Original Paper

Replacement value of cassava vinasse meal for maize on growth performance, haematological parameters and organoleptic properties of Japanese quails (*Coturnix japonica*)

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Article Details: Received: 2018-10-01 | Accepted: 2018-10-22 | Available online: 2019-01-31

https://doi.org/10.15414/afz.2019.22.01.7-12

Two hundred and twenty eight (228) one day old quails were used to assess the suitability of cassava vinasse meal (CVM) as a replacement for maize at varying inclusion levels of 0.0%, 5.0%, 10.0% and 15.0%. The birds were fed an adequate starter diet for the first week before being randomly alloted into 4 dietary group of 3 replicate of 19 birds each. The feeding trial lasted for six weeks. The crude protein, crude fibre, ether extract, ash, moisture, nitrogen free extract and metabolizable energy of the dehydrated cassava vinasse were 19.26%, 7.96%, 3.72%, 9.33%, 5.68% and 12.17 MJ kg^{-1} ME respectively. The results showed that final weight, average daily weight gain and feed conversion ratio were significantly (P <0.05) influenced as inclusion level of cassava vinasse meal increases. Significant differences were observed on the haematological parameters such as haematocrit and mean corpuscular volume (P <0.05). The analyzed panelist response on organoleptic parameters showed that tenderness, juiciness and texture were significantly different (P <0.05) with birds fed 10.0% CVM having the least values. In conclusion, 10.0% CVM (21% replacement for maize) in the diet of quails had no deleterious effect on the feed conversion ratio, haematological parameters and meat acceptability. Moreover, further research could be geared towards the use of exogenous enzymes and the performance of other poultry species including broiler chicken.

Keywords: blood, cassava, quail, sensory properties, vinasse

1 Introduction

Vinasse is a by-product of the ethanol industry (Hidalgo, 2009). The demand for ethanol has resulted in the use of various feed stocks ranging from starch and sugars crops, and lignocellulosic biomass (Farrell et al., 2006; Hahn-Hägerdal et al., 2007; Mabee, 2007; Okano et al., 2010). Unfortunately, commercial viability of converting lignocelluloses to ethanol is still at the infant stage. Apart from the use of ethanol in pharmaceuticals, liquor, industrial solvents like paints and food industries, the use as biofuel has further heightened the demand. This is because fossil energy crisis and its related global environmental impacts have resulted in an urgent search for renewable energy sources (Kerr, 2007), and bioethanol is currently the most widely used, as it can replace liquid petroleum and thus help reduce greenhouse-gas pollution. Renewable Fuels Association (2016) reported that global fuel ethanol production increased from 49,676 million litres in 2007 to 97,217 million litres in 2015.

Cassava tubers accumulate starch and this makes it one of the richest fermentable substances for the production of ethanol. Although and Onabolu (1999) reported that cassava is the third largest source of carbohydrate class of food for human consumption in the world. According to Ajibola et al. (2012), cassava tuber contains starch with 30% of fermentable properties, which appears to hold more benefits when used for industrial ethanol production.

Nevertheless, vinasse pollutes the environment (Hui and Shuri, 2013). Tolmasquim (2007) reported that 58% of total ethanol production comes from cassava materials. This implies that more cassava vinasse will be generated. However, inadequate knowledge of the vinasse properties and mode of utilization in agriculture needs urgent investigation, since vinasse posses a great threat to underground water and other water sources. Overtime, vinasse had been disposed directly to the flowing water and these affects water quality, ecosystem

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and human health; also only few countries have improved upon these issues by making stringent amendments, while many countries have a long way to go about it (EPA, 2012).

Therefore, rather than vinasse becoming an environmental nuisance, the economic use as feed needs to be researched, which form the basis for this study.

2 Material and methods

2.1 Site of the Experiment

The experiment was carried out at the Poultry unit of the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo State.

2.2 Experimental Birds and Management

Two hundred and twenty eight (228) one day old quails of mixed sexes were purchased from VOM research institute outreach, Ikire, Osun state. On arrival, the birds were rapidly but gently unloaded into a pre-warmed pen and anti-stress solution was given. The birds were fed an adequate starter feed for the first week, thereafter they were randomly allotted into 4 dietary treatment group of 3 replicate of 19 birds each. The feeding trial lasted for six weeks.

2.3 Collection of Test Ingredients

The ingredient was sourced from a research institute in Ogbomoso. It was collected in the liquid form but was dehydrated at 85 °C until constant weight was obtained. It was then milled and referred to as Cassava vinasse meal.

2.4 Experimental Diet

A maize-soyabean based diet served as the control (T_1). Cassava vinasse meal was used to replace maize at 5%, 10% and 15% inclusion level (weight for weight) in diets T_2, T_3 and T_4 respectively. The quails were fed conventional diet for one week before introducing the test diet. The birds were offered feed and water *ad libitum* throughout the duration of the experiment.

2.5 Data collection and analysis

2.5.1 Proximate and energy composition

Proximate analysis was determined using the procedure of AOAC (2000) while the energy composition was calculated using the formulae M.E (kcal kg^{-1} = 37 × %CP + 81.1 × %Fat + 35 × %NFE (Pauzenga, 1985) before being expressed in mega joule (MJ).

2.5.2 Growth performance

Growth performance indices were monitored. The following data were collected during the study; Average daily feed intake (ADFI) (g bird day^{-1}) = total feed intake / (number of birds x number of days); Average daily gain (ADG) (g bird day^{-1}) = (final weight gain-initial weight) / number of days; Feed conversion ratio (FCR) = total feed intake (kg)/total weight gain (kg).

Table 1 Composition of the experimental diets

Ingredients (%)	T_1	T_2	T_3	T_4
Maize	48.60	43.60	38.60	33.60
Wheat offal	2.00	2.00	2.00	2.00
Soyabean meal	32.50	32.50	32.50	32.50
Csaasava vinasse	0.00	5.00	10.00	15.00
Fishmeal	12.90	12.90	12.90	12.90
Limestone	1.35	1.35	1.35	1.35
Bone meal	2.00	2.00	2.00	2.00
Salt	0.20	0.20	0.20	0.20
Premix	0.25	0.25	0.25	0.25
DL-Methionine	0.10	0.10	0.10	0.10
L-Lysine	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00
Calculated Nutrients				
Crude Protein (%)	27.13	27.64	28.16	28.67
ME (MJ kg^{-1})	12.36	12.39	12.40	12.46
Crude Fibre (%)	3.38	3.68	3.98	4.28

ME = Metabolizable Energy

2.5.3 Haematological profile

On the 42nd day of the experiment, two birds were randomly selected from each replicate and blood samples were collected into ethylene diamine tetra-acetate (EDTA) bottles from the jugular vein of the birds through the use of sterilized needles and syringes and subjected to laboratory analysis for determination of haematological parameters and plasma proteins. Blood parameters such as Red Blood Cell (RBC) count and White Blood Cell (WBC) counts, haematocrit/Packed Cell Volume (PCV), Haemoglobin (Hb) content, absolute differential leucocyte counts namely neutrophil, eosinophil, lymphocyte, monocytes and basophil values were determined using the methods described by Ojediran and Emiola (2018) while Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Heamoglobin Concentration (MCHC) values were calculated using standard formulae described by Ojediran et al. (2015).

2.5.4 Organoleptic properties

Meat samples were taken from the breast of the quails used for haematological analysis. Sensory evaluation involved 10 untrained panellists but usual meat consumers. Sensory evaluation was carried out on colour, flavour, tenderness, juiciness and overall acceptability of the breast meat samples from each slaughtered birds per replicate on a nine point hedonic scale (1 = dislike extremely, 9 = like extremely) (Price and Schweigert, 1971).

2.6 Experimental design and statistical analysis

All data collected was subjected to analysis of variance in a completely randomized design using SAS (2000) software package and means was separated using Duncan multiple range test (Duncan, 1955) of the same package. Significant differences were at less than 5% probability level (p <0.05).

3 Results and discussion

The nutrient composition of cassava vinasse is as shown on Table 2. According to Marional et al. (2006) vinasse is consisting basically of water (93%). The vinasse used in this experiment was dehydrated before analyzing for the proximate composition. This may be responsible for the crude protein and metabolizable energy recorded. Meanwhile, Ahmed et al. (2013) reported that Sugarcane vinasse contained high moisture content (82.27%), ash (10.60%), proteins (6.20%), and very low carbohydrates content (0.93%). However, yeast residues will lead to the presence of amino acids and proteins in the wastewater, while, the wine characteristics depend mostly on the preparation, alcoholic fermentation system, types of yeast, distillation and separation. On the other hand, the chemical composition of ethanol vinasse is variable and depends on raw materials (Ahmed et al., 2013).

Table 2 Nutrient composition of cassava vinasse

Parameters (%)	
Moisture	5.68
Crude protein	19.26
Crude fibre	7.96
Ether extract	3.72
Ash	9.33
Nitrogen free extract	54.06
Metabolizable energy (MJ kg^{-1} ME)	12.17

The growth performance of quails fed varying inclusion levels of cassava vinasse meal (CVM) is presented in Table 3.The result shows that final weight (FW), average daily weight gain (ADWG) and feed conversion ratio (FCR) were significantly (p <0.05) affected as inclusion level of cassava vinasse meal increased. A linear decrease was observed in FW and ADWG as the inclusion level increases. The FW was higher in T_1 and lowest in T_4. This is also similar for ADWG in birds fed T_1 and T_4. A non-

Table 3 Growth parameters of Japanese quails fed varying levels of cassava vinasse meal

Parameters	T_1	T_2	T_3	T_4	SEM
IW (g b^{-1})	27.17	27.29	28.05	28.17	0.73
FW (g b^{-1})	152.87^{a}	144.02^{b}	140.91^{bc}	136.88^{c}	1.83
ADWG (g b d^{-1})	3.59^{a}	3.32^{b}	3.22^{bc}	3.10^{c}	0.06
ADFI (g b d^{-1})	18.08	17.95	18.42	18.69	0.20
FCR	5.05^{b}	5.41^{ab}	5.71^{ab}	6.02^{a}	0.14

abc – means on the same row with different superscripts are significantly different (p < 0.05)
IW – initial Weight, FW – final weight, ADWG – average daily weight gain, ADFI – average daily feed intake, FCR – feed conversion ratio, g b d^{-1} – gram per bird per day

significant increase was observed in ADFI from those fed T_1–T_4 (p >0.05). The FCR was seen to have a linear increase (p <0.05) with increasing inclusion level from T_1 to T_4. Birds fed T_1 had the least FCR which is significantly different (p <0.05) from those fed T_4 but comparable to birds fed T_2 and T_3. The significant linear decrease in weight as the cassava vinasse increases is contrary to the report of Agugu and Okeke (2005) when cassava root meal diet was fed to pullet chicks. Observation on the feed intake is in contrast of what was reported by Edache et al. (2005), when graded levels of yam peel was fed to quails but agreed with those of Guluwa et al. (2014) who reported no significant difference for Japanese quails fed graded levels of water soaked sweet oranges peel meal. The increased feed intake may be due to the need to meet up their energy requirement as observed by Akinfala et al. (2002) when intake increases as the level of cassava meal increases in broiler starter diets. Observation on the feed conversion ratio conform to the report of Guluwa et al. (2014).

Table 4 shows the haematological parameters of quails fed varying inclusion levels of cassava vinasse meal. Significant differences were observed on some of the haematological parameters such as haematocrit (HCT) and Mean corpuscular volume (MCV) (p <0.05). A significant linear decrease was observed in the HCT values. Birds fed T_1 had the highest value while the birds fed T_4 had the lowest value. MCV was observed to have a linear increase from T_1 to T_2 but showed a decrease from T_2–T_4. The haematological parameters showed that the birds were not anaemic and the immune system was not compromised. The non significant high values of WBC are indicative of the fact that they are capable of generating antibodies by the process of phagocytosis and have high degree of resistance to diseases (Soetan et al., 2013) and enhanced adaptability to local environmental and disease prevalent conditions (Iwuji and Herbert, 2012). The HCT values reported in this study could be attributed to cassava vinasse meal (Chineke et al., 2006). MCV, MCH and MCHC are red blood cell indices. The MCV shows the size of the red blood cell (Dacie et al., 1995). In most instances, a reduction in the value of MCV occurs in severe iron deficiency and is a fairly specific indicator of iron deficiency once thalassemia and the anaemia of chronic disease have been excluded (Aina and Ajibade, 2014).

The analyzed panellist response on organoleptics of quails fed cassava vinasse meal is shown in Table 5. Tenderness, juiciness and the texture were significantly different (p <0.05). The tenderness score ranges from 4.86 (T_3) to 6.86 (T_1) while juiciness recorded 6.57, 6.14, 4.57 and 4.57 in birds fed T_1–T_4 respectively unlike 5.14, 7.00, 4.71 and 5.29 for birds fed T_1–T_4 respectively for texture. The significant panellists result on tenderness, juiciness and texture shows that consumer preference was adversely influenced unlike the result of Ojediran and Emiola (2018), although, the meat colour or appearance goes a long way to influence the consumer preference. Consumers reject products in which the colour departs from the normal appearance (Qiao et al., 2001). However, colour of meat depends upon the pigment changes that take place during cooking (Price and Schweigert, 1971). According to Lawrie (1998), flavour could be influenced with the age of the animal while juiciness depends largely on the fat content of the carcasses (Lawrie, 1998). Intramuscular fat and water holding capacity of

Table 4 Haematological parameters of quails fed varying levels of cassava vinasse meal

Parameter	T_1	T_2	T_3	T_4	SEM
WBC (*10^9 l^{-1})	236.80	259.17	261.37	262.87	7.59
LYMPH# (*10^9 l^{-1})	117.87	118.60	112.27	119.43	0.75
GRAN# (*10^9 l^{-1})	32.80	31.13	31.60	31.60	0.34
HGB (g dl^{-1})	14.87	15.80	15.20	15.63	0.39
RBC (*10^{12} l^{-1})	2.84	3.22	3.84	3.85	0.28
HCT (%)	71.40^a	65.43^b	65.10^b	63.53^b	1.10
MCV (fl)	151.37^b	186.43^a	176.00^{ab}	173.37^{ab}	5.10
MCH (pg)	44.87	44.90	44.90	42.97	0.87
MCHC (g dl^{-1})	24.43	24.10	24.27	24.77	0.13
PLT (*10^9 l^{-1})	83.77	80.33	52.33	87.67	13.09
MPV (fl)	10.10	10.73	9.33	9.57	0.26

abc – means on the same row with different superscripts are significantly different (p <0.05)
WBC – white blood cells, LYMPH – lymphocytes, GRAN – granulocytes, HGB – haemoglobin, RBC – red blood cells, HCT – haematocrit or packed cell volume (PCV), MCV – mean corpuscular volume, MCH – mean corpuscular haemoglobin, MCHC – mean corpuscular haemoglobin concentration, PLT – platelets, MPV – mean platelet volume

Table 5 The organoleptic indices of quail meat fed varying inclusion levels of cassava vinasse meal

Parameters	T_1	T_2	T_3	T_4	SEM
Colour	5.86	6.29	6.14	4.57	0.34
Flavour	3.29	4.00	3.57	4.14	0.24
Tenderness	6.86^{a}	6.43^{ab}	4.86^{b}	6.14^{ab}	0.27
Juice	6.57^{a}	6.14^{ab}	4.57^{b}	4.57^{b}	0.32
Texture	5.14^{ab}	7.00^{a}	4.71^{b}	5.29^{ab}	0.35
Over all	6.71	6.71	6.14	6.43	0.22

ab – means on the same row with different superscripts are significantly different (p <0.05)

meat is directly related to juiciness. Akinwunmi et al. (2013) reported that quail meat has the least water loss during cooking compared to other poultry birds which makes it more juicy and tender than others. This might be responsible for the significant effect on tenderness, texture and juiciness. Abu et al. (2015) recorded that the organoleptic values such as: juiciness, taste, colour and overall acceptability were influenced for birds fed cassava peels and leaf meal as replacement for soya bean meal up to 20% inclusion level.

4 Conclusions

In conclusions, 10.0% CVM (21% replacement for maize) in the diet of quails had no deleterious effect on the feed conversion ratio, haematological parameters and meat acceptability. Moreover, further research could be geared towards the use of exogenous enzymes and the performance of other poultry species including broiler chicken.

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