

Effect of Replacing Maize with Sugar Industry Solid Wastes on the Performance and Economics of Production of Pullet Chicks

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Abstract

The cost of indispensable grains which function as the major energy source in livestock feeding has compelled many poultry farms to close down. This development has given rise to increasing search for substitute feed components that would replace the staple grains in the diets without automatically increasing direct cost on the feed. One of such unconventional feed ingredients accessible for use is the solid wastes (SWAPSI) arising from industrial production of table sugar. The effects of SWAPSI in place of maize on pullet chicks' growth rate, nutrient digestibility, blood parameters and economic production were examined over the course of 63-day experimentation. A total of 300 pullets (9 weeks old) were distributed to the five treatment groups such that each treatment had 60 birds. Each treatment was replicated 4 times with each replicate having 15 birds. The organization was done to fit into a Completely Randomized Design (CRD). The birds were administered a weighted amount of feed and water was provided ad – libitum. Five investigational diets labeled T₁, T₂, T₃, T₄ and T₅ were formulated to be iso-nitrogenous (18% crude protein) and iso-caloric (2700kcal/kg ME), with SWAPSI supplanting maize at 0, 20, 40, 60 and 80% for T₁, T₂, T₃, T₄ and T₅, in turn. Diet T₁ functioned as the control for the rest of the treatments and all the diets were formulated to meet the nutritional requisite of pullet chicks. Annals collected covered the growth parameters and economics of production. The result indicates that inclusion of SWAPSI in the diets meaningfully ($P<0.05$) abridged final body weight (509.49 vs. 467.63 vs. 418.06 and 399.59 g/bird), total weight gain (583.29 vs. 478.24 vs. 436.30 vs. 386.70 and 368.27 g/bird), and daily weight gain (11.21 vs. 9.19 vs. 8.39 vs. 7.43 and 7.08 g/bird/day) for birds fed diets T₂, T₃, T₄ and T₅, respectively as related to those fed the reference diet. Similarly, birds fed the control diet had better ($P<0.05$) performance of FCR (3.66) but the poorest protein efficiency ratio (0.62) and energy efficiency

ratio (21.60). SWAPSI significantly ($P<0.05$) reduced the digestibility of crude fat (78.63%) and nitrogen-free extract (49.13%) at T5; pullets fed diets T1 to T4 performed uniformly until the addition of SWAPSI up to 80% (T5). The outcome also exposed that SWAPSI inclusion meaningfully ($P<0.05$) reduced cost of feed consumed, cost of feed per kg weight gain, total cost of production, revenue produced and gross margin. It can be concluded that poultry farmers can add up to 40% of SWAPSI in diets of pullets without affecting the growth performance and profitability of the production.

Keywords: SWAPSI, Growth performance, Economics of production, Maize and pullet chicks

1.0 Introduction

One of the notable hitches about most emergent nations is their incompetence to sufficiently nourish their continually growing inhabitants with the precise percentage of calories and protein. The nourishment status of many Nigerians is categorized by truncated amount of protein and calories intake (Apantaku, 2006). Similarly, the quantity of the protein is another major concern as 35g/caput out of the 70g/ caput as previously advocated should come from animal sources, unfortunately the animal protein sources are either expensive beyond the reach of the ordinary Nigerian or highly unavailable due to low productivity.

In an attempt to reduce the high cost of feed for livestock, Nutritionists have had causes to investigate other non-conventional energy feed ingredients (Essien *et al.*, 2022; Christopher *et al* 2019; Christopher *et al.*, 2024) that would replace the staple grains and one of such high energy non-conventional ingredients are those emanating from sugar industries and particularly those of the solid component of the waste. According to Alu (2024), the solid wastes arising from the production of sugar is what is referred to as the solid waste product of sugar industry (SWAPSI) and it is believed to contain high amount of nutrients that are capable of sustaining livestock (Alu *et al.*, 2022).

In Nigeria, the annual production of SWAPSI is estimated to be about 250,000 metric tons or more. Some parts of the SWAPSI like the scrapings are thought to contain high amounts of carbohydrate and nitrogen-free extracts (2970.45 kcal/kg, ME) and could conveniently replace conventional staple grains like maize for energy in the diets of pigs and poultry, if properly processed. According to Alu (2024), most of the components of the SWAPSI being an alternative feed ingredient, are highly fibrous (over 35% crude fibre and 12 to 18% lignin) and would normally require some level of processing before they can be used as animal feed ingredient especially for monogastric like pigs and poultry that cannot handle high fibrous feeds (Alu, 2013).

The poultry sub-division of the industry has been designated as a swift means of linking the gap amongst the supply and demand of animal protein in the populace (Dairo *et al.*, 1997). The world's citizenry is anticipated to escalate to over nine billion people by 2050, and Nigeria's human race would spew to over 400 million (Alu, 2024). This will put a hassle on evolving states and present a struggle for nutrition safety. Additionally, pursuit for livestock yields has become a commodity of viable growth, which raises the burden on the livestock business to produce more with its poky resources (Bruinsma, 2003). The FAO (1997) opposed 35g as least day-to-day consumption of animal protein, but advocate at present 4.82g per capita (Tewe,

1999). However, the livestock business is one of the swiftly expanding subdivisions in agriculture, approximately 40% of the value of all agricultural production worldwide (Bruinsma, 2003), supporting nearly 1.3 billion people's incomes and nutrition safety. The effects of land conversion, the most competent way to produce food for humans, and the concerns of growing use on biodiversity and ecological services, are all brought up by this expansion.

Livestock is a foremost source of returns for the downtrodden and needy people in emergent countries and a substantial entry point in the contest against pastoral dearth (Randolph *et al.*, 2007; Smith *et al.*, 2013). The most important center of the livestock production issue in Nigeria and other emergent nations is the high worth of feed, which can make more than 70% of the total production charge. Several poultry farmers have been enforced by this status quo to either terminate operations entirely or shrivel production (Uko and Kamalu, 2003). Animal protein has become more exorbitant due to the high cost of animal products and constituents for orthodox feed, which is connected to farm animals' truncated production (Onyimanyi and Onu, 2009). Therefore, the objective of this study is to determine the influence of using solid waste products of the sugar industry in place of maize on pullet chicks' growth performance and economic production.

2.0 Materials and Methods

2.1 Location of the Study

The study was conducted at the poultry pen in the Livestock Complex of the Department of Animal Science, College of Agricultural Science and Technology Lafia, Nasarawa State. The Farmstead is sited in the Southern Guinea Savanna Zone of Nigeria on Latitude 8°35'N and longitude 8°33'E. The least temperature is 23°C and maximum temperature is 36.9°C, with mean monthly relative humidity of 74%. The mean yearly rainfall is 823mm (NIMET, 2021). At the time of the enquiry, precipitation, relative humidity and temperature, data was obtained from the Meteorological Station of the Faculty of Agriculture Shabu- Lafia Campus, Nasarawa State University, Keffi.

2.2 Sources of Test Ingredient and Processing

SWAPSI was garnered from Dangote Sugar Refinery in Numan LGA of Adamawa State. SWAPSI was parched for 2 - 3 days to decrease the soggy and outwit the growth of mould and rancidity. Consequently, it was ground to produce SWAPSI meal. Supplementary constituents such as maize, groundnut cake, rice offal, palm oil, fish meal, lysine, salt, methionine and premix were procured from Global Feeds Ltd, Abuja, Nigeria.

2.3 Biochemical Analysis of SWAPSI

The proximate analysis of SWAPSI was actualized at the Institute for Agricultural Research and Training, Ibadan, Oyo State, Nigeria to assay the crude protein, crude fibre, ether extract, ash, NFE, moisture content and metabolizable energy using the approach of AOAC (2010). The amino acids were quantitatively resolved by the approach of Spackma *et al.* (1958) utilizing programmed amino acid analyzer (Technicon Sequential Multi-sample Analyzer, TSM). The specimen was hydrolyzed for inquest of all amino acids except tryptophan in constant boiling hydrochloric acid for twenty two (22) hours beneath nitrogen flush. The results are presented in Table 2.1.

Table 2.1: Proximate, amino acid profile and energy composition of SWAPSI

Parameters	(%)
<i>Proximate composition</i>	
Dry matter	89.43
Crude protein	7.16
Ether extract	5.62
Crude fibre	21.06
Ash	4.12
Moisture	4.13
Nitrogen free extract	57.91
Carbohydrate	78.97
*Metabolizable energy (kcal/kg, ME)	2778.51
<i>Amino acid profile</i>	
Histidine	0.30
Isoleucine	0.82
Leucine	1.17
Lysine	0.87
Methionine	0.40
Phenylalanine	0.81
Threonine	0.67
Tryptophan	0.20
Valine	0.95
Arginine	0.40

Sources: Laboratory Analysis (2022) * Pazuenga (1985), ND-Not determined

2.4 Phytochemical Screening

Oxalate content was assayed by a revised approach of Libert and Franceschi (1987). In this methodology, 1g of the sample was deliberated into a 250 *ml* conical flask, dunked in 100 ml purified water and endorsed to tarry for 3 hours, monitored by percolation through a bipartite layer of sieve paper. Absorbance was assayed spectrophotometrically at 420*nm*. Oxalate and tannin were resolved by the spectrophotometric system of Griffiths and Jones (1977). Saponin was examined by the methodology of Makkar and Becker (1996). Phytic acid assay was primed according to the acclimated technique defined by Wheeler and Ferrel (1971) and Steward (1974) while trypsin inhibitor activity was queried based on the routes designated by Gupta and Deodhar (1975) and Hammerstrand *et al.* (1981). The systems share the same ethics of defining trypsin inhibitors in soybean products founded on the tryptic hydrolysis of artificial substrate, benzoyl-DL-arginine-nitroanilide. The result of the screening is summarized in Table 2.2.

2.5 Experimental Diets

Five experimental diets marked T₁, T₂, T₃, T₄ and T₅ were stated to be isonitrogenous (18% crude protein) and iso-caloric (2700kcal/kg ME), with SWAPSI supplanting maize at 0, 20, 40, 60 and 80% for T₁, T₂, T₃, T₄ and T₅, per capita. Diet T₁ tend as the reference for the rest of the treatments and all the diets were balanced to meet the nutrients requisites of chicks as presented in Table 2.3

Table 2.2: Anti-nutritional factors of SWAPSI

Parameters	(%)
Tannin	29.43
Saponin	32.27
Phytate	32.61
Oxalate	7.15
Trypsin inhibitor activity	3.72

2.6 Experimental Design and Management of the Birds

A total of 300, 9-weeks old pullets were meted out to the five treatment sets such that each treatment had 60 birds. Each treatment was imitated 4 times with each imitation having 15 birds. The scheme was done to fit into a Completely Randomized Design (CRD). The trial lasted for 63 days. All trial birds were proffered, weighed quantity of feed, and water was provided *ad libitum*. Accustomed management practices for tendering of pullet chicks were promulgated as defined by Oluyemi and Robert (2000).

About 10-12 days in advance to the arrival of chicks befitting decontaminator (Neodine) was used to divest microbes that could make birds vulnerable to diseases. Similarly, the hutches were thawed out using 200 watt heat generating bulbs for about twenty four hours (24 hours) foregoing the chick's arrival to preserve a temperature of 85 to 90°F. Wood shavings were laid on the concrete floor up to the profundity of 2cm to provide insulation and serve absorbent of moistness from excreta, after the brooding room had been scorched.

2.7 Data Collection

2.7.1 Growth Parameters

The growth response parameters taken were body weightiness, measured on a weekly basis; feed intake was catalogued on a daily basis by finding the discrepancy between the quantity offered and the scraps collected the following day (this was later expressed on a weekly basis). Body weight gain was evaluated weekly while feed conversion ratio was computed by dividing feed intake by weight gain. Protein efficiency ratio (PER) was determined as the gain in body weight to the corresponding amount of protein gobble by the birds.

2.7.2 Nutrient Digestibility

By the last 7days of the feeding trial, 5 birds from separate units were used for digestibility studies. The birds were kept undisturbed while fasting for 12 hours; this was used to empty their gut to indicate the beginning and end of the collection period. The faeces collected were oven dried for a patch of 18 hours at a temperature of 105°C and weighed daily. At the end of the collection period, the faeces samples collected from each replicate per day were pooled, ground and thoroughly mixed to obtain a homogenous mixture. Samples of the faeces were taken for proximate analysis as outlined by standard methods of AOAC (2010) and the results obtained were used to calculate the apparent digestibility using the formula below:

$$AD = \frac{\% \text{ nutrient in feed } \times F1 - \% \text{ nutrient in faeces } \times FO}{\% \text{ nutrient in feed } \times F1} \times \frac{100}{1}$$

.....Equation 2.1

Where AD = Apparent digestibility (%)
 FI = Feed intake (on dry matter basis)
 FO = Fecal output (on dry matter basis)

Table 2.3: Gross and chemical compositions of experimental diets for pullet chicks

Ingredients	T1	T2	T3	T4	T5
	(0%SWAPSI)	(20%SWAPSI)	(40%SWAPSI)	(60%SWAPSI)	(80%SWAPSI)
Maize	55.00	44.00	33.00	22.00	11.00
*SWAPSI	0.00	11.00	22.00	33.00	44.00
Groundnut cake	10.25	8.00	7.00	10.90	3.00
Soya bean meal	7.75	7.00	3.00	10.00	13.00
Wheat bran	14.00	15.00	17.00	5.00	7.00
Palm oil	4.00	4.00	5.00	4.00	5.00
Salt	2.00	2.00	2.00	1.00	1.00
Blood meal	4.00	3.00	2.00	1.00	1.00
Bone meal	1.00	1.00	1.00	1.00	1.00
Premix	1.00	1.50	1.50	1.50	1.40
Lysine	0.25	0.25	0.30	0.30	0.30
Methionine	0.25	0.25	0.30	0.30	0.30
Toxin binder	0.50	3.00	5.90	10.00	12.00
Total	100.00	100.00	100.00	100.00	100.00
Probiotic	+	+	+	+	+
Toxin binder	+	+	+	+	+
Acidifier	+	+	+	+	+
Calculated Chemical Analysis					
*Energy	2793.50	2701.26	2712.79	2725.79	2700.00
Protein	18.90	18.78	18.13	18.30	18.00
Crude fibre	4.02	4.76	5.26	5.98	6.97
Ether Extract	5.74	7.93	10.12	10.33	17.27
Ash	2.64	3.11	3.31	3.93	4.36
Calcium	3.24	3.40	4.36	3.84	3.84
Phosphorus	0.88	0.96	0.88	0.96	0.70
Lysine	1.17	1.20	1.23	1.22	1.28
Methionine	0.55	0.54	0.58	0.56	0.55

*SWAPSI= solid waste products of sugar industry, SWAPSI= solid waste of sugar industry; The vitamin- mineral premix supplied the following per 100kg of diet: vitamin A15,000 I.U, vitamin D3 300,000 I.U.,vitamin E 3,000 I.U., vitamin K 2.50mg, vitamin B₁ (thiamin) 200mg, Riboflavin (B₂) 600mg, pyridoxine (B₆), Niacin 40.0mg, vitamin B₁₂ 2mg, Pantothenic acid 10.0mg, folic acid 100mg, Biotin 8mg, choline chloride 50mg, anti-oxidant 12.5mg, manganese 96mg, zinc 6mg, Iron 24mg, Copper 0.6mg, Iodine 0.14mg, Selenium 24mg, cobalt 214mg. Using Feedwin software version 1.01 *Pauzenga (1985).

2.7.3 Blood Evaluation

2.7.3.1 Haematological Parameters

At the end of the feeding trial, blood samples were collected from 2 birds per facsimile using 5mls sterile disposable needles. The blood were collected from the van veins of the birds and voided into sample bottles containing ethylene diamine tetra acetic acid (EDTA) as anti-coagulant, to avert clotting of the blood and used to appraise the following haematological indices: red blood cells (RBC), white blood cells (WBC), packed cell volume (PCV), haemoglobin (Hb), and leucocytes differentials. The PCV was probed using the Micro haematocrit Method and the total erythrocyte and total leucocytes count using haemocytometer Method as recounted by Schalm *et al.* (1975). Haemoglobin concentration and differential leucocytes count was also determined as adopted by Schalm *et al.* (1975), while Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC) were also determined using the formulae of Schalm *et al.* (1975).

$$MCV = \frac{PCV(\%) \times 10}{RBC (X 10^6/mm^2)} \text{ fentolitre (fl)} \dots\dots\dots \text{Equation 2.2}$$

$$MCH = \frac{Hb(g/dl) \times 10}{RBC (X 10^6/mm^2)} \text{ picogram (pg)} \dots\dots\dots \text{Equation 2.3}$$

$$MCHC = \frac{Hb(g/dl)}{RBC (\%)} \times \frac{100}{1} \text{ (gm/dl)} \dots\dots\dots \text{Equation 2.4}$$

2.7.3.2 Serum Biochemical Variables

Blood samples were collected in disparate bottles without anti-coagulant to enable clotting for serum biochemical analyses. Serum protein, urea, uric acid and globulin were scrutinized using sigma kits. Glucose was scrutinized according to Feteris (1965) and cholesterol as stated by Roschlan *et al.* (1974).

2.7.4 Economics of Production

The pervasive retail worth of feedstuffs was employed to compute the price of feed per kilogram of pullet diets. Feed intake per bird for the 9-week survey period was used to generate the cost of feed consumed by a bird. The cost per kilogram weight gain was computed using the technique of Ukachukwu and Anugwa (1995) by ascertaining the product of cost per kilogram feed and feed conversion proportion of birds. The cost of production was projected as the product of cost per kilogram weight gain and mean total weight gain, while gains were calculated as price of meat multiplied by mean total weight gain. The gross margin was assessed as the variance between income and cost of production. Cost of feed per kilogram (₦/kg) was computed as the cost of the feed ingredient multiplied by the conventional retail price whereas cost of feed per unit weight gain was computed as the cost of feed divided by a unit weight gain. Profit was calculated by deducting the whole cost of production from the total proceeds established.

2.8 Statistical Analysis

All data amassed were subjected to a One Way Analysis of Variance (ANOVA) using the overall linear model of Statistical Package for Social Science (2007). Significantly varied means were measured and separated at 5% level of significance ($P < 0.05$) using Duncan's Multiple Range Test (DMRT) as well-defined by Steel and Torries (1980).

3.0 Results and Discussion

3.1 Nutrients and Anti-nutrient Composition of SWAPSI

Tables 2.1 and 2.2 summarize the nutrient and anti-nutrient configuration of SWAPSI. The results show that the trial ingredient is low in crude protein (7.16%), ether extract (5.62%), moisture (4.13%), and ash (4.12%), but has substantial quantity of carbohydrate (78.97%), nitrogen-free extract (57.91%) and crude fibre (21.06%). The material is also rich in metabolizable energy (2778.51 kcal/kg, ME). These values are generally lower than those earlier reported for maize, sorghum and most cereal grains but comparatively close to those of rice offal and rice straw (Esonu, 2000; Alu *et al.*, 2015).

The relatively low existence of anti-nutritional factors such as phytate (32.61%), saponin (32.27%), tannin (29.43%), oxalate (7.15%) and trypsin inhibitor activity (3.72%) in SWAPSI makes it fit and safe for monogastric animals as these levels do not give rise to any danger to the health of the animals. Antecedent researches reveal that swine are not expressively affected due to low levels of anti-nutritional factors especially when such components are appropriately treated (Church and Pond, 1988; Aduku, 2004; Alu, 2024).

3.2 Growth Performance of Pullet Chicks Fed SWAPSI

The result of the effect of recouping maize with SWAPSI on the growth performance of pullet chicks is presented in Table 3.1.

Table 3.1. Effect of replacing maize with SWAPSI in the diets of pullets chicks

Parameters	LEVELS OF SWAPSI REPLACEMENT					SEM	LOS
	T1 (0%)	T2 (20%)	T3 (40%)	T4 (60%)	T5 (80%)		
Initial body weight(g/bird)	30.91	31.25	31.33	31.36	31.32	0.09	NS
Final body weight (g/bird)	614.19 ^a	509.49 ^b	467.63 ^{bc}	418.06 ^c	399.59 ^c	19.35	*
Total weight gain (g/bird)	583.29 ^a	478.24 ^b	436.30 ^{bc}	386.70 ^c	368.27 ^c	19.39	*
Daily weight gain (g/bird/day)	11.21 ^a	9.19 ^b	8.39 ^{bc}	7.43 ^c	7.08 ^c	0.37	*
Daily feed intake (g/bird/day)	40.04	38.48	38.76	39.58	38.66	0.28	NS
FCR	3.66 ^d	4.21 ^{cd}	4.66 ^{bc}	5.41 ^{ab}	5.48 ^a	0.17	*
Protein intake (g/bird)	7.20	6.92	6.97	7.12	6.95	0.05	NS
Protein efficiency ratio	0.62 ^a	0.51 ^b	0.46 ^{bc}	0.41 ^c	0.39 ^c	0.02	*
Energy efficiency ratio	21.60 ^a	17.71 ^b	16.15 ^{bc}	14.32 ^c	13.63 ^c	0.54	*

*= Significantly different ($P < 0.05$), NS= Not significant ($P < 0.05$), SEM= standard error of mean, LOS= Level of significant difference, a,b,c,d = means on the same row bearing different superscript differ significantly ($P < 0.05$)

The result shows that the addition of SWAPSI in the diets significantly ($P < 0.05$) vary; final body weight (509.49 vs. 467.63 vs. 418.06 and 399.59 g/bird), total weight gain (583.29 vs. 478.24 vs. 436.30 vs. 386.70 and 368.27 g/bird), daily weight gain (11.21 vs. 9.19 vs. 8.39 vs. 7.43 and 7.08 g/bird/day) for birds fed diets T2, T3, T4 and T5, respectively as compared to those fed the

reference diet. Similarly, birds fed the referenced diet had the choicest ($P < 0.05$) performance of FCR (3.66) but inferior protein efficiency ratio (0.62) and energy efficiency ratio (21.60). These results are not in harmony with the finding of Tuleun *et al.* (1998), Atteh (2000) and Thompson and Webs (1981) who ascertained a growth in feed consumption as nutritional fibre heights ameliorate in the regimes of starter chicks.

The devitalized values documented could be due to the overall effects of fibre which is known to abate digestibility and accessibility of nutrients. It is therefore probable that the inclusion of SWAPSI could have made these diets harder to chew thus; making the birds to consume fewer amounts. The nutrients resulting from diets are what determine weight increases when immersed and deposited; this explains the observation of significant drop across the treatments in the weight gain by the birds as the level of SWAPSI surge in the diets.

Similarly, the efficiency of feed utilization amplified, as the levels of SWAPSI increased in the dietary treatments, a suggestion that the birds in the reference diet were more effective in converting feed to edible meat. It is a known fact that, fibre in the diet of monogastric animals deteriorates the exploitation of other nutrients especially crude protein consumption (Atteh 200; Savage *et al.*, 1980; Delmore and Wojeik, 1982). The observations recorded in the present study are in line with previous research by, who found that monogastric animals have reduced control ability of higher fibrous materials like sugarcane scrapping due to higher fibre and low metabolizable energy content.

3.3 Effect of Replacing Maize with SWAPSI on the Nutrient Digestibility of Pullet Chicks

The result of the effect of replacing maize with SWAPSI on the nutrient digestibility by pullet chicks is summarized on Table 3.2.

Table 3.2 Effect of replacing maize with SWAPSI on nutrient digestibility of pullet chicks

Parameters (%)	LEVELS OF REPLACEMENT OF SWAPSI					SEM	LOS
	T1 (0%)	T2 (20%)	T3 (40%)	T4 (60%)	T5 (80%)		
Crude protein	93.36	85.88	82.28	85.07	90.87	1.87	NS
Crude fat	92.64 ^a	85.15 ^a	79.87 ^a	84.93 ^a	78.63 ^b	2.04	*
Crude fiber	33.53	31.86	22.43	14.76	24.06	2.99	NS
Ash	71.58	75.93	71.47	74.97	63.31	8.92	NS
Dry Matter	46.26	36.44	45.43	41.74	46.59	3.14	NS
Nitrogen-free extract	50.52 ^a	50.32 ^a	50.10 ^a	49.99 ^a	49.13 ^b	11.08	*

NS= Not significant ($P < 0.05$), SEM= standard error of mean, LOS= Level of significant difference, a, b= means on the same row bearing different superscript differ significantly ($P < 0.05$)

SWAPSI significantly ($P < 0.05$) reduced the digestibility of crude fat (78.63%) and nitrogen-free extract (49.13%) at T5; pullets fed diets T1 to T4 performed uniformly until addition of SWAPSI up to 80% (T5). Being a monogastric, it is palpable that once the level of inclusion of fibrous ingredient like SWAPSI gets to a certain level in the diet, acceptability, digestion and exploitation would naturally be abridged. This is because of the restriction in their fibre-handling ability which was not more than 5-7%. The result in the present study is in agreement with the previous investigation of Alu *et al.* (2013) and Azi *et al.* (2022). These researchers fed animals

with high dietary fibre diets and observed a significant reduction in most of the nutrient digestibility parameters.

3.4 Effect of Replacing Maize with SWAPSI on Blood Parameters of Pullet Chicks

Table 3.3 summarizes the effect of replacing maize with SWAPSI on the haematological indices and serum biochemical constituents of pullet chicks.

Table 3.3. Effect of replacing maize with SWAPSI on blood parameters of pullet chicks

Parameters	LEVELS OF REPLACEMENT OF SWAPSI					SEM	LOS
	T1 (0%)	T2 (20%)	T3 (40%)	T4 (60%)	T5 (80%)		
Haematological indices							
Packed cell volume (%)	25.50	25.50	29.50	28.00	26.00	1.2	NS
Haemoglobin (g/dL)	11.30	8.80	10.15	10.05	8.95	0.42	NS
Red blood cells (x10 ⁶ /μL)	2.60	2.40	2.80	2.90	2.50	0.11	NS
White blood cells (X10 ⁵ /μL)	91.50	141.00	106.00	97.50	97.50	8.37	NS
MCV (fl)	115.00	109.50	105.00	106.00	109.00	2.32	NS
MCH (pg)	45.50	36.00	37.00	36.00	35.00	2.03	NS
MCHC (g/dL)	38.00	34.50	34.50	34.00	34.50	0.91	NS
Serum biochemistry							
Total protein (g/L)	33.50	33.50	42.50	42.00	34.50	1.96	NS
Albumin (g/L)	19.00	20.00	22.50	25.00	20.00	1.19	NS
Creatinine (mmol/L)	48.50	65.50	35.50	36.00	41.00	6.13	NS
Urea (mmol/L)	3.25	1.85	2.65	2.80	2.80	0.32	NS
Cholesterol (mmol/L)	3.75	3.95	3.45	3.35	4.30	0.17	NS
Triglycerides (mmol/L)	1.30	1.10	1.40	1.20	1.10	0.06	NS

MCV= meal cell volume; MCH= mean cell haemoglobin; MCHC=mean cell haemoglobin concentration; %= percentage, SEM= Standard error means, NS= No significant ($P>0.05$), LOS= Level of significant.

The result shows that SWAPSI inclusion did not affect ($P>0.05$) any of the haematological indices as well as serum biochemistry of the pullets. These clarifications are in agreement with the earlier submission of Alu *et al.* (2020) who report non-significant variation on all the blood parameters of broiler finisher birds fed tiger nut offal. The observation in the existent study suggests that dietary fibre does not affect the blood parameters of animals; this is further long-established in other species of farm animals such as pig as previously reported by Alu *et al.* (2011). Alu *et al.* (2011) fed high fibre of rice offal based to pigs and noted that all the blood indices were not affected by the dietary treatment. The values recorded in the present study fell within the normal range for healthy pullet chicks as earlier reported by Ogbe *et al.* (2013) and Ombugu *et al.* (2022).

3.5 Economics of Production of Pullet Chicks Fed SWAPSI

The result of the effects of replacing maize with SWAPSI on the economics of production of pullet chicks is presented on Table 3.4.

Table 3.4 Effect of replacing maize with SWAPSI on economics of production of pullet chicks

Parameters	T1 (0%)	T2 (20%)	T3 (40%)	T4 (60%)	T5 (80%)	SEM	LOS
Cost of feed/kg (₦/kg)	351.75	328.50	319.30	309.03	275.23	-	NA
Cost of feed consumed (₦/bird)	788.71 ^a	707.96 ^b	693.06 ^b	685.06 ^b	595.90 ^c	10.06	*
Cost of feed/kg weight gain (₦/bird)	1289.29 ^b	1386.11 ^b	1488.74 ^{ab}	1673.49 ^a	1509.25 ^{ab}	43.16	*
Total cost of production (₦/bird)	1535.49 ^a	1273.74 ^b	1273.74 ^{bc}	1045.16 ^c	998.99 ^b	48.39	*
Revenue (₦)	1654.71 ^a	1573.91 ^b	1559.06 ^b	1551.06 ^b	1461.90 ^c	13.37	*
Gross margin (₦)	119.21 ^a	300.16 ^{ab}	285.32 ^b	505.90 ^b	462.90 ^b	41.08	*

NA= Not applicable, NS= Not significant ($P < 0.05$), SEM= standard error of mean, LOS= Level of significant difference, a, b= means on the same row bearing different superscript differ significantly ($P < 0.05$)

The results revealed that SWAPSI inclusion significantly ($P < 0.05$) abridged the cost of feed consumed, cost of feed per kg weight gain, total cost of production, proceeds generated and gross margin. SWAPSI, being a waste product of sugar industry does not have economic value therefore; its inclusion in the diets does not attract any financial implication. This opinion is in line with the previous findings of Ogbe *et al.* (2013), who affirmed that incorporating non-conventional components and particularly desiccated rumen contents into broiler diets led to a prominent drop in feed expenditure and revenue. Similarly, Alu *et al.* (2013) reported that addition of sugarcane scrapings in the diets of broiler chickens meaningfully ($P < 0.05$) abridged all the pecuniary indices but increased income and gross margin.

4.0 Conclusion and Recommendation

From the results acquired, poultry farmers can augment up to 40% of SWAPSI in the diets of pullets without upsetting the growth performance and profitability of the production.

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