# Utilisation of cassava products-copra meal based diets supplemented with or without Allzyme SSF by growing pullets

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## Abstract

The utilisation of cassava root-leaf meal (CRLM) and copra meal with or without enzyme by growing pullets was investigated. A total of 180 six week-old Shaver 579 pullets (549.79 ± 0.39 g/bird) were allotted to 12 floor pens containing 15 birds each. A commercial grower diet (control) and 2 diets based on CRLM and copra meal with or without added Allzyme® SSF (test diets) were fed each to 4 replicate pens in a completely randomized design. Growth performance, age at first egg, feed cost of rearing and the count of floor primary feathers formed the major response criteria. Birds fed the control commercial diet consumed more feed and gained more weight ($P<0.05$) than those fed the test diets. Age at first egg did not differ ($P>0.05$) between the control and enzyme supplemented CRLM groups. There was no dietary effect ($P>0.05$) on the weight of the first egg among the 3 groups. Feed cost of rearing was reduced ($P<0.05$) on the test diets compared to the control diet. The count of floor primary feathers was higher ($P<0.05$) in the group fed the control compared to the test diet without enzyme but did not differ ($P>0.05$) between the two test diets as well as between the enzyme supplemented and the control diets. It was concluded that CRLM and copra meal can be used as major energy and protein sources respectively in growing pullets' diets. Enzyme supplementation may however, be needed to maintain performance of the birds.

**Keywords: cassava products, copra meal, enzyme, Shaver Brown pullets, growth, age of lay**

## Introduction

Conventional ingredients for poultry feeding are not readily available in most countries of the South Pacific region including Samoa. Energy sources such as wheat and maize are either not grown in the area (Ochetim, 1992) or the cultivation is insignificant to meet the demand of the livestock industry. Oilseeds such as groundnut and soyabean which form important sources of the protein in poultry diets are not grown in most countries of the region as well. Commercial poultry farmers in the region solely rely on the importation of finished feeds at exorbitant costs. The cost of feeding poultry in the South Pacific region is reported to account for about 70% of total cost of producing meat and eggs (Glatz, 2012). This makes farmers unable to produce and sell poultry products at prices that can compete with the imported poultry meat and eggs.

There are however, readily available ingredients in the region such as cassava roots and their by-products, breadfruit, cassava, leaves and copra meal which have potential as feedstuffs and could be utilized more effectively for poultry feeding (Ochetim, 1988; ALFID, 2002; FAO, 2012). There is available information on the nutrient composition of many of such materials (Dignan *et al.*, 2004), but their use as major ingredients in poultry diets in the region is still limited on account of the high fibre content and presence of anti-nutritional factors.

Cassava (*Manihot esculenta*) is an important crop in the South Pacific (Ochetim, 1992) and copra meal, the by-product of coconut oil extraction is readily available in almost all the countries of the region (Mael and Ajuya, 2001). Cassava root is a good source of energy ranging from 12.0 to 14.6 MJ ME/kg (Fetuga and Oluyemi, 1976; Khajarern *et al.*, 1982) but its protein content (10 to 36 g/kg) (Ochetim, 1992; Buitrago and Luckett, 1999; Chauynarong *et al.*, 2009; Anaeto and Adighibe, 2011) is lower than the 80-90 g/kg in maize. According to Oruwari *et al.* (2003) with a good protein balance cassava root meal could completely replace maize in poultry diets. Copra meal is a moderate source of protein ranging from 190 g/kg (Sauvant *et al.*, 2004) to 224 g/kg (Panigrahi, 1991) but its use as source of dietary protein for poultry is limited by the high fibre content (Thorne, 1992; Kim *et al.*, 2001; Siebra *et al.*, 2008;), low lysine and sulphur amino acids (Sundu and Dingle, 2009) contents. Fibre contents of 113 g/kg (Diarra *et al.*, 2014) and 160g/kg (Dairo and Fasuyi, 2008) have been reported in copra meal.

However, there are several exogenous enzymes with fibre degrading activity which have been used to improve the utilisation of fibrous materials by monogastric animals. Sundu *et al.* (2006) observed improved weight gain, feed conversion ratio, nutrient digestibility and digesta viscosity in broiler chicks fed high copra meal diet supplemented with Allzyme SSF. The beneficial effect of Allzyme SSF addition on poultry performance has also been reported by Gonzales *et al.* (2005) and Hooge *et al.* (2010). Lysine and methionine which are limiting in most alternative feed ingredients are also available in commercial forms.

Although high levels of cassava root meal, cassava root-leaf meal (Tewe and Bokanga, 2001; Eruvbetine *et al.*, 2003) and copra meal (Dairo and Fasuyi, 2008) have been included in the diet of egg-type birds with acceptable performances, there is little or no documented information on their use in combination as main energy and protein sources respectively. This study investigated the effects of Allzyme® SSF supplementation of a cassava root-leaf and copra meal based diets on the growing performance of Shaver Brown pullets in Samoa.

## Materials and Methods

### *Study Site*

The study was conducted at the Poultry Unit of the University of the South Pacific’s School of Agriculture and Food Technology livestock farm Alafua, Samoa (latitude: 13.5$^{o}$S and longitude: 172$^{o}$W). Cassava is well grown in the area, but not a staple food for humans, making it readily available as feed. Copra meal is also readily available from coconut meal industries in the study area.

### *Preparation of Cassava Products*

Fresh roots from the sweet variety of cassava were purchased from the market, chopped and sun-dried for 72 hours on a clean surface. Cassava leaves excluding petioles were plucked from cassava plants during harvest and air dried for a wk. The dried cassava roots and leaves were ground separately in a hammer mill to pass through a 2-mm sieve. The processed cassava products (roots and leaves) were analysed for proximate composition (Table 1) and mixed in the ratio of 4:1. This product was labelled cassava root-leaf meal (CRLM) which was analysed to have protein content (9.80%) similar to that of maize grain.

Table 1: Proximate composition and calculated metabolisable energy content of the experimental ingredients

| | Ingredients | | | | |
|---|---|---|---|---|---|
| Constituents (g/100g) | CRM | CLM | CRLM | Copra meal | Fish meal |
| Crude protein | 3.98 | 25.90 | 9.80 | 24.90 | 68.70 |
| Crude fibre | 2.68 | 18.70 | 9.92 | 11.29 | 0.16 |
| Ether extract | 0.83 | 4.30 | 2.52 | 6.61 | 13.27 |
| Ash | 3.44 | 10.60 | 4.18 | 6.60 | 12.69 |
| Nitrogen-free extract | 80.74 | 31.47 | 63.08 | 40.85 | 2.37 |
| [1]ME (kcal/kg) | 3,080.76 | 2,423.79 | 2,806.06 | 2,906.08 | 3,700.91 |

CRM: Cassava root meal; CLM: Cassava leaf meal; CRLM: Cassava root-leaf meal (4:1)
[1]Calculated according to Fisher and Boorman (1986).

*Experimental Diets*

Two pullet grower diets based on 15% crude protein were formulated using CRLM as the main energy source and solvent extracted copra meal from Pacific Oil Samoa, as the main source of dietary protein (Table 2). One of the diets was supplemented with Allzyme® SSF (from Alltech Inc., Kentucky, USA) with 7 enzyme activities (amylase, betaglucanase, cellulase, pectinase, xylanase, protease, and phytase) and the other non-supplemented. Both diets were fortified with vitamins and mineral premixes, L-lysine HCl and Dl-methionine. Vegetable oil was added to boost the energy content of the diets on account of the high fibre in CRLM and copra meal.

*Birds and Management*

The research was approved by the University of the South Pacific’s Research Committee and birds were managed in compliance with the University’s research ethics guidelines for animal welfare. One hundred and eighty six week-old Shaver 579 pullets (549.79 ± 0.39 g/bird) were allotted to twelve pens (2.4 m x 3.9 m) containing 15 birds each. Two tube feeders and a bell shape drinker were provided in each pen. A purchased commercial pullet grower feed (control) and the formulated feeds were fed each *ad-libitum* to birds in four randomly selected pens in a completely randomized design for a period of 13 wk. Clean drinking water was also supplied *ad-libitum* throughout the experimental period. The lighting programme was limited to 13 h daylight (6.00 to 19.00).

Table 2: Ingredient composition and calculated analysis of the experimental diets

| Ingredients (g/kg) | Diets | |
|---|---|---|
| | Without enzyme | With enzyme |
| CRLM | 694.50 | 694.20 |
| Vegetable oil | 30.00 | 30.00 |
| Copra meal | 150.00 | 150.00 |
| Fish meal | 75.00 | 75.00 |
| Limestone flour | 40.00 | 40.00 |
| Lysine HCl | 3.00 | 3.00 |
| DL-Methionine | 2.00 | 2.00 |
| Vitamin-mineral premix* | 2.50 | 2.50 |
| Allzyme® SSF | 0.00 | 0.30 |
| NaCl | 3.00 | 3.00 |
| Calculated composition (g/100g) | | |
| Crude protein | 15.06 | 15.10 |
| Lysine | 0.64 | 0.65 |
| Methionine | 0.30 | 0.32 |
| Metabolisable Energy (kcal/kg) | 2,860.58 | 2,851.11 |

CRLM: Cassava root-leaf meal; CRLM + E: Cassava root-leaf meal + enzyme;
*Premix supplied/kg: Vitamin A 1.000.000 IU., Vitamin D3 200.000 IU, Vitamin E 1.500 mg, Vitamin K3 200 mg, Vitamin B1 150 mg, Vitamin B2 400 mg, Vitamin B6 200 mg, Vitamin B12 1.200 mcg, Niacin 2.000 mg, Calcium pantothenate 500 mg, Biotin 10.000 mcg, Folic acid 40.000 mcg, Choline chloride 40.000 mg, Vitamin C 2.000 mg, Methionine 30.000 mg, Iron 4.000 mg, Copper 800 mg, Manganese 8.000 mg, Zinc 6.000 mg, Iodine 60.000 mcg, Selenium 15.000 mcg, Cobalt 20.000 mcg, Carophyll 2.000 mg, Antioxidant BHT 10.000 mg

*Data Collection and Analysis*

Weighed quantities of feed were supplied daily and the left over weighed the next day to account for feed consumed by difference. Body weight change was monitored through weekly weighing. The cost of the kg feed was calculated based on the market price of individual ingredients. Feed cost of rearing was calculated as the product of feed consumed and the cost per kg feed. The age of birds at first egg was recorded for each pen and the weight of the first egg recorded using a digital scale sensitive to 0.01 g. Primary feathers on the floor were collected weekly from each pen and counted.

Cassava root meal (CRM), cassava leaf-meal (CLM), cassava root-leaf meal (CRLM), copra meal, and fish meal were analysed for proximate composition (Table 1). The formulated diets were also analysed for crude protein and crude fibre contents (Table 3). Chemical analysis was carried out in the Central Laboratory, USP Alafua Campus, Samoa, according to AOAC (1990).

Table 3: Proximate composition and calculated metabolisable energy content of the experimental diets and reported values for the commercial grower diet

| | Diets | | |
|---|---|---|---|
| Constituents (g/100g) | Without enzyme | With enzyme | Commercial** |
| Dry matter | 90.50 | 90.10 | NR |
| Crude protein | 15.11 | 15.07 | 15.00 |
| Crude fibre | 7.96 | 7.88 | 5.00 |
| Ether extract | 4.36 | 4.28 | NR |
| Ash | 8.98 | 9.01 | NR |
| Nitrogen-free extract | 54.09 | 53.86 | NR |
| ME (kcal/kg)* | 2,832.43 | 2,816.30 | 2,800.00 |

CRLM: cassava root and leaf meal; CRLM + E: cassava root and leaf meal + Enzyme
*Calculated according to Fisher and Boorman (1986).
**Values from the feed company; NR: not reported

Rearing performance data (feed intake, body weight change, cost of rearing, age at first egg and egg weight) and floor feathers count were subjected to analysis of variance (ANOVA) of a completely randomised design using the SPSS package (SPSS, 2013 version 22). Significant differences were reported at 5% level of probability (Steel and Torrie, 1980).

## Results and Discussion

### *Chemical Composition*

From the results of proximate analysis of the test ingredients (Table 1) both CLM and copra meal were moderate sources of protein (25.90 and 24.90 g/100g, respectively) but CLM contained more fibre than copra meal. With the exception of fish meal, CLM had a higher ash and lower nitrogen-free extract contents than all other ingredients used in the formulation. The analysed protein and calculated metabolisable energy (ME) contents of the test diets were similar to the values reported in the commercial diet (Table 3). The test diets however, contained more crude fibre than reported in the commercial grower diet. Cassava leaves used in this experiment had higher protein and lower fibre contents than values of 21 and 25%, respectively, observed in cassava leaves by Ravindran (1993). Factors such as age, cultivar and agronomic practices have all been reported to affect the composition of cassava leaves (Rogers and Milner, 1963). The leaves used in the present experiment were older as they were collected as by-products of cassava harvest. The experimental cassava root contained more protein that the 2.8% reported by Buitrago and Luckett (1999) but similar to the value of 3.6% protein observed by Chauynarong *et al.* (2009). Several factors including stage of maturity, soil fertiliser status, and cassava cultivar have been reported to affect the chemical composition of cassava products (Ravindran and Ravindran, 1988, Oni *et al*, 2011). The crude protein, ether extract and crude fibre contents of copra meal used in the experiment are comparable to values observed in solvent extracted copra meal (NRC, 1994). The crude protein and metabolisable energy (ME) contents of the formulated diets met the requirements of

15-16% protein and 2,750-2,800 Kcal ME/kg for growing pullets (NRC, 1994; Shaver 579 Management Guide, 2005).

*Rearing Performance*

Results of rearing performance of the pullets (Table 4) showed significantly (P<0.05) higher feed intake, body weight change and final body weight of pullets fed the commercial grower diet compared to those fed the two test diets. There were no significant (P>0.05) differences between the test diets in terms of daily feed intake, body weight change and final body weight. Feed cost of rearing was higher (P<0.05) on the control compared to the test feeds. Pullets fed the control diet laid the first egg earlier (P<0.05) than those fed the test diet without enzyme. Age at first egg was not different (P>0.05) between the 2 test diets as well as between the enzyme supplemented diet and the control. There was no significant (P>0.05) dietary effect on the weight of first egg. There were more (P<0.05) primary floor feathers on the control compared to the non-enzyme supplemented CRLM diet but the count did not differ (P>0.05) between the test diets as well as between the control and the enzyme supplemented diets. There was no record of mortality during the experimental period.

Table 4: Performance of growing Shaver Brown pullets fed cassava-copra meal based diets with or without Allzyme SSF and commercial grower diet

| | Diets | | | |
|---|---|---|---|---|
| Performance indices | Commercial | CRLM | CRLM + E | S.E.M. |
| Initial weight (g/bird) | 550.33 | 549.45 | 549.58 | 0.44 |
| Final weight (g/bird) | 1759.47[a] | 1516.67[b] | 1551.67 [b] | 33.68 |
| Daily feed intake (g/bird) | 100.95[a] | 87.51[b] | 88.48[b] | 2.50 |
| Weight change (g/bird) | 1209.14[a] | 967.22[b] | 1002.09[b] | 33.80 |
| Cost of kg feed (ST$) | 1.32 | 0.74 | 0.76 | NA |
| Feed cost of rearing (ST$/bird) | 13.71[a] | 6.80[b] | 7.06[b] | 0.39 |
| Age at first egg (days) | 130.33[b] | 143.00[a] | 137.00[ab] | 1.84 |
| Weight of first egg (g) | 45.67 | 46.67 | 48.17 | 1.10 |
| Primary feather count (number) | 578[a] | 245[b] | 365[ab] | 73.09 |

CRLM: cassava root and leaf meal; CRLM + E: cassava root and leaf meal + Enzyme
[ab]Means within the same row with common superscripts are statistically comparable (P<0.05).
S.E.M.: standard error of the mean;
NA: not analysed.
ST$ = Samoan Tala $ (ST$1 = US$0.43 at the time of the experiment)

Increased retention time of fibrous materials in the gizzard is well documented (Rougière and Carré, 2010; Svihus, 2011; Meremikwu *et al.*, 2013). Since the fullness of the gizzard is a major factor controlling feed intake, the test diets with higher fibre content must have been retained longer in the gastro-intestinal tract resulting in the lower intake compared to the control. The body weights of birds fed the two test feeds at 19 wk of age compared favourably with the weight of the breed (1,550 g/bird) at this age (Shaver 579 Management Guide, 2005). The higher intake of the commercial grower diet resulted in a heavier weight of birds on this diet than the average of the breed. The increased feed intake on the commercial feed coupled with its higher cost (ST$1.32/kg) compared to the test diets (ST$0.74 and ST$0.76/kg for non-supplemented and enzyme supplemented feeds respectively) were the main reasons for the increased cost of rearing on the commercial grower feed. This high level of feed intake must have stimulated early sexual maturity in birds fed the control commercial feed. The pattern of the age of lay suggests an early attainment of sexual maturity of birds fed the control feed on one hand, and the beneficial effect of enzyme supplementation on the other. Values for the weight of first egg on all the diets compared with the 46.00 g reported for the first egg of the breed (Shaver 579 Management Guide, 2005).

Gentle feather pulling is common during rearing (Huber-Eicher and Sebo, 2001) which can have serious consequences during the laying period as misplaced feathers may attract further pecking (McAdie and Keeling, 2000). Fullness or emptiness of the gastro-intestinal tract is known to be an important factor influencing the rate of feather pulling in poultry (Esmail, 1997; Rodenburg *et al.*, 2013). The test feed without supplemental enzyme in this study must have been retained longer in the tract on account of its higher fibre content compared to the commercial feed which could be the reason for lower feather count observed on this diet compared to the control. Although the two test diets had similar fibre contents, there must have been an increased digesta transit on the enzyme supplemented diet probably due to some fibre hydrolysis by the enzyme resulting in the similarity in feather count between this group and control. The pattern of feather pulling in the present study is consistent with the findings of Esmail (1997) who observed an increased incidence of feather pecking in hens fed below 8% dietary fibre.

Based on these results, it is concluded that cassava root-leaf meal and copra meal based diets as main dietary energy and protein sources respectively will reduce the cost of pullet rearing compared with the commercial grower diet. Enzyme supplementation of the diet will maintain performance of the birds. Further researches into appropriate combinations of cassava products, cassava varieties and processing methods, enzyme level and activity are needed.

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