EFFECT OF MAIZE REPLACEMENT WITH VARYING LEVELS OF ROASTED CASSAVA SIEVATE ON PERFORMANCE, CARCASS TRAITS AND ECONOMICS OF PRODUCTION OF BROILER CHICKEN

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Abstract
Nigeria is the world's largest producer of cassava. There is a growing interest in exploring the use of cassava by-products, such as cassava sievate, as alternative feed ingredients. This experiment was conducted to examine the growth performance, carcass traits and economics of production of broiler chickens fed maize replaced with varying roasted cassava sievate. One-hundred-day-old chicks were used to experiment for six (6) weeks. The birds were fed 0% 10% 20% 30% and 40% levels of maize replaced with roasted cassava sievate meal. The experiment showed that roasted cassava sievate meal influenced the growth performance of broiler chicken. Also, the experimental diet influenced feed intake in broilers. Results showed that maize replaced with roasted cassava sievate diet has a significant effect on liveshrunk, defeathered and dressed carcass weights of the birds. The breast muscle percentage of the birds was influenced by the inclusion of cassava sievate in the broiler diet. The result also showed that percent broiler primal parts was not significantly different among the treatment groups. Diet did not exert any significant difference in the percentage of liver, pluck, gizzard and heart of experimental birds. Price per kg feed reduced with increased levels of replacement. However no significant difference in price per kg bird produced. There was no mortality throughout the experimental period, which suggested that roasted cassava sievate meal has no deleterious effect on the experimental birds.

Keywords: broiler chicken, growth performance, carcass traits, roasted cassava sievate meal

Introduction

Poultry farming, particularly broiler chicken production, is a significant component of Nigeria's agricultural sector, contributing to food security and economic growth. In Nigeria, poultry meat is a major source of animal protein, and the demand for it continues to rise due to population growth and urbanization (Akinola, 2019). However, the increasing cost of conventional feed ingredients, such as maize and soybean meal, has made poultry production more expensive, creating a pressing need for alternative, cost-effective feed sources. The cost of poultry feed in Nigeria has been on the rise, primarily due to the increasing prices of conventional feed ingredients such as maize and soybean meal. Energy is the most critical component of broiler diets, influencing not only growth performance but also feed intake and nutrient utilization. Carbohydrates and fats are the primary sources of energy, with maize being the most commonly used ingredient due to its high energy content and digestibility (Adewumi & Togun, 2015).

The competition and inadequate supply have invariably led to their constantly increasing market price. This has led many poultry keepers to reduce their flock or completely shift to other businesses with lesser financial involvement. The current trend in the poultry industry is on alternative feedstuffs; mainly those that can either directly replace maize or can be incorporated at

certain levels in the diet to achieve a comparable worth. In addition, the reliance on maize and soybean meal, both of which are also important for human consumption, raises concerns about food security. This competition between human and animal food chains for the same resources drives up prices and limits the availability of these essential foodstuffs. This trend poses a significant challenge to poultry farmers, who are forced to spend a large portion of their production costs on feed, which can account for up to 70% of total expenses (Esonu, 2012).

Cassava (Manihot esculenta Crantz) is a staple root crop in Nigeria and is not only a crucial food source but also a key agricultural product with vast potential as an animal feed ingredient. Nigeria is the world's largest producer of cassava, with production levels exceeding 59 million tonnes annually (FAO, 2020). Given Nigeria's status as the world's largest producer of cassava, there is a growing interest in exploring the use of cassava by-products, such as cassava sievate, as alternative feed ingredients. The processing of cassava into products like garri, fufu, and cassava starch generates substantial by-products, including cassava peels, pulp, and sievate. These by-products, particularly cassava sievate, a by-product of starch extraction and garri processing, are often underutilized or discarded, despite their potential as alternative feed ingredients.

Roasted cassava sievate, when properly processed and graded, could serve as a valuable energy source in broiler diets. The use of cassava by-products in animal feed has been explored in various studies, with a focus on reducing the content of anti-nutritional factors such as cyanogenic glucosides, which can pose a risk to animal health if not properly managed (Oluwatosin, 2018). Advances in processing techniques, such as drying and roasting, can significantly reduce these risks, making cassava sievate a safer and more viable option for poultry feed. This study aims to explore the effect of roasted cassava sievate on the growth performance of broiler chickens, thereby assessing its potential to serve as a sustainable and cost-effective alternative to conventional feed ingredients in Nigeria.

Materials and methods

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm of Adeyemi Federal University of Education, Ondo, Ondo State. Stone-free roasted cassava (garri) sievate was obtained from Lipakala in Ondo, Ondo state. The garri sievate was checked thoroughly to avoid dirt or any form of particles. Thereafter, it was milled and then stored in bags for use. Other ingredients like maize, soya meal, full-fat soya, limestone, bone meal, salt, were procured from Obokun Avenue feed mill in Ilesa, Osun State, Nigeria. Rations were formulated such that maize was replaced with roasted cassava sievate at 0, 20, 30 and 40% levels.

Table 1: *Percentage Composition of Experimental Diet*

INGREDIENTS	Level of replacement with roasted cassava sievate (%)				
	0	10	20	30	40
Maize (kg)	63	56.68	50.4	44.1	37.8
Cassava Sievate (kg)	0	6.32	13.6	18.9	25.2
Wheat Offal (kg)	7	7	7	7	7
Concentrates (kg)	30	30	30	30	30
Total %	100	100	100	100	100

Management of the Experimental Birds

One hundred day-old broiler chickens were bought from Amo Farm, Ibadan, Oyo State. They were brooded together for two weeks with commercial starter broiler feed (New Hope Feed) to stabilize them before distributing them into five experimental treatment groups. Each treatment group contains 20 broiler chicks and was divided into 2 replicates with 10 birds per replicate. Birds were allocated to five experimental diets of maize replaced with roasted cassava sievate at 0,10,20,30, and 40levels of replacement. Feed intake was recorded daily by weighing the quantity given and the leftovers the following morning.

Health management practices were carried out on the broiler chicken. They were given Newcastle disease vaccine, the first Gumboro vaccine was administered at the end of the second week, the Lasota vaccine against Newcastle disease was administered at the end of the third week, and the final Gumboro vaccine was administered at the end of the fourth week. Coccidiostal and other antibiotics were also administered by drinking water to prevent coccidiosis.

Table 2: *Growth Performance of Broiler fed maize replaced with roasted cassava sievate*

Parameters	Level of Maize replaced with roasted cassava sievate meal (%)					
	0	**10**	**20**	**30**	**40**	**SEM**
Final weight (g)	2200.00	2225.00	2115.00	2170.00	2075.00	27.50NS
Total weight gain (g)	1645.00^{b}	1600.00^{ab}	1605.00^{ab}	1393.50^{a}	1450.00^{ab}	49.19
Weekly weight gain (g)	276.67^{b}	266.67^{ab}	267.50^{ab}	252.50^{ab}	241.67^{a}	6.19
Daily weight gain(g)	39.52^{b}	37.98^{ab}	38.22^{ab}	36.07^{ab}	34.52^{a}	0.88
Total feed intake (g)	5840.91^{c}	5763.14^{b}	5836.37^{c}	5754.55^{b}	5685.45^{a}	28.88
Weekly feed intake (g)	973.49^{c}	960.61^{b}	972.73^{c}	959.09^{b}	947.58^{a}	4.81
Daily feed intake (g)	139.07^{c}	137.03^{b}	138.96^{c}	137.01^{b}	135.37^{a}	0.69
Feed gain ratio (g)	3.59^{a}	3.69^{ab}	3.77^{ab}	3.89^{ab}	4.14^{b}	0.10
Feed efficiency (g)	0.29^{b}	0.28^{ab}	0.27^{ab}	0.26^{ab}	0.25^{a}	0.01

abc: Means value within row carrying different superscripts differ significantly ($P<0.05$)
NS: Not Significant

The results of the growth performance of broiler chicken fed maize replaced with roasted cassava sievate are presented in Table 2. Results showed that there is no significant difference in the final weight of the birds on the tested diet across the treatment groups.

There are significant variation in total weight gain, weekly weight gain and daily weight gain across the treatment groups. Total weight gain is significantly higher in birds fed maize-based diets when compared with 30% levels of maize replacement. Also, the weekly and daily weight gain of birds on the control diet was significantly higher when compared with those fed a 40% level of replacement. However, there is no significant difference between weekly and daily weight gain of birds fed a control diet when compared with those fed 10-30% replacement levels. Results showed that replacing maize with roasted cassava sievate at more than 30% levels significantly reduced the daily and weekly weight gain when compared with those fed maize maize-based diet. This result is contrary to that of Tewe and Egbunike (2014), who reported that properly processed cassava sievate could replace up to 50% of maize in broiler diet without negative effect on growth performance or health.

There are significant differences in total, weekly and daily feed intake across the treatments. Broilers' feed intake is significantly higher in a maize-based diet when compared with those on 30-40% maize replaced with roasted cassava sievate. This report is similar to that of (Oluyemi and Robert 2000) where broiler chickens were fed maize replaced with roasted cassava sievate. They reported that there were significant differences in feed intake among the groups. There are significant differences in the feed-to-gain ratio across the treatments. Feed again ratio is significantly higher in birds fed 40% levels of maize replaced with roasted cassava sievate when compared with those fed with a maize-based diet.

Variation was observed in feed efficiency of birds fed varying levels of maize replaced with roasted cassava sievate across the treatments. This result is similar to the research work of Adeyemo (2018), who reported that the feed gain ratio is significantly higher in birds fed diets with 40% maize replacement with roasted cassava sievate compared to those fed maize-based diets. This result is contrary to that of Aro et.al. (2010), who indicate that cassava sievate can be included at levels of up to 20-30% in broiler diet without negatively affecting growth rates or feed conversion ratios (FCR), provided that the diets are balanced for protein and other essential nutrient.

Feed efficiency is significantly higher in maize maize-based diet when compared with a bird fed a 40% level of replacement. This result is similar to research by Tewe and Egbunike (2014), who reported that broiler-fed diets containing cassava sievate had a feed conversation ratio (FCR) similar to those on maize diets, suggesting that sievate can be an effective energy source without compromising feed efficiency. This result is contrary to research of Afolabi (2020), who reported that feed efficiency was not significantly different among broilers fed maize-based diets and those fed diets with 40% maize replacement with roasted cassava sievate.

Table 3: *Carcass attributes of broiler chickens fed maize-replaced with roasted cassava sievate diets.*

PARAMETERS	Level of Maize replaced with roasted cassava sievate meal (%)					
	0	**10**	**20**	**30**	**40**	**SEM**
Liveshrunk (g)	1393.33[a]	1469.00[a]	1502.00[a]	1511.33[a]	1686.00[b]	126.28
DeFeathered (g)	1292.00[a]	1329.67[a]	1400.67[a]	1423.33[a]	1598.33[b]	135.77
DressedCarc (g)	883.00[a]	912.00[a]	935.66[ab]	964.33[ab]	1074.00[b]	97.39
Thigh (%)	16.19	16.73	17.39	17.73	18.55	1.48 NS
Drumstick (%)	16.06	16.60	16.75	17.32	17.58	1.28 NS
Breast (%)	31.20[a]	33.07[a]	33.61[ab]	34.35[b]	34.62[b]	1.79
Wing (%)	14.05	14.08	14.14	14.92	16.96	2.13 NS
Back (%)	17.26	18.09	18.19	18.60	18.60	1.29 NS
Neck (%)	4.95	4.97	5.12	5.14	5.29	0.49 NS
Shank (%)	4.24	4.26	4.69	4.85	4.87	0.56 NS
Head (%)	2.48	2.54	2.75	2.89	2.93	0.39 NS
Liver (%)	2.37	2.37	2.74	2.77	2.97	0.41 NS
Pluck (%)	0.62	0.63	0.69	0.99	0.63	0.274 NS
Gizzard (%)	2.72	3.05	3.16	3.33	3.58	0.64 NS
Intestine (%)	6.55	6.96	7.19	7.70	8.44	1.42 NS
Heart (%)	0.53	0.57	0.61	0.69	0.75	0.14 NS

abc: Means value within row carrying different superscripts differ significantly (P<0.05)
NS: Not Significant

The results of the carcass characteristics of broiler chickens fed maize-replaced replaced with roasted cassava sievate diets are presented in Table 3. Results showed that there are significant differences (P<0.05) in the liveshrunk weight, defeathered weight and dressed carcass weight of the experimental birds across the treatment groups.

Liveshrunk weight, defeathered and dressed carcass weights are significantly higher in birds fed a 40% level of maize replaced with roasted cassava seivate when compared with 0-30% levels. This is similar to the findings of Ngandju et al. (2011), who reported that 50% substitution of maize with cassava flour led to a significant (P<0.05) rise in broiler carcass yield after seven weeks of experimental trial. It is also in conformity with the findings of Obi et al. (2008), who recorded a significant difference in the liveshrunk weight, which reported the effect of cassava root meal on broiler growth, carcass and organ weights.

The result of this study showed that there is no significant difference in the thigh percentage of the eviscerated birds. Broiler on 40% levels of maize replaced with roasted cassava sievate exhibited a higher value in thigh per cent when compared with 0 -30% levels of maize replaced with roasted cassava sievate diets. However, they are not statistically different. Significant differences were observed in breast muscle per cent of the experimental birds across the treatments. Breast muscle is significantly higher in birds fed a 40% level of maize replaced with roasted cassava sievate when

compared with those on a control diet. This is contrary to the report of Bhauna et al. (2004), who investigated the impact of fermented cassava leaf meal (FCLM) on broiler chicken. They found out that higher inclusion levels of fermented cassava leaf meal reduced weight gain and the quality of breast muscle.

The result showed that there were no significant differences ($P<0.05$) in Wing, Back, shank and head percents of birds across the treatment groups. Broiler on 40% levels of maize replaced with roasted cassava sievate exhibited higher numerical value in wing per cent, back per cent, shank per cent and head per cent when compared with the control diet. However, they are not significantly different. This is contrary to the findings of Alade et al. (2023), who evaluated the impact of degraded cassava sift flour on carcass parameters. He reported significant differences in organ weights among broilers fed different levels of cassava sift flour. The broiler fed 100% level of cassava sift flour had the highest value of kidney, gizzard and gastro-intestinal tract.

Broilers on a 40% level of maize replaced with roasted cassava sievate exhibited higher neck per cent when compared with the control groups. These results are contrary to the findings of Alabi (2020), who investigated the impact of roasted cassava sievate as a dietary supplement on the cassava characteristics, internal offal and primal parts of broiler chicken. He reported significant differences on carcass, internal offals and primal cuts, highlighting the potential of roasted cassava sievate as a viable feed ingredient. Adebayo et al. (2014) reported improved carcass characteristics in broiler feed diets. Studies by Alabi et al. (2020) have shown that cassava sievate can be an effective feed supplement enhancing both growth performance and carcass quality in poultry birds.

No significant difference in experimental birds' internal offals (heart, liver, lungs, intestine and gizzard) among the treatment groups. Broiler on 0% levels of maize replaced with roasted cassava sievate exhibited lower numerical value in heart, liver, lungs, intestine and gizzard percents when compared with 10-40 levels of maize replaced with roasted cassava sievate diets. However, it is not significantly different. This conforms to the findings of Kana et al (2004) who reported that cassava residue in substitution of maize in the broilers' feed has a significant effect on all carcass parameters except heart. However, Eruvbetine et.al. (2003) reported that increased bulkiness of the feed containing high levels of dietary cassava meal led to an increase in the size of the gizzard in broilers.

Table 4: *Economics of Production of Broiler fed maize replaced with roasted cassava sievate*

Parameters	Level of Maize replaced with roasted cassava sievate meal (%)					
	0	10	20	30	40	SEM
Final weight (g)	2200.00	2225.00	2115.00	2170.00	2075.00	27.50 NS
Total weight gain (g)	1645.00^{b}	1600.00^{ab}	1605.00^{ab}	1393.50^{a}	1450.00^{ab}	49.19
Weekly weight gain (g)	276.67^{b}	266.67^{ab}	267.50^{ab}	252.50^{ab}	241.67^{a}	6.19
Daily weight gain(g)	39.52^{b}	37.98^{ab}	38.22^{ab}	36.07^{ab}	34.52^{a}	0.88
Total feed intake (g)	5840.91^{c}	5763.14^{b}	5836.37^{c}	5754.55^{b}	5685.45^{a}	28.88
Weekly feed intake (g)	973.49^{c}	960.61^{b}	972.73^{c}	959.09^{b}	947.58^{a}	4.81
Daily feed intake (g)	139.07^{c}	137.03^{b}	138.96^{c}	137.01^{b}	135.37^{a}	0.69
Feed gain ratio (g)	3.59^{a}	3.69^{ab}	3.77^{ab}	3.89^{ab}	4.14^{b}	0.10
Feed efficiency (g)	0.29^{b}	0.28^{ab}	0.27^{ab}	0.26^{ab}	0.25^{a}	0.01
Price/kg feed (₦)	926.50^{e}	876.60^{d}	844.60^{c}	803.70^{b}	762.70^{a}	28.37
Price/kg animal (₦)	3325.21	4475.07	3184.14	3122.37	3165.05	257.44 NS

abc: Means value within row carrying different superscripts differ significantly (P<0.05)
NS: Not Significant

The results of the economics of the production of broiler chicken fed maize replaced with roasted cassava sievate meal are presented in Table 4.

There were significant differences in the feed-to-gain ratio across the treatments. Feed gain ratio is significantly higher in birds fed 40% levels of maize replaced with roasted cassava sievate when compared with those fed with a maize-based diet. Variations were observed in the feed efficiency of birds fed varying levels of maize replaced with roasted cassava sievate across the treatment. This result is similar to the research work of Adeyemo (2018), who reported that the feed gain ratio is significantly higher in birds fed diets with 40% maize replacement with roasted cassava sievate compared to those fed maize-based diets. This result is similar to research of Aro et al (2010) who indicate that cassava sievate can be included at levels of up to 20-30% in broiler diet without negatively affecting growth rate or feed conversion ratios (FCR), provided that the diets are balanced for protein and other essential nutrients.

Feed efficiency is significantly higher in a maize-based diet when compared with a bird fed 40% levels of replacement. This result is contrary to research of Afolabi (2020), who reported that feed efficiency was not significantly different among broilers fed maize-based diets and those fed diets with 40% maize replacement with roasted cassava sievate. The price per kilogram of feed decreased as maize replacement levels increased in the experimental diet. This shows that maize replacement with roasted cassava sievate, which is cheaper than maize, reduced the price per kilogram of feed. This result is in line with the work of Olukosi (2020), who reported that the cost savings associated with using roasted cassava sievate as a substitute for maize resulted in a decrease in the price per kilogram of feed, making it a more economical option for broiler

producers. Also, this result is contrary to the research of Emenalom (2019), who reported that the price per kilogram of feed did not decrease significantly as maize was replaced with cassava sievate levels increased in the experimental diet. No significant differences in the price per kilogram of animal produced. This showed that inclusion of roasted cassava sievate in broiler diet did not influence the price per kilogram of animal produce. Price per kilogram of animal produced decreases with an increase in the level of maize replaced with roasted cassava sievate. However, it is not statistically different ($P<0.05$).

Conclusion

Based on the results of the experiment, it could be concluded that roasted cassava sievate significantly influenced the growth performance and feed intake of broiler chicken. Experimental diets exert significant effects on primal cuts. However, internal organ percents were not influenced, suggesting that roasted cassava sievate is not deleterious to the birds. Price per kg of ration formulated reduced with increased levels of maize replacement. Price per kilogram animal produced decreases with an increase in the level of maize replaced with roasted cassava sievate, however, the values were not statistically different. It could be suggested to poultry farmers that maize could be replaced with roasted cassava sievate up to a 30% level.

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