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Millet and Sorghum as Possible Dietary Energy Sources in the Diet of Japanese Quails

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Abstract: An experiment was conducted to assess the effect of millet and sorghum as alternatives to maize. on performance and egg production parameters of quails. Three hundred (300) day old quails were sourced form National Veterinary Institute Jos. The birds were brooded for two weeks and randomly allotted to three (3) different energy sources i.e. maize, millet and sorghum designated as treatment 1, 2 and 3 respectively. The birds were fed with experimental diets for six months. Results showed daily feed intake (68.35-79.86), daily weight gain (3.41-3.43) and feed conversion ratio (3.33-3.91) were not affected by the different energy sources (P>0.05). Most of the carcass parameters were statistically similar (P>0.05). The hen day egg production (80.21-84.51) and egg production parameters were not affected by the alternative energy sources (P>0.05), similarly hematological parameters showed that packed cell volume (50.20-56.00), red blood cells (4.72-5.21) and hemoglobin (16.98-18.38) were statistically similar (P>0.05). The serum biochemical parameters showed that total protein (36.20-39.80), globulins (11.60-14.44), total protein (36.20-39.80), glucose (12.68-14.82), cholesterol (5.36-6.78), urea (17.80-20.00) and ASAT (1.98-2.08) were not affected by the different energy sources (P>0.05). I It can be concluded that millet and sorghum can be alternative energy sources in quail production in semi-arid environment of Gashua Yobe state with reduction in cost of production.

Keywords: Quails Production, Energy Sources, Performance, Egg Production Parameters

1. Introduction

Nigerian livestock industry has been greatly affected by high cost of feed which is reported to account for 60-80% of the total cost of monogastric production [15]. This high cost of feeds has necessitated the search of alternative energy sources. Maize is the major source of energy in poultry feeds and energy constitute about 40% of the feed cost in livestock production [8]. Therefore, any cereal can be alternative to maize in poultry feed industry and could be the only immediate solution to reduce cost of poultry production. The aim of this research work is to evaluate the use of millet and sorghum as alternative energy sources on growth performance, carcass characteristics and egg production parameters of Japanese quails in semi-arid environment of Gashua, Yobe state.

2. Materials and Methods

2.1. Study Area

The study was conducted in teaching and research farm of Federal University Gashua, Yobe State. Bade local government lies between latitude 10° and 11° east of Greenwitch and longitude 13° and 12° north of equator [13].

2.2. Sources and Processing of Ingredients

The millet and sorghum were purchase in Bade Central Market. The supplements were purchase from animal care Kano state. The millet and sorghum were used to formulate the experimental diets which are isonitrogenous and isocaloric, the composition of the experimental diets are shown in Table 1.

2.3. Experimental Birds and Management

Three-hundred-day old quail chicks were sourced from National Veterinary Research Institute Vom, Plateau State. The birds were brooded for one week. The birds were randomly allotted to three dietary treatments, there are one hundred birds per treatment replicated five times (twenty birds per replicate) in a completely randomized design (CRD). The experiment lasted for twenty weeks.

2.4. Feed Intake and Live Weight Gain

A given quantity of feed was measured and fed to the birds on a weekly basis. From which weekly feed intake was measured. Daily feed intake and total feed intake were determined. The birds were weighed in the early morning before receiving any feed and water using a weighing balance at weekly intervals during the experimental period. Initial and final body weights of the Japanese quails were measured at the beginning and end of the experiment respectively. Mortality was recorded as it occurred.

2.5. Carcass Evaluation

At the end of the growing period carcass evaluation was carried out using three quails around the average live body weight of each treatment. The quails were fasted, then individually weighed to the nearest gram, and slaughtered by severing the jugular vein. Few minutes after bleeding, each bird was dipped into a hot water bath for two minutes, and feathers were removed by hand. After the removal of head, the carcasses were eviscerated manually, they were then weighed to obtain carcass weight. Dressing percentage was determined. Weights of different parts of the gut were measured using a digital scale and recorded.

2.6. Egg Production

Female Japanese quails from growth were used for this experiment. The birds were reared in constructed cages. Feed and water were provided ad libitum. The birds were fed with layers mash from the 8th week until when they were 20 weeks of age (laying period). The percentage composition of the feed fed to laying quails is shown in Table 2.

2.7. Egg Production

Hen day egg production was calculated using the formula below

Hen day production (%)=No. of eggs laid a day x 100

No. of birds available that day

2.8. Determination of Egg Quality Parameters

Five fresh eggs were randomly picked each day from each replicate fortnightly starting from the 10th week to determine the egg quality parameters. The parameters determined were:

2.8.1. Egg Weight

The eggs were weighed using a sensitive electronic scale to the nearest 0.01g.

The values were used to calculate the average weight of an egg per replicate.

2.8.2. Albumen Weight, Yolk Weight and Shell Weight

Albumen weight and yolk weight were measured for individual egg to the nearest 0.01g using a sensitive electronic scale. Shell weight was also measured after sun drying to remove moisture.

2.8.3. Shell Thickness

Shell thickness was measured for individual sun dried egg shells to the nearest 0.01mm using a micrometer screw gauge.

2.8.4. Egg Haugh Unit

The haugh unit values for each replicate using the formula outlined by Haugh [7].

$$HU=100\log10\ (H - 1.7W0.37 + 7.6)$$

Where HU=Haugh unit
H=observed height of the albumen in (mm)
W=weight of eggs in gram

Table 1. *Percentage composition of experimental diets fed to quails.*

Ingredients	T_1 Maize	T_2 Millet	T_3 Sorghum
Maize	52.03	00.00	00.00
Millet	00.00	52.03	00.00
Sorghum	00.00	00.00	52.03
Full fat soyabean	29.07	29.07	29.07
Wheat offal	10.00	10.00	10.00
Fishmeal	5.00	5.00	5.00
Bone meal	3.00	3.00	3.00
Lysine	0.20	0.20	0.20
Methionine	0.20	0.20	0.20
Salt	0.25	0.25	0.25
Premix*	0.25	0.25	0.25
Total	100.00	100.00	100.00
Calculated analysis			
Crude protein (%)	21.00	21.00	21.00
Metabolizable energy (kcal/kg)	2879	2745	2725

*Each kilogram contains Vit A 3600, 000 IU. Vit. D_3 600.000 IU. Vit E 4.000.000mg. Vit B_1-B_6 640, 1600, 600, 4.00mg. Panthothenic acid 2000mg, Biotin 300mg. Manganese 16000mg. Manganese 16000mg. Selenium80mg. Vit. K_3 600mg. Cobalt 80mg. Copper1200mg. Zinc 12,000mg. Folic acid 200mg. Choline chloride700000mg. Antioxidant 500mg.

2.9. Blood Profile Analysis

Ten [10] birds per treatment (i.e., two birds per replicate) were randomly selected, fastened overnight. Samples of blood were collected from the brachial vein using 1ml disposable syringe and needle, the blood were stored in a blood samples bottles with and without anticoagulant (EDTA). Blood samples were analyzed for hematological parameters according to routine available clinical methods described by Baker et al. [1]. The biochemical parameters were determined by biuret reaction expanded by Bush [4]. Data sets generated were subjected to analysis of variance ANOVA SPSSS 2010. LSD was used to separate the means.

Table 2. *Percentage composition of experimental diets fed to laying quails.*

Ingredients	Maize	Millet	Sorghum
Maize	70.46	00.00	00.00
Millet	00.00	70.46	00.00
Sorghum	00.00	00.00	70.46
Full fat soyabean	10.14	10.14	10.14
Wheat offal	10.00	10.00	10.00
Fishmeal	5.00	5.00	5.00
Lysine	0.20	0.20	0.20
Methionine	0.20	0.20	0.20
Bone meal	2.00	2.00	2.00
Limestone	1.5	1.5	1.5
Salt	0.25	0.25	0.25
Premix*	0.25	0.25	0.25
Total	100.00	100.00	100.00
Calculated analysis			
Crude protein (%)	16.00	16.00	16.00
Metabolizable energy (kcal/kg)	2700	2645	2625

*Each kilogram contains Vit A 3600, 000 IU. Vit. D_3 600.000 IU. Vit E 4.000.000mg. Vit B_1-B_6 640, 1600, 600, 4.00mg. Panthothenic acid 2000mg, Biotin 300mg. Manganese 16000mg. Manganese 16000mg. Selenium80mg. Vit. K_3 600mg. Cobalt 80mg. Copper1200mg. Zinc 12,000mg. Folic acid 200mg. Choline chloride700000mg. Antioxidant 500mg.

Table 3. *Growth performance of quails fed different energy sources.*

Parameters	T_1 Maize	T_2 Millet	T_3 Sorghum	SEM	P-value
Initial weight (g)	2.39	2.22	2.31	0.06	0.473
Final weight (g)	490.88	508.74	521.61	14.68	0.723
Daily weight gain (g)	3.41	3.43	3.41	0.04	0.981
Total feed intake (g)	69.59	68.35	79.86	4.03	0.539
Daily feed intake (g)	11.60	11.39	11.31	0.67	0.981
Feed conversion ratio	3.42	3.33	3.91	0.21	0.496
Mortality	2	0	2	0.09	0.52
Total cost (₦ per kg)	80.25	74.61	72.67	0.97	0.56
Cost per kg (₦ gain)	273.00	247.76	241.03	0.87	0.34

Table 4. *Carcass yield and gut characteristics of quails fed different energy sources.*

Parameters	T_1 Maize	T_2 Millet	T_3 Sorghum	SEM	P-value
Initial weight (g)	2.39	2.22	2.31	0.06	0.473
Final weight (g)	490.88	508.74	521.61	14.68	0.723
Slaughter weight (g)	468.50	467.85	501.88	14.81	0.598
Plucked weight (g)	453.88	448.76	482.14	14.91	0.650
Eviscerated weight (%)	61.15	58.42	58.97	1.15	0.628
Dressed weight (%)	57.59	53.09	52.94	1.23	0.224
Breast weight (g)	139.32	132.42	134.48	3.33	0.718
Thigh weight (g)	110.68	109.64	112.22	4.11	0.972
Drumstick	8.34b	9.14b	10.43a	0.32	0.012
Wings	27.78	29.84	29.48	1.14	0.762
Head	23.04	22.04	24.40	0.77	0.487
Neck	23.24b	27.92ab	31.62a	1.62	0.100
Liver	8.82	9.66	11.94	0.66	0.229
Gizzard	11.34	12.62	14.16	0.66	0.229
Small intestine	21.46	28.04	29.44	2.33	0.351
Heart	4.26b	4.99ab	5.32a	0.20	0.090
Lungs	4.66b	5.86ab	7.40a	0.46	0.033

Means bearing different superscripts were statistically different

Table 5. *Egg production parameters of quails fed different energy sources.*

Parameters	T_1 Maize	T_2 Millet	T_3 Sorghum	SEM	P-value
Initial weight (g)	2.39	2.22	2.31	0.06	0.473
Final weight (g)	490.88	508.74	521.61	14.68	0.723
Hen day (%)	80.21	84.51	82.11	4.13	0.63
Egg weight (g)	8.80	9.00	9.00	0.18	0.810
Egg length (cm)	3.06	2.92	2.99	0.06	0.668
Egg width (cm)	2.28	2.28	2.32	0.04	0.894

Parameters	T_1 Maize	T_2 Millet	T_3 Sorghum	SEM	P-value
Albumen weight (g)	1.96	2.34	2.80	0.19	0.214
Yolk weight (g)	3.36	3.48	3.24	0.20	0.906
Yolk height (cm)	1.30	1.30	1.36	0.003	0.696
Yolk colour	4	4	4	-	-
Shell weight (g)	0.63	0.67	0.61	0.02	0.319
Shell thickness (mm)	0.19	0.18	0.18	0.00	0.397

Table 6. *Hematological and serum biochemical parameters of quails fed different energy sources.*

Parameters	T_1 Maize	T_2 Millet	T_3 Sorghum	SEM	P-value
Packed cell volume (%)	53.80	56.00	50.20	1.40	0.246
Red blood cells (X 106/mm	5.21	4.91	4.72	0.49	0.321
Haemoglobin (g/dl)	17.49	18.38	16.98	0.45	0.482
MCH (fl)	103.26	114.05	106.36	1.56	0.214
MCH (pg)	0.33	0.32	0.33	1.22	0.078
MHCV (%)	32.51	32.82	33.82	0.56	0.065
Neutrophils	25.20^{b}	32.60^{a}	32.60^{a}	1.45	0.041
Lymphocyte	74.80	67.25	67.40	1.55	0.055
Albumin (g/100ml)	24.60	23.80	25.40	0.52	0.045
Total protein (g/100ml	36.20	37.80	39.80	0.82	0.480
Globulins	11.60	14.00	14.44	0.80	0.207
Glucose (mmol/l)	14.82	12.84	12.68	0.77	0.322
Chlorine	143.40	128.20	131.40	3.80	0.484
Potassium	8.38^{a}	4.83^{b}	4.18^{b}	0.65	0241
Cholesterol	5.36	6.34	6.78	0.29	0.006
Urea (µmol/l)	20.00	18.60	17.80	0.86	0.112
HCO_2	29.00^{a}	18.60^{b}	17.80^{ab}	0.86	0.112
Sodium	168.80^{a}	153.00^{b}	154.00^{b}	2.55	0.070
Calcium	3.20	3.36	3.00	0.07	0.006
AST (UI/L)	2.00	1.94	2.08	0.04	0.242
ALT (UI/L)	124.20^{a}	117.20^{ab}	108.80^{b}	2.64	0.266
ALP (IU/L)	38.80	36.00	32.00	1.06	0.044
TB	302.00	342.00	330.00	17.07	0.659
CB	15.48^{a}	8.38^{b}	10.82^{ab}	1.18	0.029

Means bearing different superscripts were statistically different

2.10. Data Analysis

Data collected were subjected to analysis of variance (ANOVA) using start view statistical package [14]. Where significant differences exist, least significant difference (LSD) was used to separate the means.

3. Results and Discussion

Table 3 showed the growth performance of quails fed different energy sources. The daily feed intake, daily weight gain and feed conversion ratio were not affected by the different energy sources (P>0.05) this indicated sorghum and millet can be alternative to maize, this reaffirms the earlier reports of Zakari et al. [17] who fed quails with diets containing varying levels of dietary energy and proteins and reported no significant difference in growth performance, similarly Seema et al. [16] fed different energy sources to broiler chickens as a replacement for maize and reported no significant difference (P>0.05) in daily weight gain, feed conversion ratio and final body weight. The similarities in growth performance of quails fed alternative energy sources can be attributed to proximity of sorghum and millet in their nutritional profile. The total feed cost (N /kg) and feed cost per kg gain (N /kg gain) reduced from control diets to alternative energy sources (Table 3). Table 4 showed the carcass characteristics and gut yield of quails fed different energy sources. Results showed that live weight, slaughter weight, pluck weight, eviscerated weight and dressed weight were statistically similar (P>0.05), This indicated that sorghum and millet can be alternative to maize and this concur with earlier reports of Davis et al. [5] who fed different levels of pearl millet to replace corn in quail's diet and reported no significant difference in carcass yield. Similarly, Bello et al. [2] fed diets containing varying levels of millet as substitute to maize and reported no significant difference in carcass and organs weight of broiler chickens. Table 5 showed that the egg production parameters of quails fed energy sources and results indicated that hen days' production is not affected by different energy sources (P>0.05) and this finding reaffirm the earlier reports of Seema et al. [12] who fed different energy sources and reported no significant difference, similarly Edache et al. [6] fed quails with peeled and cooked sweet potato as energy feed and reported no significant difference in the hen day egg production. The egg weight was not affected by the alternative energy sources (P>0.05) even though Lotfi et al. [9] showed that egg weight increases with more energetic feeds. The egg length and egg width were not affected by different energy sources (P>0.05) and this an indication of that sorghum and millet can be used as close substitute. and

concur with the reports of Shehab et al. [11] on quails fed different energy sources. The albumen weight, yolk weight, yolk height, yolk colour, shell weight and shell thickness were not affected by different energy sources (P>0.05) and this finding is in line with earlier repot of [10] on quails fed different types of millet and reported no significant difference. Hematological and serum biochemical parameters are shown in Table 6. Results showed that packed cell volume, hemoglobin and red blood cells were not affected by the different energy sources (P<0.05), this finding suggested that the alternate energy sources provide enough energy for quail's metabolism. The values are within the normal range (Banerjee, 2008) The MCH, MCV and MCHC were not affected by different types of energy. The values of the RBC, Hb, MCH, MCV and MCHC obtained in this study indicated that there were normal bone marrow functions, no macrocytic, hypochromic and autoimmune hemolytic anemia. Neutrophils was affected by the different energy sources (P<0.05), the neutrophils were better in millet and sorghum diets and this implies higher resistance to infection and bacteria while lymphocytes were better in the control diets. The serum biochemical studies revealed that albumin, total protein, globulins, glucose, chlorine and calcium were statistically similar (P>0.05) and this suggest that millet and sorghum can be alternative energy sources. The potassium and bicarbonate were affected across the treatment (P<0.05), the control diet had higher values of this mineral compared to alternative energy sources. Similarly, the control diet had higher level of sodium compared to alternative energy sources. The cholesterol, urea, creatine, ASAT, ALP and TB were not affected by the different energy sources (P<0.05), and this indicate that the liver and the kidney were physiologically normal. Higher significant values of ALAT (P<0.05) were observed in the control diet while the lowest was observed in millet diet, this suggest that millet is safer compared to maize for normal liver functions. Similarly, the CB were statistically higher in the control diet (P<0.05) and lowest in millet-based diet.

4. Conclusion and Recommendations

Considering the results of this study millet and sorghum can be alternative to maize, it is recommended that millet and sorghum can be used in Gashua environment to reduce cost of quail production and ensure availability of quail feeds.

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