copra Cake in Diets of Broiler Chickens: II Effects of Feeding Rumen LiquorFermented Cake on Performances of Broiler Finishers. Alafua Agricultural Bulletin, 12:1-4.

Tamate, A., 2001. Status and Breed of the Poultry and Pig Industry in Samoa: Production constraints and scope for future growth and development. *In* Regional Training Workshop for Pig and Poultry Small Holder Farmers. 24th-28th September 2001, Samoa, Ed. A.O. Ajuyah.