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Research article

Formulation of a Ketogenic Diet for Starter-Finisher and its Effect on the Growth Performance and Carcass Quality of Broiler Chicken (*Gallus gallus domesticus*)

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Abstract: A study was conducted to evaluate the effects of ketogenic diets on the growth performance and carcass quality of broiler chickens. The ketogenic approach aims to shift caloric intake towards protein and fat, with reduced carbohydrate content. A total of 128 three-week-old, straight-run broiler chicks were randomly assigned to four dietary treatments: Diet A (control/commercial feed), Diet B (lipid-based ketogenic diet), Diet C (protein-based ketogenic diet), and Diet D (fiber-based ketogenic diet). The study followed a Randomized Complete Block Design (RCBD) with cage location as the blocking factor. Data were analyzed using ANOVA in SAS v.9, and treatment means were compared using Tukey's HSD at α = 0.05. Results revealed that Diet A outperformed all other treatments in terms of Voluntary Feed Intake (VFI), Body Weight (BW), Average Daily Gain (ADG), Weight Gain (WG), and Feed Conversion Ratio (FCR). It also yielded the highest carcass weight (CW) and dressing percentage (DP). In contrast, Diet D showed the poorest growth performance and the highest cost to produce (CTP), along with the lowest Broiler Production Efficiency Factor (BPEF). However, Diet D recorded the lowest abdominal fat (AF), comparable with Diet C, while both Diet C and D had the lowest visceral fat (VF) yield. The reduced performance of ketogenic diets may be due to the lower quality of raw materials used in home-mixed rations. Nonetheless, the notable reduction in AF and VF suggests that ketogenic feeding may offer a viable strategy for producing leaner broiler meat.

Keywords: Broiler chicken; carcass quality; growth performance; ketogenic diet

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1. Introduction

Increased demand for poultry meat has led to the selection of rapid-growing broiler chickens with better feed conversion efficiency. These economic qualities, including breast output, have seen substantial advances as a result of active selection to fulfill market demand. However, today's broilers tend to have over-accumulation of fat in their abdominal region [1]. The quality of the carcass and feed efficiency is negatively impacted by excessive abdominal fat buildup [2]. There is a coincidental rise in the deposition of abdominal fat in genetically modified chickens with enhanced development and early maturity [3]. This results in lower-quality meat that may be deemed unhealthy, as well as an increase in feed costs [4]. One potential method for reducing fat deposition in broiler chickens is the application of a ketogenic diet. The ketogenic diet has become one of the most popular diet trends in human nutrition today. The objective is to get the majority of one's caloric intake from protein and fat, with fewer calories coming from carbohydrates. In this type of diet, high production of ketone bodies, which are derived from the breakdown of fat into energy, is induced [5]. A diet high in lipids, proteins, or fiber can promote ketogenesis, the process by which ketone bodies are created. Fatty acids and glycerol are the building blocks of lipids. Excess levels of these components are transformed into fatty acids (FA) and stored as fats when this nutrient is consumed in large amounts. When blood glucose levels are low, the body will use its fat reserves, go through beta-oxidation, and produce acetyl-CoA. However, the utilized acetyl CoA will be used gradually because of low amounts of oxaloacetate, a glucose-dependent molecule. Excess acetyl-CoA will encourage the ketogenesis process, which is the process of producing ketone bodies. Amino acids (AA) make up proteins, and an excess of them encourages the synthesis of high concentrations of acetyl CoA, which, if not used, can lead to FA synthesis and fat deposition. These lipids will undergo beta-oxidation and create acetyl-CoA when blood glucose levels are low. Similar to this, when oxaloacetate levels are low, the body uses less acetyl CoA, which can lead to ketogenesis when there is an oversupply. Some of these AAs have a ketogenic nature and produce acetyl-CoA, which cannot be converted to glucose. Ketone bodies will be created by synthesizing these acetyl-CoAs. A low-carbohydrate diet lowers the amount of oxaloacetate produced, which is needed for the conversion of acetyl-CoA to citrate. Animals will turn to their body's fat reserves when glucose is in limited supply. Acetyl CoA is produced through the beta-oxidation of these. Oxaloacetate production will decrease due to the low glucose level, which will affect acetyl-CoA utilization. Acetyl CoA in excess will then be converted into ketone bodies.

Numerous studies have demonstrated that nutritional interventions could alter the accretion of fat deposits in the body, and the broiler industry is actively employing this strategy. Adjustments to the caloric, protein, amino acid, and mineral levels in the diet, as well as the addition of feed additives, triggered a decrease in abdominal fat deposition and carcass fatness[1]. However, it is not well understood and shown which of these methods for lowering fat deposition in broilers will have the best performance in terms of growth and carcass quality; hence, this study.

2. Materials and Methods

2.1 Procurement of Birds

A total of 128 day-old straight-run Cobb 500 strain of broiler chicks were acquired from a reliable source. These birds were presumed to have been vaccinated as prescribed by the local supplier.

2.2 Preparation of the Study Area

Thirty-two (32) cages with an area of 4.80 sq. ft. per cage were constructed to accommodate 4 birds each. The floor height of the cages was at least 1.80 meters from the ground to minimize the build-up of ammonia. For optimum ventilation, the ceiling height was at least 2.40 meters from the cage flooring [6]. A general light was also installed above the cages to stimulate feed and water intake and meet the birds' light requirements. To sanitize and prevent the entry of disease-causing microorganisms brought by people arriving from outside the study area, a foot bath and a hand washing station were positioned at the building's entrance. At least three days before the chicks' arrival, the building, cages, and equipment were thoroughly cleaned and disinfected.

2.3 Management of Birds

The brooder lamps were turned on at least 3-4 hours before the arrival of chicks. An electrolyte solution was prepared ahead of time and provided to the chicks upon arrival. The temperature in the first week was kept at 35°C. It was reduced by 2°C in the following week and continued until the 5th week. On the 1st day of brooding, a 24-hour lighting program was implemented and was reduced to 23 hours on the following day until the 5th day. By the time the birds reached the age of 6 – 11 days, the lighting program was reduced to 18 hours and was increased to 20 hours on days 12 - 35 [7]. Clean water was made available at all times. A medication and vaccination program designed for broilers was administered to the birds. For the first 2 weeks, all broiler chicks were provided with the same brand of commercial booster feeds. All animals

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without ketogenic diet were provided with a commercial brand of broiler feeds (Table 1) upon entering the age of 15 days, which was also the start of data collection, while the remaining animals were provided with a ketogenic diet formulation for broiler starter (week 3) to broiler finisher (weeks 4 - 5) on *ad libitum* basis.

Table 1. Ingredient and Nutrient Composition of the Control Feed

Feed type	Ingredients	Guaranteed Analysis (%)					
		Moisture	CP	EE	CF	Ca	P
Broiler Starter	YC, SBM, RB, FM, WP, CM, Mol, CCO, MDCP, Lime, VMP, AA	12 max	19 min	5 min	4 max	0.9-1	0.70 min
Broiler Finisher	YC, SBM, RB, FM, WP, CM, Mol, CCO, MDCP, Lime, VMP, AA	12 max	18 min	6 min	6 max	0.8-0.9	0.70 min

YC – Yellow corn, SBM – Soybean meal, RB – Rice bran, WP – Wheat pollard, CM – Copra meal, Mol – Molasses, CCO – Crude Coconut Oil, MDCP – Monocalcium Phosphate, Lime – Limestone, VMP – Vitamin-mineral premix, AA – Amino acid, Min - Minimum, Max - Maximum

2.4 Design and Treatments

The study was conducted in a Randomized Complete Block Design (RCBD) using the location of cages as a blocking factor. Blocking was done because the temperature, humidity, and other environmental factors inside the broiler house are not automatically controlled. There were four treatments with eight blocks and four birds per block. The following were the diets given during the starter and finisher stages of broilers: Diet A – Commercial feed, Diet B – Lipid-based ketogenic diet, Diet C – Protein-based ketogenic diet, Diet D – Fiber-based ketogenic diet.

2.5 Preparation of Dietary Treatments

All birds were provided with the same brand of commercial feeds at the booster stage. The birds were given a broiler starter or finisher ration formulated using the Brill Feed Formulation Software (Tables 2 and 3). The broiler nutrient requirement as reflected in the 4th edition of PHILSAN Feed Reference Standards was used as a reference in feed formulation [8].

Table 2. Ingredient Composition of Different Dietary Treatments

Ingredient	Inclusion, %							
	Starter				Finisher			
	A Control	B Lipid-based	C Protein-based	D Fiber-based	A Control	B Lipid-based	C Protein-based	D Fiber-based
YC		30.00	30.00	30.01		20.97	29.99	30.00
SBM		30.46	31.04	17.35		23.58	26.73	11.58
RBD1		10.00	10.00	-		15.00	5.00	-
FM		1.00	1.00	1.00		1.00	1.00	7.91
WP		5.00	5.00	6.60		10.00	5.00	4.60
RBD2	Table 1	-	-	15.00	Table 1	-	-	20.00
CM		5.00	10.00	10.00		10.00	15.00	10.00
Mol		3.00	3.00	3.00		4.70	5.00	5.00
CCO		8.50	5.00	5.50		10.00	6.00	6.10
MDCP		2.69	1.16	1.26		0.99	1.08	-
Lime		1.58	1.05	1.02		1.03	2.48	0.96

Table 2. Ingredient Composition of Different Dietary Treatments (Continuation)

Ingredient	Inclusion, %							
	Starter				Finisher			
	A Control	B Lipid-based	C Protein-based	D Fiber-based	A Control	B Lipid-based	C Protein-based	D Fiber-based
VMP	Table 1	0.20	0.20	0.20	Table 1	0.20	0.20	0.20
AA		1.65	1.65	1.65		1.65	1.65	1.65
Salt		0.50	0.50	0.50		0.50	0.50	0.50
CC		0.01	0.01	0.01		0.01	0.01	0.01
Met		0.06	0.04	0.16		0.02	0.01	1.13
Lys		-	-	6.33		-	-	-
Enz		0.10	0.10	0.10		0.10	0.10	0.10
Zinc		0.05	0.05	0.05		0.05	0.05	0.50
Threo		-	-	0.06		-	-	-
Tryp		-	-	0.01		-	-	-
TB		0.20	0.20	0.20		0.20	0.20	0.20
TOTAL		100	100	100		100	100	100

YC – Yellow corn, SBM – Soybean meal, RBD1 – Rice bran D1, FM – Fishmeal, WP – Wheat pollard, RBD2 – Rice bran D2, CM – Copra meal, Mol – Molasses, CCO – Crude coconut oil, MDCP – Monodicalcium phosphate, Lime – Limestone, VMP – Vitamin-mineral premix, AA – Acetic acid, CC – Choline chloride, Met – Methionine, Lys – Lysine, Enz – Enzyme, Threo – Threonine, Tryp – Tryptophan, TB – Toxin binder

Table 3. Nutrient Composition of Different Dietary Treatments

Nutrient	Starter				Finisher			
	A Control	B Lipid-based	C Protein-based	D Fiber-based	A Control	B Lipid-based	C Protein-based	D Fiber-based
ME (kcal)	Table 1	2901.00	2702.00	2700.00	Table 1	2900.00	2700.00	2700.00
CP (%)		19.29	20.58	20.00		18.01	19.20	18.00
EE (%)		12.25	9.32	9.71		14.59	10.07	11.25
CF (%)		3.92	4.38	4.84		4.63	4.52	5.11
Ash (%)		3.75	4.10	3.68		4.04	3.78	4.77
Ca (%)		1.30	0.87	0.81		0.81	1.40	0.76
P (%)		0.72	0.41	0.41		0.38	0.38	0.38

ME - Metabolizable Energy, CP - Crude Protein, EE - Ether Extract, CF - Crude Fiber, Ca - Calcium, P - Phosphorus (Available)

2.6 Statistical Analysis

Data were analyzed using one-way Analysis of Variance (ANOVA) in RCBD in Proc GLM of SAS v.9. Differences among treatments were determined using Tukey's Honestly Significant Difference Test (HSD) and declared significant when $p<0.05$. The results were presented as mean values and standard error of the means.

3. Results and Discussion

3.1 Growth Performance

Table 4 shows the growth performance of broiler chickens fed with different ketogenic diet formulations at 3-5 weeks old based on voluntary feed intake (VFI), body weight (BW), average daily gain (ADG), weight gain (WG), and feed conversion ratio (FCR). Based on the result, significant differences can be observed in all growth performance parameters ($p<.0001$).

The VFI for the whole duration of the study revealed that Diets A (control), B (lipid-based), and C (fiber-based), with 2398.07 grams, 2335.39 grams, and 2290.73 grams, respectively, are comparable with each other. Diet D (fiber-based) with 1,723.09 grams had the lowest overall VFI. Diet B (lipid formulation) was formulated by reducing the corn inclusion in the diet and increasing the use of oil to provide the energy requirement of broiler chickens. In the study of Benitez et al. [9], when conventional corn was substituted with a high oil corn in the diet of broilers, comparable results in the VFI were observed. Diet C (protein-based), which also had comparable VFI with Diet A (control), was formulated by reducing the inclusion of corn and replacing it with materials that are high in protein. In the study of Ferguson et al. [10], no significant difference in VFI was observed in broilers fed with low CP (21.9% in starter and 16.53% in grower) and medium diet (24.13% in starter and 19.58% in grower). The combination of good quality raw materials in both Diet B (lipid-based) and Diet C (protein-based) may have contributed to comparable VFI with Diet A (control) and better VFI than Diet D (fiber-based). The VFI of Diet D (fiber-based) was consistent with the study of Khempaka et al. [11], who found that fiber-based diets, such as 12% and 16% dried cassava pulp, reduced feed intake in broilers between 14 and 35 days. According to the researchers, this could be attributed to the increased bulkiness of the feed and reduced digestive capacity in broilers. Furthermore, an increase in mass has been shown to diminish palatability, which may limit broiler feed intake. Moreover, Jha and Mishra [12] explained that soluble fibers such as β-glucans, arabinoxylans, and pectins increased intestinal viscosity and reduced the rate of passage of feed, thereby reducing feed intake (FI) and the rate at which nutrients are absorbed, which may influence the growth performance of poultry. Rice bran and wheat bran are rich sources of these dietary fibers. Additionally, Cui et al. [13] mentioned that wheat bran has 46% non-starch polysaccharides, comprising 70% arabinoxylan, 24% cellulose, and 6% beta-glucan, with small amounts of glucoglucomannan and arabinogalactan. Rice bran, on the other hand, contains about 12% dietary fiber, 90% of which is insoluble dietary fiber such as cellulose, hemicellulose, and arabinoxylans. Soluble dietary fibers, such as pectin and β-glucan, are present in trace amounts [14].

Table 4. Growth performance of broiler chickens fed with different types of ketogenic diet at 3-5 weeks old

Parameters	A	B	C	D	SEM	p-value
	(Control)	(Lipid-based)	(Protein-based)	(Fiber-based)		
VF (g)	2398.07^{a}	2335.39^{a}	2290.73^{a}	1723.09^{b}	47.03	<.0001
BW (g)	1819.29^{a}	1367.42^{b}	1337.78^{b}	1161.64^{b}	27.94	<.0001
ADG (g)	62.52^{a}	42.11^{b}	41.05^{b}	33.48^{c}	1.21	<.0001
WG (g)	1312.85^{a}	884.32^{b}	862.00^{b}	703.14^{c}	25.27	<.0001
FCR	1.83^{a}	2.67^{b}	2.68^{b}	2.46^{b}	0.10	<.0001

*Means with the same superscript are not statistically significant

In terms of BW, significant differences can be observed ($p<0.0001$) with Diet A (control) weighing the heaviest (1819.29 grams) upon completion of the study. It was followed by Diet B (lipid-based), Diet C (protein-based), and Diet D (fiber-based), which had comparable BW of 1367.42 grams, 1334.78 grams, and 1161.64 grams, respectively. The higher VFI in Diet B (lipid-based) and Diet C (protein-based), as well as the combination of highly digestible components of these dietary treatments may have contributed to the greater BW of broiler chickens relative to Diet D (fiber-based). In a study by Tabook et al. [15], when the amount of dietary fiber in the diet was increased from 10% to 15%, body weight gain was reduced by 8% and 12%, respectively. The inclusion of more than 5% dietary fiber reduced daily gain, feed intake, and feed conversion ratio. Significant differences can also be observed in the ADG of broiler chickens ($p<0.0001$). Throughout the study, ADG was highest in Diet A (control) with 62.52 grams, whereas Diet B (lipid-based) and Diet C (protein-based) had no significant difference at 42.11 grams and 41.05 grams, respectively. The least was Diet D (fiber-based) with 33.48 grams. The aim of providing ketogenic-based diets was to limit the intake of calories from carbohydrates and increase intake from protein or fat. With this, inclusion of carbohydrate-rich raw materials such as corn was minimized, allowing usage of other ingredients, mostly milling by-products, to be maximized. Corn is a highly digestible feed material, and limiting the use of this ingredient may have affected the digestibility of the feed. This is one reason why ketogenic-based diets have lower ADG compared to Diet A (control). At increasing percentages of high fiber dietary ingredients, Loar et al. [16] also observed a decrease in broiler BW gain. Diet B (lipid-based) and Diet C (protein-based), although they had lower ADG than Diet A (control), performed better than Diet D (fiber-based) because of their higher nutrient level. Diet B (lipid-based) had the highest ME (kcal) content while Diet C (protein-based) had the highest CP. In the study of Maiorka et al. [17], broilers fed the diet containing 3200 kcal ME/kg had higher weight gain compared to those fed the diet containing 2900 kcal ME/kg. Moreover, Gheisari et al. [18] observed higher total feed consumption and WG of birds in the high protein group compared to the low and medium protein groups. The lower ADG of ketogenic-based dietary treatments compared to the control (commercial) can also be attributed to the form of the feeds. The control diet was in the form of crumble, while the ketogenic-based feeds were in mash form. In the study by Massuquetto et al. [19], broiler chickens given pelleted/crumbled feed had higher ADG than those provided with mash. The outcome was associated with the higher FI of pelleted diets as a result of the pellets' greater durability and physical quality.

For the WG of broiler chickens, a significant difference can be observed among treatments ($p<0.0001$), and with 1312.85 grams WG, Diet A (control) had the best performance out of the four diets. Diet B (lipid-based) and Diet C (protein-based) are comparable at 884.32 grams and 862.00 grams, respectively, while Diet D (fiber-based) had the least WG (703.14 grams). Commercial feeds in the Philippines are usually formulated on a corn-soya-based approach. They are much digestible compared to ketogenic diets that were formulated low in digestible carbohydrate and high in either protein or lipid. The reason that the two ketogenic-based diets, Diet B (lipid-based) and Diet C (protein-based), performed better in WG compared to Diet D (fiber-based) was because of the combination of better-quality raw materials (more digestible) and higher digestible nutrient levels, particularly energy and protein. A study by Gallinger et al. [20] in broiler chicks showed that the addition of rice bran significantly reduced WG. At certain periods in the study, diets with rice bran performed poorly on growth assessments compared to the control diet, and increasing its percentage in the diet from 30% to 40% had a significant negative impact on WG.

FCR is a measure of how efficient an animal converts feed into live weight. It measures how many kilograms of feed are needed to produce a kilogram of weight gain. Producers, therefore, are aiming to attain a lower FCR in their production. Significant differences can be observed ($p<0.0001$) in the FCR of the experimental animals. Diet A (control) had the best FCR (1.83), followed by Diet B (lipid-based), Diet C (protein-based), and Diet D (fiber-based), which were statistically comparable at 2.67, 2.68, and 2.46, respectively. Given the underwhelming results in VFI, BW, ADG, and WG of broilers fed ketogenic diets, it's not surprising that these also led to poor FCR performance.

3.2 Carcass Quality

Table 5 shows the carcass weight (CW), dressing percentage (DP), abdominal fat (AF), and visceral fat (VF) yield of broiler chickens fed with different ketogenic feed formulations at 5 weeks old. Significant difference in CW ($p<0.0001$), DP ($p<0.0001$), and AF ($p=0.0034$) can be observed in the study, while visceral fat results are comparable ($p=0.3599$) among treatments. Diet A (control) had the highest CW at 1241.50 grams. Both Diet B (lipid-based) and Diet C (protein-based) had comparable CW at 871.13 grams and 895.50 grams, respectively, while the lowest CW was in Diet D (fiber-based) at 738.75 grams. The DP of Diet A (control) was the highest of all four diets, with 76.16% followed by Diet B (lipid-based), Diet C (protein-based), and Diet D (fiber-based) with 71.69%, 72.10%, and 70.53%, respectively. The AF yield was highest in Diet B (lipid-based) with 1.42%, comparable to Diet A (control) with 1.31%. It was followed by Diet C (protein-based) with 0.91% and lastly by Diet D (fiber-based) with 0.83%. When it comes to the VF yield, despite having no significant result, Diet A (control) relatively had the highest yield at 1.86%, followed by Diet B (lipid-based) with 1.70% and lastly by Diet C (protein-based) and Diet D (fiber-based) with both 1.37%.

A variety of factors, including breed, age, sex, environment, diet, and processing, can influence DP. Diets high in energy and protein will result in a higher dressing percentage [21]. The increased DP of the control animals can also be a result of commercial feeds that are high in digestible energy and protein, which promote better growth and muscular development. Finishing diets high in fiber can minimize DP. Diets high in fiber are thought to increase intestinal mass, reducing DP because intestinal mass accounts for a bigger share of live weight. This assumption agrees with the result of the study showing lower DP of broilers fed ketogenic-based diets. The abdominal fat also affected the DP of the carcass. Since this is included during the actual weighing of the broiler carcass, overestimation of the actual DP may occur. Moreover, visceral fat and DP had an indirect relationship. Since visceral fat is not included during carcass weighing but is included during live weighing, a higher percentage may result in lower DP.

The reduced abdominal fat yield in a protein-based diet was consistent with the study of Jlali et al. [22]. Their study revealed that chickens fed a high CP diet had a lower ($p<0.001$) accumulation of abdominal fat than chickens fed a low CP diet. It was also in agreement with the study of Sterling et al. [23] showing that dietary CP level significantly affected abdominal fat pad for both genotypes (Arbor Acre and Ross 508) of broiler chicks. Abdominal fat pad weights were higher for chicks fed the lower CP diets. Diet C (protein-based) had the highest DP among ketogenic-based diets and one of the lowest abdominal fat levels in the study. This is a positive outcome since abdominal fat, while included in the carcass weighing, is usually removed during fabrication. Diet B (lipid-based) had reduced DP but more abdominal fat. Because of the increased abdominal fat, the actual DP of broilers fed with this diet may be reduced even further. According to a study by Bhuiyan et al. [24], dietary fiber had a substantial ($p=0.0001$) impact on abdominal fat. Compared to birds with low fiber diets, those with medium (and high) fiber diets deposited less abdominal fat. Meanwhile, Nassar et al. [25] found that chickens fed a diet high in lignocellulose had less visceral fat deposition and less intramuscular fat than those fed a diet low in fiber. In general, crude fibers have three impacts on fat metabolism. First, they accelerate the flow of chyme through the intestinal tract, hence decreasing the possibility that intestinal cells would absorb fat [26]. Second, through interacting with bile acid in the digestive tract, crude fibers decrease lipid absorption and accelerate bile acid excretion [27]. Third, restricting poultry's dietary energy absorption can reduce cholesterol and fat synthesis [28].

Table 5. Carcass quality of broiler chickens fed with different types of ketogenic diet at 5 weeks old

Parameters	A (Control)	B (Lipid-based)	C (Protein-based)	D (Fiber-based)	SEM	p-value
CW (g)	1241.50^{a}	871.13^{b}	895.50^{b}	738.75^{c}	27.51	<.0001
DP (%)	76.16^{a}	71.69^{b}	72.10^{b}	70.53^{b}	0.54	<.0001
AF (%)	1.31^{ab}	1.42^{a}	0.91^{bc}	0.83^{c}	1.12	0.0034
VF (%)	1.86^{a}	1.70^{a}	1.37^{a}	1.37^{a}	0.23	0.3599

*Means with the same superscript are not statistically significant

3.3 Cost to Produce (CTP) and Broiler Production Efficiency Factor (BPEF)

The CTP and BPEF of broiler chickens fed with different ketogenic feeds are shown in Table 6. CTP was computed by dividing the total expenses of consumables (chick cost, feed cost, and medication) by the BW of the broiler chicken. On the other hand, BPEF is a comprehensive indicator of broiler performance. It is derived by dividing the BW of the broiler chicken by the FCR and multiplying the quotient by 100. Significant differences can be observed in both CTP ($p=0.0004$) and BPEF ($p<0.0001$). Based on the result, Diet A (control) had the lowest CTP at Php 89.43, whereas Diet B (lipid-based) with Php 101.68, Diet C (protein-based) with Php 101.32, and Diet D (fiber-based) with Php 102.32 were statistically comparable. These three ketogenic-based diets had higher CTP than the control, in terms of BPEF, Diet A (control) had the highest value with 99.72%. On the other hand, the three formulated ketogenic diets had comparable BPEF at 52.27%, 50.51%, and 48.27% for Diet B (lipid-based), Diet C (protein-based), and Diet D (fiber-based), respectively. ADG and FCR play a major role in determining animal performance. Commercial feeds use low-fiber ingredients like corn, making them more digestible than ketogenic-based formulations. These ingredients can easily be broken down and utilized by the animal's body. Due to the reduction in the sources of digestible carbohydrates, ketogenic-based diets were typically high in dietary fiber. It was anticipated that poor growth performance would also affect production efficiency. Diet D (fiber-based) was mainly affected by this intervention.

Table 6. CTP and BPEF of broiler chickens fed with different types of ketogenic diet

Parameter	A (Control)	B (Lipid-based)	C (Protein-based)	D Fiber-based)	SEM	p-value
CTP	88.08[a]	100.21[b]	98.89[b]	100.93[b]	1.97	0.0004
BPEF	99.72[a]	52.27[b]	50.51[b]	48.27[b]	2.72	<.0001

*Means with the same superscript are not statistically significant

4. Conclusions

This study found that Diet A (control) has the best growth results, notably in terms of BW, ADG, and FCR. Additionally, it has the greatest BPEF and the lowest CTP. However, when solely comparing the three ketogenic diets, Diet C (protein-based) outperforms the others across all growth performance metrics. Moreover, Diet A (control) had the highest carcass yield and dressing percentage, but also the most abdominal and visceral fat. In contrast, ketogenic diets, especially Diets C (protein-based) and D (fiber-based), significantly reduced fat accumulation.

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