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Research Article

Diets Digestibility, Carcass and Haematological Characteristics of a Dual-Purpose Local Chicken Strain Fed Graded Levels of Cassava-Sweet Potato Meal as Energy Substitute for Maize

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Abstract | The increasing pressure on maize for human and livestock nutrition, coupled with the cost of maize which keeps increasing, stimulate the use of alternative and locally available sources of energy. This study aimed at contributing to chicken productivity by evaluating effect of pelleted diets with graded inclusion levels of cassava-sweet potato meal (CASPM) as energy substitute for maize on the digestibility, carcass and haematological parameters of Cameroon Kabir chickens. A completely randomised design was used to allocate a total of 315 Kabir chickens (270 hens and 45 rosters) of 23 weeks of age to five dietary formulations T1 (0% replacement of maize with CASPM considered as control diet), T2 (25%), T3 (50%), T4 (75%) and T5 (100%). Animals within the treatments were balanced for weight in each sex, each treatment having 63 Kabir chickens in three replicates of 18 hens and 3 roosters each. The apparent digestibility of metabolizable energy was found to be positive. Lipids apparent digestibility value was negative for diet but positive for other treatments. Crude protein, Ash and crude fibre were all negative irrespective of treatments. The rosters had higher carcass weight than the hens ($P<0.05$), which in turn had a higher liver to carcass ratio as well as abdominal fats compared to the rosters. No significant difference was observed among other organs. The lowest RBC count was registered for T5 whereas unusual high RBC count was observed for hens from T4. T5 (100% substitution) and T3 (50% substitution) had the highest digestibility mean while T3 (50% substitution) had the lowest FCR. T1 and T3 were found to have the best optimum range blood characteristics. Overall, T3 was the best of the five treatments as neither mortality nor adverse effects on chickens was recorded. Besides, no abnormalities were found upon carcass analysis. It is therefore recommended that 50% substitution of cassava-sweet potato meal as energy substitute for maize shall be used for the improvement and productivity of Kabir chicken production.

Keywords | Local chicken, Alternative feed, Digestibility, Carcass, Productivity

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INTRODUCTION

Maize occupies the highest percentage of most compounded rations for monogastric animals, taking about 40-60% their diet (Onimisi and Dafwang, 2010). The increasing pressure on the use of maize by human population and livestock feed millers coupled with the cost of maize which fluctuates with the seasons of the year, thus making the cereal grain to be either scarce or expensive, stimulate the use of alternative sources of energy that are

locally available, particularly the starchy roots and tubers abounding throughout humid tropics. Replacing maize with cheaper feed ingredients like cassava and sweet potato is likely to significantly reduce the total production cost (Okah, 2004; Akinmutimi, 2004). In family production, feeding system is one of the main constraints to development, alongside with diseases and genetic potential. Exploitation of locally available feedstuffs could be of great contribution to booster that livestock sector, particularly when they are non-high-competitive feed materials.

Under tropical conditions cassava and sweet potato are the most productive crop in terms of energy yield per unit land area. The availability throughout the year, efficient production of cheap energy, drought tolerance and ability to thrive on marginal oils motivate renewed attention to these crops (Hahn and Keyser, 1985; Lekule and Sarwatt, 1992).

In ten years, the cassava production in Cameroon has double, moving from 2 047 710 tons in 2003 to 4596 383 tons in 2013 (http://www.factfish.com/statistic-country/cameroon/cassava). With such increase, the national government and the International Institute for Tropical Agriculture (IITA) through the National Program for Roots and Tubers (NPRT) has recently launched new varieties of cassava yielding up to 35 tons/hectare (http://www.iita.org/2012-press-releases/) and dedicated 270 000 hectares to the crop (http://www.rtb.cgiar.org/). Improvement in productivity of new varieties of cassava and sweet potato suggests that production in excess for direct human consumption will become available for feeding farm animals in Cameroon.

Although, cassava and sweet potato are cheap sources of energy, the extent of their practical use in poultry feeding has been limited. The presence of toxic cyanogenic glycosides and other undesirable substances, dustiness of the dried products and mouldiness represent some limitations impairing productivity. However, heat treatment methods (boiling, steaming, roasting, sun drying, and fermenting) considerably reduce the toxicity and improve the palatability and storage characteristics. Steam pelleting of mash rations where maize has been substituted by cassava-sweet potato meals will also contribute to improve the palatability, the texture and feed intake by reducing the dustiness, the irritation of respiratory organs. Garcia and Dale (1999) stated that these steps yield chick performance superior to that obtained with mash diets.

This study aimed at contributing chicken productivity by evaluating effect of pelleted diets with graded inclusion levels of cassava-sweet potato meal (CASPM) as energy substitute for maize on the carcass and haematological parameters of Cameroon Kabir chickens.

MATERIALS AND METHODS

The study was carried out at the Green Gold Agro-Venture experimental farm, located in Buea (4° 10' 57" N and 9° 18' 40.55" E). A completely randomised design was used to allocate the chickens to five treatments. A total of 315 Kabir chickens (270 hens and 45 rosters) of 23 weeks of age, were allocated to five dietary formulations T1, T2, T3, T4 and T5 define as follows:

T1: O% replacement of maize with cassava-sweet potato meal (CASPM), Control diet
T2: 25% replacement of maize with CASPM (The CASPM containing 50% each by weight of cassava and sweet potato meal)
T3: 50% replacement of maize with CASPM
T4: 75% replacement of maize with CASPM
T5: 100% replacement of maize with CASPM

Animals within the treatments were balanced for weight within each sex, each treatment having 63 Kabir chickens in three replications of 18 hens and 3 roosters each. The composition and bromatological values of the diets are represented in the Table 1.

Table 1: Formulation of various diets using least cost ingredients

Ingredient	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	T5 (100%)
Maize	54	40.5	27	13.5	00
Cassava	00	6.75	13.5	20.25	27
Sweet potato	00	6.75	13.5	20.25	27
Remoulage	16	15	14	10	08
Soya bean cake	07	07	08	08	10
Fish meal	03	04	05	08	08
Palm kernel	06	05	05	05	06
Oyster shell	07	07	07	05	07
Bone meal	02	03	02	05	02
Layer concentrate	05	05	05	05	05
Total	**100**	**100**	**100**	**100**	**100**
Calculated bromatoltogical composition					
Energy (Kcal/kg)	2796	2769	2779	2731	2719
Protein (%)	16.68	16.04	16.07	16.42	16.32
Fat content	3.89	3.59	3.33	3.14	2.77
E/P ratio	167.63	172.63	172.93	166.32	166.61
Lysine	0.75	0.75	0.79	0.87	0.88
Methionine	0.29	0.29	0.29	0.31	0.30
Calcium	4.16	4.60	4.38	4.95	4.70
Phosphorus	0.89	1.07	0.96	1.56	1.09

The various diets were then pelletized to 6 mm in diameter at 80°C for five minutes, allowed to cool down, dried

and solidified by simple air exposure, then packaged into pre-labelled bags and stored in a dry environment.

The pens were disinfected using the conventional protocol in force in poultry farms in Cameroon, and the floor covered with a deep litter of wood shaving. Water and feed were offered *ad libitum*, and each pen was provided with laying nests. The prophylaxis plan was then applied to layers. The adaptation period lasted for 3 weeks, during which chickens received the control pelleted diet.

The initial weight of the chicken were taken at the beginning of the experiment, the feed given was weight and the left over quantified at the end of the week. Weekly determination of feed intake, feed conversion ratio, feed efficiency and body weight gain was carried out. The parameters evaluated concerned the proximate analysis of the diets and digestibility, late growth performances, carcass and haematological characteristics.

Data collected were analysed using Microsoft excel and GraphPadInStat version 3.10. They were submitted to the Analysis Of Variance for the comparison of means, and Duncan multiple range test for separation of these means in case of significant difference.

RESULTS

Proximate Analysis of Experimental Diets, Sweet Potato and Cassava Meal

Table 2 presents the proximate analysis of the experimental diets, cassava and sweet potato meals. The proximate analysis of the various formulated diets had a fairly similar metabolizable energy for all the diets, except D4 that was lower than expected. The protein varied slightly within a narrow range (10.02 to 12.93%). Meanwhile, ash content gradually increased from D1 to D5. Lipid and crude fibre content had no constant trend across the diets as the levels of inclusion increases.

The proximate analysis of dropping samples of chickens from the various experimental treatments are presented in Table 3.

The analysis on the chicken droppings shows a general drop in metabolizable energy, lipids and crude protein in the faeces from DSD1 (0%) to DSD5 (100%). Meanwhile crude fibre was fairly constant from throughout all the CASPM inclusion levels, except it content which slightly raised to 13.39% in DSD3 (50%). Ash content had a constant increase from DSD1 to DSD5.

Digestibility of Test Diets

The apparent digestibility in Kabir chicken fed test diets containing graded levels of cassava-sweet potato meal as energy substitute for maize is presented in Table 4.

The apparent digestibility of metabolizable energy was found to be positive, indicating digestion taking place, and increasing across the diets, with DSD5 and DSD3 being the highest respectively. Lipids apparent digestibility gave a negative value for DSD1, showing lipids being excreted,

Table 2: Proximate analysis of experimental diets (D1, D2, D3, D4 and D5), cassava and sweet potato meals

Experimental diet	DM %	Crude Protein (%DM)	Lipids (%DM)	Crude Fibre (%DM)	Ash (%DM)	Metabolizable Energy (kcal/kg DM)
D1 (0%)	91.29	11.21	0.72	3.98	15.29	3013.3
D2 (25%)	90.66	12.93	4.60	6.15	15.73	3013.9
D3 (50%)	91.11	10.02	2.13	4.77	15.29	3019.9
D4 (75%)	91.61	10.90	0.73	7.76	16.83	2615.7
D5 (100%)	92.80	11.84	3.25	4.27	17.01	3055.0
Sweet Potato meal	86.10	4.63	1.74	8.31	5.60	3080.1
Cassava meal	89.45	9.74	1.17	4.89	2.31	3486.6

Table 3: Proximate analysis of droppings of chickens from the experimental treatments containing graded levels of cassava-sweet potato meal as energy substitute for maize

Dropping Samples	DM %	Crude Protein (% DM)	Lipids (% DM)	Crude Fibre (% DM)	Ash (% DM)	Metabolizable Energy (kcal/kg DM)
DSD1 (0%)	91.76	17.02	2.85	11.30	28.66	1934.4
DSD2 (25%)	91.01	13.29	1.40	11.07	36.62	1551.1
DSD3 (50%)	90.39	13.60	1.49	13.39	42.08	1127.5
DSD4 (75%)	91.06	15.12	0.44	10.71	40.50	1372.6
DSD5 (100%)	90.78	12.71	0.99	11.80	45.03	1120.9

Table 4: Apparent digestibility (%) of Kabir chicken fed test diets containing graded levels of cassava-sweet potato meal as energy substitute for maize

Dropping Samples	Crude Protein (%DM)	Lipids (%DM)	Crude Fibre (% DM)	Ash (%DM)	Metabolizable Energy (kcal/kg DM)
DSD1 (0%)	-51.83	-295.83	-183.92	-87.44	35.80
DSD2 (25%)	-2.78	69.57	-80.00	-132.87	48.54
DSD3 (50%)	-35.73	30.05	-180.71	-175.21	62.66
DSD4 (75%)	-38.72	39.73	-38.02	-140.64	47.52
DSD5 (100%)	-7.35	69.54	-176.35	-164.72	63.31

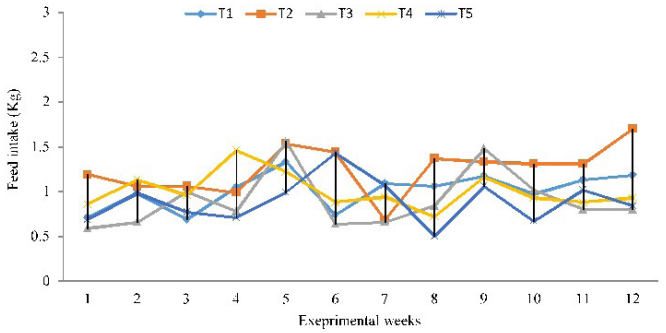

Figure 1: Evolution of weekly feed intake of Kabir chickens fed test diets containing graded levels of cassava-sweet potato meal as energy substitute for maize

Table 5: Feed conversion ratio of Kabir chickens fed test diets containing graded levels of cassava-sweet potato meal as energy substitute for maize

Parameter	Weight gain-based feed conversion ratio				
	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	T5 (100%)
FCR	2.49	2.89	1.89	3.7	2.13

while the rest of the treatments had a positive value with DSD2 and DSD5 having the highest and almost similar values. Crude protein was negative across all the experimental treatments, DSD1 having the highest amount of excreted crude protein, followed by DSD4, DSD3, DSD5 and DSD2, respectively. Ash and crude fibre were both negative across all the experimental treatments, with ash having an increased abundance in faeces across the experimental treatments.

Growth Performances of Kabir Chickens

Feed Intake: The average weekly feed intake (test diets containing graded levels of cassava-sweet potato meal as energy substitute for maize) as shown in Figure 1 was found to vary within a narrow range of 0.5-1.5 kg, with lesser feed intake at the beginning which increases with time across the treatments.

In general, though the feed intake was fluctuating in all the groups and along the weeks, animals fed T2 presented the overall higher feed intake, followed by T1, while animal fed T3 and T5 generally showed less feed intake.

Feed Conversion Ratio: Table 5 showing the feed conversion ratio, it is observed that T3 had a better feed conversion ratio than the other treatments.

T4 was found to have the lowest weight gain-based feed conversion ratio followed by T2, T1 and T5. Though Kabir chickens were at their plateau stage of growth, they were still found to have better weight gain-based feed conversion ratio than the traditional local chickens.

Growth Evolution: The evolution of growth curve in Kabir chickens fed test diets containing graded levels of cassava-sweet potato meal as energy substitute for maize illustrated by Figure 2.

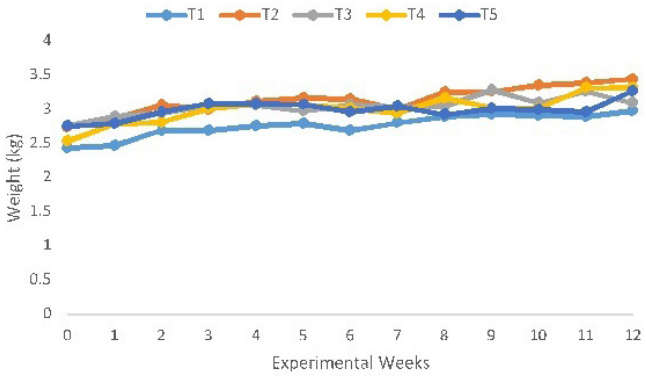

Figure 2: Growth curve evolution in Kabir chickens fed test diets containing graded levels of cassava-sweet potato meal as energy substitute for maize

Table 6: Mortality of Kabir chicken fed test diet containing graded levels of cassava-sweet potato meal as energy substitute for maize

Parameters	Mortality				
	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	T5 (100%)
Number of birds at start	8	8	8	8	8
Number of dead recorded	1	1	0	2	1
Mortality rate (%)	12.5	12.5	0	25	12.5

The evolution of the growth curve indicates that at this phase of their growth, animals from all the treatments have slow steady growth. The slow steady growth across the ex-

perimental treatments is indicative that the Kabir chickens are attaining their plateau stage of curve in the growth curve.

Mortality Rate: The mortality of Kabir chicken fed test diets containing graded levels of cassava-sweet potato meal as energy substitute for maize are presented in Table 6.

T3 recorded no mortality. Meanwhile T4 recorded the highest mortality at week 8 and week 11 successively. T1, T3 and T5 recorded mortality each at week 7, 8, and 12, respectively.

Carcass Parameters of Kabir Chickens

Kabir Chickens fed test diet containing graded levels of cassava-sweet potato meal as energy substitute for maize. The mean weight of the carcass and its associated organs was noted at the end of the trial and summarised in Table 7.

Form the analysis of Table 7, the rosters have higher carcass weight than the hens. Meanwhile, the hens had a higher liver to carcass ratio as well as abdominal fats compared to the rosters across the treatments. All the other organs were found to fall within narrow limits with no significant differences.

Haematological Parameters of Kabir Chickens

Haematological indices that were assessed are presented in Table 8. The RBC count was averagely low for T5 (especially for rosters), followed by T2 (low for the Hen), then by T1, T3 and T4, with averagely higher levels. The Hen for T4 had unusually high RBC count than observed for all the treatments.

Table 7: Carcass analysis of Kabir chicken fed test diets containing graded levels of cassava-sweet potato meal as energy substitute for maize

Organs	Treatments and sex									
	T1 (0%)		T2 (25%)		T3 (50%)		T4 (75%)		T5 (100%)	
	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
Live weight(g)	2450	3125	2450	3800	2450	4375	2800	4000	2750	3575
Carcass weight %	67.35	82.4	71.43	80.26	68.37	81.14	66.96	81.88	72.73	75.52
Kidney %	0.57	0.37	0.37	0.38	0.56	0.34	0.57	0.41	0.46	0.38
Heart %	0.46	0.61	0.46	0.53	0.41	0.59	0.35	0.57	0.45	0.47
Gizzard %	1.75	1.06	1.11	0.81	1.68	0.92	1.01	1.16	1.33	1.15
Liver %	2.56	1.09	2.26	1.11	2.05	0.93	2.19	1.13	1.81	0.98
Spleen %	0.17	0.11	0.21	0.10	0.13	0.09	0.07	0.13	0.14	0.10
Lungs %	0.39	0.52	0.38	0.47	0.31	0.40	0.31	0.40	0.39	0.61
Proventriculus %	0.62	0.21	0.65	0.23	0.30	0.24	0.42	0.26	0.40	0.27
Abdominal fats %	3.04	0.36	4.08	1.35	3.20	2.24	6.54	0.03	5.42	0.76

Table 8: Haematological analysis of Kabir chicken fed test diets containing graded levels of cassava-sweet potato meal as energy substitute for maize

Parameter measured	Treatments and sex									
	D1 (0%)		D2 (25%)		D3 (50%)		D4 (75%)		D5 (100%)	
	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
RBC (x10^6/mm^3)	2.405	4.205	1.9	3.9	2.6	4.04	4.695	2.22	2.62	2.69
HGB (g/dl)	12.55	24.95	9.5	21.95	13.7	23.95	15.8	12.3	13.2	13.45
HCT (?)	31.8	56.05	24.3	52.8	34.1	58.9	65.25	30.5	32.9	32.95
MCV	132.6	133.55	128.4	135.65	131.3	146.1	137.45	137.6	125.6	122.9
MCH	52.15	59.2	50	56.15	52.6	59.15	54.8	55.4	50.3	50.2
MCHC	39.4	44.4	39	41.45	40.1	40.7	41.2	40.3	40.1	40.8
PLT	6	74.5	12	33	17	72.5	52	8	0	11.5

RBC: Red Blood; **HGB:** Haemoglobin; **HCT:** Haematocrit level; **MCV:** Mean Cell Volume; **MCH:** Mean Corpuscular Haemoglobin; **MCHC:** Mean corpuscular haemoglobin concentration; **PLT:** Platelets

The cost analysis of the various experimental diets containing graded levels of cassava-sweet potato meal as energy substitute for maize are presented in Table 9.

Table 9: Cost analysis of the various experimental diets containing graded levels of cassava-sweet potato meal as energy substitute for maize

Parameter	Experimental diets				
	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	T5 (100%)
Cost/kg in FCFA	214.74	262.72	310.50	364.16	408.60

According to the cost analysis of the various formulated diets, T1 was found to be the cheapest of the formulations. The cost was found to increase steadily across the formulations as the level of substitution of maize by cassava and sweet potato meal increased. T5 was found to be the most expensive of all the formulations. Hence, the substitution for maize by cassava and sweet potato meal was not economical for Kabir chicken production for the period of study. However, it is worth noticed that during and immediately after the harvesting period of a of cassava and potato, the situation was totally inverted, suggesting that cassava and sweet potato should preferably be used during abundance, or stocked during that period for later use.

DISCUSSION

In this study, sweet potato and cassava meal had a lower metabolizable energy than that stated by Heuzé et al. (2015). Meanwhile, the crude protein was found to be the same as mentioned by these authors. Comparatively to the same research outcomes, this study revealed that crude fibre, lipids and ash content of the sweet potato meal were higher, Cassava meal had lower ash content than expected, but had higher protein content, ash and lipids content than what stated earlier by Heuzé et al. (2015). The differences found in the tubers used as compared to literature results may have numerous origins that could be intrinsic or extrinsic to the genetic makeup of the tubers. In fact Schoeninger et al. (2000) mentioned that irrespective of season and presence of above-ground foliage, the age of the tuber may be an important factor as older tubers have a higher fraction of inedible material.

Feed intake was found to increase across the treatments with increased level of substitution for maize with cassava-sweet potato meal. This is opposed to Salami and Odunsi (2003), Anaeto and Adighibe (2011) and Kana et al. (2013) who reported a decrease feed intake with increased level of inclusion of similar test diet. However, it should be mentioned that an important aspect suggested to have favoured increase feed intake was the fact that the feed was pelleted, meanwhile with studies by Salami and Odunsi (2003), Anaeto and Adighibe (2011) and Kana et al. (2013), mash feed was used. Indeed, Munt et al. (1995) and Preston et al. (2000) mentioned the advantages of pelleted feed on feed intake and growth performances in chicken.

Metabolizable energy intake was found to increase in the substituted diets with the control diet having the lowest intake. This is contrary to the observation by Aina and Fanimo (1997) in which inclusion of cassava meal in the diet of layer birds significantly reduced metabolizable. Crude protein intake was also found to increase with cassava-sweet potato meal substituted diets, while the control diet had the least crude protein intake. This disagrees with Aina and Fanimo (1997) where no significant difference in crude protein intake of layer birds fed sweet potato and cassava meal was observed. Lipid intake for this experimental trial was found to increase with cassava-sweet potato substitution. The increase in apparent digestibility of organic nutrients of pelleted feed is in accordance with Zelenka et al. (2003) who observed higher apparent digestibility with pelleted feed as oppose to mash feed (with crude fat being highly significant).

In general, T5 recorded the highest digestibility closely followed by T3, then T2, T4 and T1 with the least of them all. An increase in digestibility across the experimental treatments was observed, indicating that digestibility increased with increase substitution of maize by cassava-sweet potato meal. This is supported by Heuzé et al. (2015) who stated that cassava and sweet potato meal are much more dusty and soluble than maize, hence cassava and sweet potato meal diets are digested faster than maize diets (confirm in this study by T5 achieving the highest digestibility). Therefore, to achieve better digestibility in Cameroon Kabir chickens production, T5 (100% substitution) and T3 (50% substitution) are recommended according to this experimental trial.

The growth study of all the experimental treatments showed no statistical difference in growth amongst the treatments. This confirms the fact that Cameroon Kabir chickens used were at their plateau stage of growth. This is in accordance with what was reported by INRA (1989) who confirmed the fact that most of the nutrients assimilated at this stage are principally oriented for body maintenance and less for growth.

Weight base FCR indicates that T3 had a better FCR followed by T5, T1, T2 and T4. Meanwhile, egg base FCR showed better FCR for all cassava-sweet potato substituted diets with the control diet having the poorest egg base FCR. This suggest that cassava-sweet potato meal substituted diets had better reproductive performances than the maize base diet (control diet). This differ from what was reported by Farooq et al. (2002) in which egg base FCR

was found to vary between 1.92-2.13 less than what was observed in this study.

The formulated test diet increased in cost per kg from 214.7 Fcfa for the control diet (T1) to 408.6 Fcfa for 100% substitution of maize with cassava-sweet potato meal (T5). This is in contrast to what was observed by Aderemi et al. (2006), Anaeto and Adighibe (2011), Kana et al. (2013) and Salami and Odunsi (2003) who all observed a decrease in the cost of formulated feed per kg as the percentage substitution of maize increased. This increase in cost shows that substituting maize with cassava-sweet potato meal for Kabir chicken production was not economical during the experimental period in Buea.

The RBC count ranges from 1.9-4.7($\times 10^6$ mm) with the hens having lower counts and rosters higher counts, which agrees with the study carried out by Bahman et al. (2011). The RBC count were all within accepted ranges for T1 and T3. T2 count levels where low, meanwhile the RBC count for T4 hens were abnormally high. Whereas, the blood count for T5 rosters were abnormally the same as those of hens.

Haemoglobin levels for the treatments were found to follow the same trend of variation as do the RBC count, T1 and T3 varying within acceptable ranges as discussed by Bahman et al. (2011) and Keambou et al. (2014).

HCT (Haematocrit level) for T4 hens were abnormally high above normal range display by T1, T3, and T5 hens whereas T2 and T5 rosters values were abnormally low. MCV (Mean Cell Volume in fl), MCH (Mean Corpuscular Haemoglobin in pg), and MCHC (mean corpuscular hemoglobin concentration) for T1 and T3 were within normal range. T2 was abnormally low together with T5 rosters. T4 values for both sexes were averagely the same and within range for hens. All the normal ranges were found to be in conformity with Adeyemo and Sani (2013) who witness increase in these blood parameters using hydrolyzed cassava peel meal diet.

From the carcass analyses results, hens from the various treatments had a higher % weight of kidney, gizzard, liver, spleen, proventriculus and abdominal fat than their corresponding rosters in the same treatment had a corresponding higher % weight of heart and lungs with respect to carcass. This is conformity to their respective physiological requirements. From the data obtained and analyzed, there were no abnormalities found within the treatments in relation to their carcass characteristics.

CONCLUSION

T5 (100% substitution) and T3 (50% substitution) had the highest digestibility and thus the diets are recommended for Cameroon Kabir chickens production. T3 (50% substitution) had the best weight base FCR meanwhile egg base FCR demonstrated the best performance with T4. The growth rate recorded from all the experimental treatments showed no statistical difference in growth rate amongst the treatments. Only T1 (control) was found to be economical important whereas the other substituted diets were expensive and not economical at the time period in Buea. T1 and T3 were found to have the best blood characteristics within the recommended range, 50% substitution of CSPM (T3) with no recorded mortality had no adverse effects on Cameroon Kabir chickens and thus recommended for Cameroon Kabir chickens production. This is also supported by the fact that no abnormalities were found upon carcass analysis of Cameroon Kabir chickens. Considering all that has being examined above, T3 (50% substitution of cassava-sweet potato meal) was found to yield better results for this experimental trial and thus is recommended for Cameroon Kabir chicken production in Buea.

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CONFLICT OF INTEREST

The authors declare no conflict of interest for this publication.

AUTHORS' CONTRIBUTION

Christian Keambou Tiambo, Raquel Soares Juliano and Frederico Oliviera Lisita are the co-leaders of the grant and have contributed in designing the experiment. Christian Tsitoh Vukiesu, Jean Paul Toukala and Annie Marie Yvonne Tedongmo executed the experiment at the farm level. Kenneth Ndamukong co-supervised the students research and all the other authors contributed in writing and editing the drafted publication.

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