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Effect of Dietary Inclusion of Sunflower (*Helianthus Annus*) Oil on the Growth Performance of Broiler Finisher Chickens

[*1]AGUBOSI, O.C.P., [2] WIKA, BEKITDA KIRITMWA And [3]ALAGBE, J.O
[1,2,3] DEPARTMENT OF ANIMAL SCIENCE
UNIVERSITY OF ABUJA, NIGERIA
*Corresponding Author: Agubosi.oluchi@uniabuja.edu.ng

Abstract: A research was conducted to determine the dietary inclusion levels of sunflower ((*Helianthus annus*) oil (SWO) on the growth performance of broiler chickens. One hundred and fifty four- weeks old broiler chickens were randomly allotted into 5 treatments with three replicates consisting of 10 birds each in a completely randomized design (CRD). Birds in T_2, T_3, and T_4 and T_5 were fed the basal diet mixed with 100, 200, 300, and 400 mg/kg of sunflower oil, while birds in T1 were fed the basal diet and Neomycin at 2.0 g/kg. The experiment lasted for 28 days. Feed and clean water were offered *ad libitum* and all other management practices were strictly observed throughout the experimental period. Data were collected on average weight gain (AWG), total feed intake (TFI), and feed conversion ratio (FCR). Data generated was analyzed using analysis of variance (ANOVA) using SPSS. Phytochemical composition of sunflower oil revealed the presence of bioactive chemicals like Flavonoids (10.06 %), tannins (6.96 %), phenols (7.06 %), trepenoids (5.01 %), steroids (4.47 %), alkaloids (3.86 %) and saponins (4.47 %). Results of the growth performance showed that birds fed sunflower oil had significantly *(P*<0.05) higher final body weight, average body weight gain, total feed intake and better feed conversion ratio compared to the control given synthetic antibiotics (T1). Mortality was only recorded among birds in T1 and none was recorded in the other treatments (*P*<0.05). It can be concluded that the inclusion of sunflower oil up to 400 mg/kg in the diets of broiler chickens enhanced growth performance and suppressed the activities of pathogenic microorganisms.

Keywords: Broiler chicken, Sunflower oil, Growth Performance, Phytochemicals

Introduction

Broiler is the most widely organic meat consumed and predicted to have increased consumers demand and production because it's a good source of protein with relatively high concentration of polyunsaturated fatty acids (Bourre, 2005). Broiler consumption has no religious sentiment or taboo and it has an overall acceptable nutritional profile and taste, and many Nigerians consume it (Hatab *et al*., 2019). The need for the use of antibiotics to decrease the spread of diseases (Waldrop *et al*., 2003) and as a growth enhancer is increasing day by day to sustain the growth of livestock production and management (Roura *et al*., 1992). However, the continuous and indiscriminate use of antibiotics has led to increasing cases of antimicrobial resistance and possible transmission of toxic residues into livestock products such as meat and eggs (Oluwafemi *et al*., 2021). The replacement of antibiotic growth promoters with other safe and natural alternatives is crucial to prevent environmental pollution and promote food safety (Alagbe, 2022; Agubosi *et al*., 2022). There are some promising results on the use of Essential oils and other natural products as performance enhancers.

Plant-derived feed additives known as phytogenic feed additives (PFAs), comprising of herbs, spices, Essential oils (EOs), plant extracts, and their components have therefore become a growing class of feed additives for livestock production because they contain phytochemicals or secondary metabolites (Burt, 2004; Wenk, 2000; Dorman and Deans, 2000) . The potential of PFA to improve performance is attributed to their ability to maintain a healthy gut environment and prevent dysbiosis (Windisch *et al.*, 2007; Burt, 2004). In a significant number of scientific studies, Essential oils containing most of the active substances of the plant have been reported to promote health and enhance the zoo technical performance by increasing nutrient availability for animals due to their antioxidant and anti-inflammatory effects, gut microbial modulation, beneficial impacts on the gut quality resulting in better performance (Diaz-Sanchez *et al*., 2015; Upadhaya and Kim 2017; Luna *et al*., 2019), improved nutrient digestibility (Jamroz *et al.*, 2003). Essential

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oils can be extracted from the leaf, stem, roots, buds and flowers of plants (Shittu *et al*., 2021). Among the potential plants loaded with several bioactive chemicals is Sunflower seeds.

Sunflower *Helianthus annuus,* is a short season plant classified into family Asteraceae and genus *Helianthus* with more than 70 species known worldwide (Adesina, 2018). Sunflowers have been employed in the preparation of various delicacy as seed, in the processed or extracted form, or form of composite products (Adesina, 2018). Sunflower seeds can be processed into different forms, such as flour, roasted, baked, or boiled as composite functional foods (Grasso *et al*., 2019). Sunflower remains a source of nutritional food for humans. Studies have revealed that sunflower seeds are rich nutrients and certain different phytochemicals such as antioxidants, flavonols, phenolic acids, procyanidins, phytosterols, amino acids, Dietary fiber, potassium, arginine monounsaturated, and polyunsaturated fatty acids which contribute to the improvement of human health (Alagawany *et al.,* 2015; Islam *et al.,* 2016).

The presence of some essential amino acids such as aspartic acid, glutamic acid, serine, histidine, glycine, threonine, arginine, alanine, tyrosine, cysteine, valine, methionine, phenylalanine, isoleucine, leucine, lysine, and proline in sunflower products has also been reported (Karangwa *et al.,* 2015); (Karefyllakis, *et al*., 2019).

This experiment was designed to effect of dietary inclusion of sunflower (*Helianthus annus*) oil on the growth performance of broiler finisher chickens.

Materials And Methods

Experimental sites

The experiment was carried out at the University of Abuja Teaching and Research Farm, Poultry Section University of Abuja, Gwagwalada- Abuja, is geographically located within the guinea savannah zone with latitude 8.9807^0N and longitude 7.1805^0E with an altitude of maximum elevation change of 180 feet and elevation above the sea level of 642 feet.

Pre-experimental actions

Pens and galvanized battery cages were washed and disinfected with CID-20 two weeks before the commencement of the experiment. Plastic drinkers and feeders were properly washed and foot dip was constructed to prevent the transmission of diseases.

Collection and processing of Sunflower oil

The seeds of sunflower (*Helianthus annuus*) plant were collected within the University of Abuja Teaching and Research Farm Abuja, Nigeria. Taxonomic authentication was conducted in the Department of Crop Science, University of Abuja, Gwagwalada. The dried seeds were granulated into coarse particles using a laboratory grinder. Oil was extracted from the granulated seeds using soxhlet extraction method and subjected to further analysis.

Experimental animals, management and diet formulation

A total number of 150 unsexed 4 weeks broiler chickens (Ross 308) were purchased from a commercial hatchery in Ibadan, Oyo State, Nigeria. The birds were weighed on arrival and randomly allotted into 5 dietary treatments. Each treatment was further subdivided into 3 replicates consisting of 10 birds in a completely randomized design. A galvanized wire battery cage measuring (705 × 300 × 100 cm) (length × breathe × height) suspended 80 cm above the floor level was equipped with manual feeder and drinker in a well ventilated pen and 200 Watt bulbs in each cage to provide heat for the animals. Anti-stress and glucose was also administered on arrival of the birds to reduce stress on the animals. Feed was formulated to meet the nutritional requirements of birds according to NRC (1994) as presented in Table 1. Clean water and feed were given to the birds *ad libitum* throughout the experiment which lasted for 28 days.

Experimental set-up

Treatment 1: Basal diet + 2 grams of neomycin/kg feed; treatment 2: basal diet + 100 mg sunflower oil/kg feed; treatment 3: basal diet + 200 mg sunflower oil/kg feed; treatment 4: basal diet + 300 mg sunflower oil/kg feed; treatment 5: basal diet + 400 mg sunflower oil/kg feed.

Measurements

Initial weight (IW): The initial weights of the birds were measured before the commencement of the experiment.

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Final weight (FW): The weight of the broiler chickens was measured at eight weeks of the experiment, where birds per replicate were weighed and the average was calculated and recorded.
Weight gain (WG): It was calculated by subtracting the initial weight from final weight.
Average daily weight gain (ADWG) = $\frac{\text{weight gain (WG)}}{\text{No of days of the experiment}}$
Daily feed intake: It was determined by subtracting quantity of left over feed from quantity of feed given.
Feed conversion ratio: It was calculated by dividing the quantity of feed consumed by weight gain.

Phytochemical analysis

Alkaloids and terpenoids were determined using the method described by Harborne, (1973); Odebiyi and Sofowora (1978). The alkaline method of titration was employed for the determination of tannins (AOAC, 2000). The percentage composition oxalate was determined by the permanganate titration method by Dye (1956) while saponin content was determined using the method of AOAC (2000). Determination of flavonoid content was done by the method described by Boham and Kocipai (1974).

Statistical analysis

Completely randomized design was used in this study. The data generated were subjected to analysis of variance (ANOVA) using SPSS (25.0) software. Where differences in means manifest, the Duncan's multiple range test (DMRT) was used to separate them at ($P< 0.05$) level of probability.

Table 1 Chemical composition of experimental diets

Ingredients (kg)	T1	T2	T3	T4	T5
Maize	66.53	66.53	66.53	66.53	66.53
G/cake (44%)	7.58	7.58	7.58	7.58	7.58
Soya cake	17.00	17.00	17.00	17.00	17.00
Fish meal	5.00	5.00	5.00	5.00	5.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25	0.25
Vit TM Premix	0.25	0.25	0.25	0.25	0.25
L-Lysine	0.25	0.25	0.25	0.25	0.25
Di- Methionine	0.14	0.14	0.14	0.14	0.14
Sun flower oil (mls)	0	0.10	0.20	0.30	0.40
Total	100	100	100	100	100
Calculated analysis (% DM)					
Crude Protein (%)	20.5	20.5	20.5	20.5	20.5
ME: kcal/kg	3015	3015	3015	3015	3015
Crude fibre	3.30	3.30	3.30	3.30	3.30
Ether Extract	1.40	1.40	1.40	1.40	1.40
Ash	7.80	7.80	7.80	7.80 `	7.80

*Biomix premix supplied per kg of diet: Vit.A:10,000IU; Vit.D3:2000IU;Vit. E: 23mg; Vit. K: 2mg; Vit.B1:1.8mg; Vit.B2:5.5; Niacin: 27.5mg; pantothenic Acid: 7.5mg; Vit. B12:0.015:Folic acid:0.75mg; Biotin: 0.06mg;Choline Chloride:300mg; Cobalt: 0.2mg;Copper: 3mg; Iodine :1mg Iron:1mg; Manganese: 40mg; Selenium:0.2mg; Zinc:30mg; Antioxidant:12.5.

Table 2: Photochemical Composition of Sunflower oil (SWO)

Parameters	% Composition
Alkaloids	3.86
Tannins	6.96
Phenols	7.06
Terpenoids	5.01
Saponins	4.47
Steroids	3.51
Flavonoids	10.06

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Table 3: Effect of dietary inclusion of sunflower oil on the growth performance of broilers

Parameters	Inclusion levels of sunflower oil (mg/kg) 2.0 g/kg Neomycin	100mg	200mg	300mg	400mg	SEM	SIGN
IBW(g)	718.86	717.6	717.7	718.3	718.9	0.15	NS
FBW(g)	1320.8^{e}	1722.1^{d}	2200.4^{c}	2570.2^{b}	2850^{a}	15.70	*
WG(g)	601.94^{e}	1004.3^{d}	1482.7^{c}	1851.9^{b}	2131.1^{a}	2.55	*
ADWG(g)	21.498^{e}	35.875^{d}	52.954^{c}	66.139^{b}	76.111^{a}	5.01	*
TFI (g)	2910.4^{e}	2916.6^{d}	2956.1^{c}	3008.3^{b}	3033.3^{a}	0.55	*
ADFI(g)	103.942^{e}	104.164^{d}	105.575^{c}	107.439^{b}	108.332^{a}	0.16	`*
FCR	2.13^{c}	1.74^{b}	1.73^{b}	1.71^{b}	1.53^{a}	0.02	*
Mortality(%)	1.5	-	-	-	-	0.01	*

$^{a-e}$Means in the same row with different superscripts differ significantly (P<0.05)
SEM: Standard error of mean; IBW: initial body weight; FBW: final body weight; WG: weight gain; ADWG: average daily weight gain; TFI: total feed intake; ADFI: average daily feed intake; FCR: feed conversion ratio.

Results and discussion

Phytochemical composition of Sunflower oil (SWO)

Table 2 shows the phytochemical composition of sunflower oil. Phytochemical components revealed the presence of alkaloids (3.86 %), tannins (6.96 %), phenols (7.06 %), terpenoids (5.01 %), saponins (4.47 %), steroids (3.51 %) and flavonoids (10.06 %). Flavonoids had the highest concentraction while steroids had the lowest concentration. In order of abundance flavonoids > phenols > tannins > terpenoids > saponins > alkaloids > steroids respectively. Phytochemicals are bioactive chemicals that occur naturally in plants and are capable of promoting the health status of animals (Alagbe, 2019; Agubosi *et al*., 2021). According to Oluwafemi *et al*. (2021), phytochemicals also have therapeutic properties and are capable of performing multiple biological functions such as antibacterial, antiviral, anti-inflammatory, anti-helminthic, antidiuretic, antioxidants, antifungal, antispasmodic, immune-modulatory, neuro-protective, anti-inflammatory and neuroprotective functions (Adewale *et al*., 2021; Singh *et al*., 2021; Agubosi *et al*., 2022).
The concentration of phytochemicals in plants are not the same for all species, it depends on the extraction method, storage condition, environmental factors, anti-nutrients, stage and age of plants, parts of plants used as well geographical origin (Oluwafemi *et al*., 2022; Alagbe, 2022; Shittu *et al*., 2021). Phytochemicals have also been reported to be safe and effective without causing any negative effective on animals once administered in right doses and concentrations (Alagbe, 2022). For instance, Alkaloid exhibits cytotoxic and analgesic effects and also capable of inhibiting bacteria growth (Faizi *et al*., 2008; Agubosi *et al*., 2022). Tannins have been shown to possess antimicrobial and antibacterial activity (Redondo *et al*., 2014; Oluwafemi *et al*., 2021). Phenols are strong antioxidants capable of scavenging free radicals, thus strengthening the immune system and preventing diseases (Shittu *et al*., 2021). Saponins inhibit the growth of gram positive and gram-negative bacteria (Min *et al*., 2005) and also performs antiprotozoal role (Wallace *et al*., 1994; Alagbe and Oluwafemi, 2019). Flavonoids are used as adjuvants in vaccine production and have the ability to scavenge free radicals (Allan and Miller, 1996; Agubosi *et al*., 2021).

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Steroids play a vital role in fertility (Allan and Miller, 1996). However, all the phytochemical components were within the safety level recommended for broiler chickens according to Alagbe and Oluwafemi (2019).

Effect of dietary inclusion of sunflower oil on the growth performance of broilers

The effect of dietary inclusion of sunflower oil on the performance of broiler chicks is presented in Table 3. Initial body weight (IBW), final body weight (FBW), weight gain (WG), average daily weight gain (ADWG), total feed intake (TFI), average daily feed intake (ADFI) and feed conversion ratio (FCR) ranged from 718.86 – 718.9 g, 1320.8 – 2850g, 601.94 – 2131.1 g, 21.498 – 76.111 g, 2910.4 –3033.3 g, 103.942-108.332g, 1.53- 2.13 g respectively. FWG and ADWG were highest in T3, T4 and T5, intermediate in T2 and lowest in T1 ($P < 0.05$). ADFI and FCR were significantly ($P < 0.05$) influenced by the inclusion of SWO.

The Result of the growth performance revealed that dietary inclusion levels of sunflower oil had significant effect ($P<0.05$) on the final body weight (FBW), weight gain (WG), total feed intake (TFI), feed conversion ratio (FCR). The dietary inclusion of SWO has shown to be able to enhance growth and feed intake compared to the treatment fed antibiotics T1 (neomycin). Higher weight gain recorded in T3 – T5 could be attributed to the presence of bioactive chemicals especially flavonoids and phenols in SWO which is capable of exerting positive effects on nutrient utilization possibly by stimulating digestive enzymes such as lipase, amylase, or protease, preventing dysbiosis and improving the gastrointestinal morphology of birds (Jamroz *et al*., 2006; Dhama *et al*., 2014). Higher feed intake observed among birds in T3 – T5 is a clear indication that the oil can enhance good smell and palatability (Oluwafemi *et al*., 2021).

This result is in agreement with the reports of Khattak *et al*. (2014); Giannenas *et al*. (2018) and Mathlouthi *et al*. (2012) who fed mixtures of essential oils, rosemary or garlic oils to chickens and reported a positive impact of essential oil on the growth performance of birds compared to the control group fed synthetic antibiotics. Similar result was recorded by Aji *et al*. (2011) who found out that body weight gain and feed conversion ratio were improved by the dietary inclusion of garlic oil at 100 mg/kg feed. Conversely, Lee *et al*. (2004) reported that the incorporation of oregano essential oil at 50 -100 mg/kg in normal broiler diets had no effect on the overall growth and feed conversion ratio compared to the control. This variation could be linked to the inclusion level of the oil, extraction and storage mechanisms of the oil.

Mortality was recorded only among birds in (T1) – antibiotics group while none was recorded in the other treatments ($P<0.05$). This result is consistent with the reports of Olafadehan *et al*. (2020) when *Daniellia oliveri* leaf extract was fed to broiler chickens at 80 ml/liter of water. This result implies that phytochemicals in the diets (oil) which alters and stabilizes the intestinal microbial and reduces microbial toxic metabolites in the gut, owing to their direct antimicrobial properties on various pathogenic bacteria, which results in relief from intestinal challenge and immune stress, thus improving performance. A reduction in the number of pathogenic bacteria changes the microbial ecology in favour of beneficial species such as *lactobacillus spp* in the intestine (Lee *et al*., 2010) resulting in improved ability of epithelial cells to regenerate villus and thus enhances intestinal absorptive capacity.

Conclusion

The dietary inclusion of sunflower oil (SWO) in the diets of broiler chickens up to 400 mg/kg enhanced growth performance and reduced mortality among birds. This could be attributed to the presence of phytochemicals in the oil especially flavonoids which had the highest concentration. The dietary inclusion of SWO resulted in better body weight gain and feed conversion ratio. This implies that the oil at 400 mg/kg is safe for the birds and could be use as a natural alternative to antibiotics to ensure food safety.

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