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Research Article

Evaluation of Mexican Sunflower (*Helianthus annuus* L) Leaf Meal as a Feed Ingredient in Shaver Brown Pullets

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Abstract

This study examined the effect of replacing soybean meal with sunflower leaf meal in the diet of laying shaver brown pullets. A total of 30 laying birds were assigned to three treatments of 0% 10% and 15% MSFLM inclusion. Four eggs per replicate were randomly taken for three consecutive days at two weeks interval for five times. External (egg weight, egg length, egg breadth, and egg shape index) of the eggs were measured. Egg length, egg breadth, and shell thickness showed a significant difference ($p < 0.05$) in from the control birds. Final body weight, weight gain, feed intake, and hen day production showed comparable results with values from eggs of birds on the control diet. The study revealed the ability of birds to easily utilize the nutrients in the protein sources. The MSFLM utilization up to 15% in pullets' diet revealed no detrimental effect on the performance of the laying birds and the external qualities of eggs produced.

Keywords: Mexican Sunflower; Performance; Hen Day Production; Egg Profile; Carcass Characteristics

Introduction

Poultry is the quickest source of meat in relation to other livestock enterprises [1]. Poultry adapts easily to most areas of the world, have a low economic value, low generation interval and a high rate of productivity [2]. In Nigeria, the daily dietary intake of animal protein (3.24 g) falls grossly short of the recommended 27 g animal protein per caput/day [3,4]. The ascribed low protein consumption may be attributed to the declining animal protein production occasioned by the high cost of livestock production which amounted to cost of feeds [5]. It is obvious therefore that any one of the possible remedies will be an effort to reduce the cost of production [6].

Poultry feedstuffs are expensive, thereby limiting the growth of the poultry industry in the tropics. Most of the developing countries are situated in tropical areas and there is lack of the necessary funds to import the ingredients for human and livestock feeding [7,8]. The current low supply of animal protein in developing countries justifies the research into the potentials of local produced feed resources for productive animals such as leaf meals, which could be included into the poultry diets in order to sustain the poultry enterprises and to improve the profit margin through reducing the use of the conventional protein sources (Nworgu and Fasogbon 2007). The Mexican sunflowers (*Helianthus annuus* L. Gray) which belong to the Compositae family are seen on roadsides, fallow land and as invader of field crops in the forest savannah transition zone [9-12]. Its acceptability by ruminant and non-ruminant livestock, its relative abundance and the low cost of processing the forage makes it a potential non-conventional animal feed source in the derived savannah zone [13]. It grows as annual, biennial or perennial plant depending on the habitat. It has been fed to sheep, goat, and cattle [14] and pigs [15]. Therefore, its acceptability by ruminant

and non-ruminant livestock and its relative abundance makes it a potential non-conventional animal feed source in the derived savannah zone.

Helianthus annuus L is a woody herb, stoloniferous, annual or perennial that can reach a height of 2 to 3 m [16]. It has a taproot with many fine secondary roots [17]. The herbaceous mass can develop from subterranean stolons. The leaves are alternate or opposite, sub-ovate, densely pubescent, 5-17 cm long x 3.5-12 cm broad. Each mature stem may bear several large yellow flowers, up to 12 cm in diameter [18].

Mexican sunflower seeds are almost free of toxic compounds that may impede their use in human or animal nutrition. However, sunflower seeds have arginase and trypsin inhibitors which are heat labile and inactivated easily [12,19]. The seeds of Mexican sunflower have a polyphenolic compound, chlorogenic acid, which has been hindering their broad use for human consumption. Chlorogenic acid is bound to low molecular weight proteins by a hydrogen bond between the hydroxyl groups of phenolic compounds and peptide bond in proteins [20]. Both genotypes of the seeds and environmental conditions during seed maturation have a direct effect on the concentration of chlorogenic acid in the seed.

Mexican sunflower is a tropical herb or shrub cultivated in many countries of Africa, Asia, and South America for its multipurpose value. As fodder, it is rich in protein, valuable for ruminants and rabbits, but less for poultry and pigs, probably due to the presence of fibre and anti-nutritional factors. Mexican sunflower is used for a variety of purposes: ornamental, fuel, compost, land demarcation, soil erosion control, soil remediation, building materials and shelter for poultry [21]. It is considered to be a weed in some areas [22]. Mexican sunflower is commonly used as fodder for ruminants and rabbits, which can eat the leaves, soft branches, and flowers. Its potential has been tested in pigs and poultry with mixed results [23]. Mexican sunflower is a fast-growing plant that tolerates heat and drought and can rapidly form large herbaceous shrubs [24]. It is adaptable to most soils. It is found in disturbed areas, abandoned and wastelands, along roadsides and waterways and on cultivated farmlands [25]. It can also be found from sea level up to an altitude of 1500 m.

However, the major limitation to the use of *Helianthus annuus* leaves in livestock feeds is the presence of some anti-nutrients notably phytin and tannins with some traces of alkaloids, saponins, oxalates and flavonoids [20]. Major anti-nutrients in *Helianthus annuus* leaves (phytin, tannin, oxalate, alkaloid and flavonoid) gradually decreased with lengthening duration of ensiling. Ensiling is the preservation of forage (or crop residue or by-product) of high moisture content based on a lactic (ideally) fermentation under anaerobic conditions [26]. Ensiling is a feed processing technique reported to have helped in enhancing the feeding quality of agro-industrial by-products and other potential plant feedstuffs by reducing the level of toxicants were present, improving the nutrient value, acceptability of feed and utilization by animals [27]. Mexican sunflower (*Helianthus annuus*) leaf meal is rich in protein and, in Nigeria, has been assessed as a potential replacement for soybean meal in pig diets [20].

This study however assessed these objectives: as to evaluate the utilization of Mexican sunflower leaf meal as feed for feeding shaver brown laying birds, examined the effects of feeding Mexican sunflower leaf meal at the expense soya bean meal to Shaver brown layers on performance and cost of production and finally determined the levels of inclusion of Mexican sunflower leaf meal in diets for shaver brown laying birds on carcass characteristics and egg profiles.

Materials and Methods

Experimental site

The experiment will be carried out at the Poultry unit of the Teaching and Research farm, Imo State Polytechnic Umuagwo, Imo State. Umuagwo is in the derived savannah zone of Nigeria. The study area is located on latitudes 5^{o} 28^{1} 00^{11}N and 5^{o} 30^{1} 00^{11}N and longitudes 7o 01 0611E and 7o 031 0011. The mean annual rainfall is 1247 mm with a relative humidity of between 75 and 95%. It is situated at about 600 m above sea level with a mean annual temperature of 26.2°C [28].

Processing of Mexican sunflower leaf meal

The Mexican sunflower plants to be used for the preparation of Mexican sunflower Leaf Meal (MSFLM) was harvested from the uncultivated plots of the Polytechnic farm. The leaves and succulent stalks were harvested prior to the flowering stage. The harvested leaves were spread on a concrete slab and air dried under shade for seven days and then ground in a laboratory mill with 4.0 mm sieve size and stored for later use.

Experimental diets

Three experimental diets containing 0, 10 and 15% Mexican sunflower leaf meal (MSFLM) were formulated (Table 1).

Ingredients (Kg)	0%	10%	15%
Maize	55.00	55.00	55.00
Soybean meal	30.20	27.18	24.16
Sunflower leaf meal	0.00	3.02	6.04
Wheat offal	6.40	6.40	6.40
Fish meal	4.00	4.00	4.00
Bone meal	2.50	2.50	2.50
Limestone	1.20	1.20	1.20
Salt	0.25	0.25	0.25
Methionine	0.20	0.20	0.20
Premix	0.25	0.25	0.25
Crude Protein %	22.12	22.34	22.33
Crude Fibre %	6.24	6.25	6.34
Dry Matter %	95.69	95.42	94.34
MEKcalKg-1	2889.4	2897.4	2949.7

Table 1: Percentage Ingredient Composition.

*Premix composition per kg feed: Vit A, 1500 1.U; Vit E 5mg; Vit D_3 300 1.U; Vit K 3 mg; Vit B_{12} mg; Vit B_2 5.5 mg; Niacin 25 mg; Vit $_{12}$ 10 Ug; choline 120 mg; Mn, 5.2 mg; Mb 240 mg; Zn, 25 mg; Cu, 2.6 g; folic acid 2 mg, I 2 mg; Fe, 5 g; Pantothenic acid, 10 ug; Biotin, 30.5 g; Antioxidant, 56 mg

Experimental animal and management

Preparation of diet

Sunflower leaves and inflorescence were harvested at the flowering stage and air-dried for 7 days. The dried collection was then milled, using a manual grinding machine. Diets were prepared by replacing maize with varying levels of the sunflower forage meal. Three diets were formulated to contain 0% for group 1 (control), 10%, and 15% for the experimental groups 2 and 3, respectively.

Animals and management

Thirty points of lay shaver brown pullets were used for the study. They were first maintained on a standard commercial layer mash as a baseline diet for one week after which they were randomly assigned to three dietary treatment groups containing Mexican sunflower leaf meal (MSFLM) at 0% (control) as group 1, 10% (group 2), and 15% (group 3). There are 3 replicates per group with each replicate containing 3 birds. Birds were housed in a well-ventilated deep litter house partitioned into 2×5 m^2 pens. The experiment lasted for eight weeks during which the birds were offered feed and clean water *ad-libitum*. Routine poultry production management and health care practices were carried out during the experimental period.

Experimental design

The birds were allocated into three treatment groups. Each treatment group contains 10 birds with three replicates of 3 birds each per treatment in a Complete Randomized Design Experiment.

Data collection

At the pubertal age of 18 weeks, three shaver brown pullets per replicate were randomly selected. The live weights of the birds were taken before they were slaughtered by severing their jugular veins. The carcasses were properly drained of blood, de-feathered and eviscerated. The dressed carcasses were weighed and their weights were recorded. Feed intake, weight gain, feed conversion efficiency were also be monitored.

Sampling of eggs

Four eggs per replicate of 3 birds were sampled at random for 3 consecutive days fortnightly for five times. Each egg was assessed separately for internal and external egg quality traits. For external quality traits, data on egg weight, egg length, egg breadth, and egg shape index and shell thickness were collected.

Egg weight

The weight of each egg was measured with a top loading weighing balance to the nearest 0.01 g.

Shell thickness

The shell of the broken egg was further broken into smaller pieces. The shell membrane was manually removed and the thickness of the eggshell was measured using a micrometer screw gauge.

Albumen height

This was measured by using a tripod micrometer calibrated in 0.1 mm. The dimension measured was taken between the yolk edge and the external edge of the thick albumen. The values obtained were used together with egg weight to calculate the Haugh unit. The Haugh unit of eggs was calculated using the formula of Haugh [29].

Chemical analysis

Proximate analysis of Mexican sunflower leaf meal and experimental diets as well as the fecal samples will be carried out using the procedures of AOAC [30].

Statistical analysis

Data collected were subjected to Analysis of Variance (ANOVA) [30]. The treatment means values were tested for significant differences by Duncan's Multiple Range Test of Gordon and Gordon [31].

Results and Discussion

The proximate composition of MSFLM used in this study showed crude protein, crude fibre, ether extract, ash and nitrogen free extract of 17.2, 12.51, 6.04, 14.20 and 50.05% respectively (Table 2). The crude protein value was slightly lower than 18.4% reported by Fasuyi., *et al.* [20]. This observation indicates that variation exists in nutrients composition of forage plants collected from different locations.

Parameters	Content %
Dry Matter	89.00
Crude protein	17.2
Crude fibre	12.51
Ether Extract	6.04
Ash	14.02
NFE	50.05
ADF	42.63
NDF	60.00
Hemicellulose	17.37
ADL	9.96

Table 2: Proximate Composition of Mexican Sunflower Leaf Meal (MSFLM).

NFE: Nitrogen Free Extract; NDF: Neutral Detergent Fiber; ADF: Acid Detergent Fiber; ADL: Acid Detergent Lignin; Hemicellulose=NDF– AD, NFE = (100 – CP +CF +EE +Ash).

Performance characteristics

The similarity and adequate consumption of experimental diets by birds placed on different inclusion levels of MSFLM indicated that the factors responsible for reduced feed intake must have been sufficiently eliminated as the previous study on *Helianthus annuus* leaf meal (MSFLM) revealed that birds did not consume MSFLM adequately [20]. The poor feed intake associated with un-ensiled MSFLM by birds was attributed to the low palatability as a result of tannin [10]. The similarity among AWG and FCR values of layers on the control diet without MSFLM, 10 and 15% MSFLM was a strong indication that the process of ensiling must have broken down some anti-nutrients such as phytin, tannin, alkaloids and flavonoids which were hitherto responsible for the poor growth indices recorded for studies in which un-ensiled MSFLM were used in layers feeding trials [8].

It has been suggested that a high phytin value of 79.10 mg/100 g in MSFLM [20] could lower bioavailability of minerals and inhibition of several proteolytic enzymes and amylases. This is further buttressed by the submission that anti-nutritional nature of phytin lies in its ability to chelate certain mineral elements especially Calcium, Manganese, Iron and Zinc, thereby rendering them metabolically unavailable and leading to the subsequent development of osteomalacia when certain legumes and cereals are fed to growing animals [32].

Performance indices were not significant (P>0.05) among the treatment means (Table 3). Final body weight, weight gain, and hen – day production was least in layers fed the 15% MSFLM based diet. The similar values across dietary treatments in terms of performance may be due to the ability of layers to utilize easily the nutrients in the protein sources.

		MSFLM		
Parameters	**0%**	**10%**	**15%**	**SEM**
Initial body weight (g)	1250	1253	1233	3.45
Final body weight (g)	1530.00	1490.50	1450.50	4.33
Weight gain (g)	90.91	80.49	80.50	2.02
Feed intake (g/week/bird)	185.4 2	179.43	201.71	4.16
Hen day production (%)	79.0	73.5	72.0	3.15

Table 3: Effects of Graded Levels of Mexican Sunflower Leaf Meal (MSFLM) on Performance of Shaver Brown Layers.

Proximate and chemical compositions of sun-dried ensiled *Helianthus annuus* Leaf

The ensiling process of *Helianthus annuus* leaf possibly facilitated the breakdown of complex non - starch polysaccharides (NSPs) and subsequently increased the soluble carbohydrates. It is also conceivable that the fermentation process during ensiling of

Helianthus annuus leaf must have contributed to the significant reduction of the anti-nutrient composition of *Helianthus annuus* leaf. This reduction of the anti-nutritional factors such as phytin, tannin, oxalate, alkaloids, and flavonoids in *Helianthus annuus* leaf when ensiled agreed with a previous study [20].

		MSFLM		
Parameters	**0%**	**10%**	**15%**	**SEM**
Egg qualities				
Egg weight (g)	9.71	9.41	9.41	0.07
Egg length (cm)	3.46[a]	3.24[b]	3.20[b]	0.01
Egg breadth (cm)	2.92[a]	2.49[b]	2.44[b]	0.01
Egg shape index	0.86	0.91	0.91	0.01
Shell thickness (mm)	0.34[a]	0.28[b]	0.29[b]	0.03
Haugh unit	92.90	91.94	90.40	2.54
Yolk color	3	4	6	6
Yolk index	0.36	0.26	0.37	0.01
Shell weight (g)	0.92	0.83	0.87	0.01
Shell density (cm^3)	0.98	0.99	0.97	0.01
Shell surface area (cm^2)	2.87	3.23	2.85	0.03

Table 4: Effects of Graded Levels of Mexican Sunflower Leaf Meal (MSFLM) on Egg Quality of Shaver Brown Layers.
a and b symbols are the levels of significance tested at 5% Level of significance.

The result of the egg quality indices was presented in Table 4. The normal avian egg consists of the shell, shell membrane, albumen, chalazae, and yolk. The quality of the egg, its marketability, and chances of hatchability are dependent on these factors added to the weight [33]. Haugh unit (HU) is an expression of the relationship between egg weight and height of thick albumen [29] and it is the most widely used research measure of albumen quality. Its value had proved to be more significantly correlated to quality measurements than any other [34].

The HU of the eggs from birds on all the treatments were comparable to those values obtained by [27]. The absence of significant changes in the values of yolk, shell weight, shell density, shell surface, and egg weight showed that the test ingredient did not contain any material whose toxicity could impair these egg quality indices. Yolk colour was influenced by the inclusion of MSFLM in the diets. Birds on 10% and 15% MSFLM had the highest values for yolk colour. This could result from the increased level of carotene and xanthophyll in the diets as the level of MSFLM increases. Carotene and xanthophyll are features of green feedstuffs that are responsible for the yolk colour. Egg length, egg breadth, shell thickness, and percentage albumen showed significant ($p< 0.05$) difference in favor of birds placed on the control diet. All value obtained for these parameters fell within the range obtained by Ahaotu and Agunanne [27,35-49].

Conclusion

Mexican sunflower leaf meal (MSFLM) as an alternative feed ingredient in shaver brown layer egg production is yet to be popularized despite the abundance of the material in various parts of the country. Its use up to 15% gave a performance that was comparable with the control diet. Yolk colour of the shaver brown layers egg was influenced by the carotene and xanthophyll content of the sunflower leaf meal.

A remarkable improvement in the consumption and utilization of ensiled MSFLM, when fed to pullets, could have been occasioned by the activities of anaerobic, facultative and aerobic micro-organisms responsible for the degradation of the complex fibrous and other anti-nutritional compounds naturally present in MSFLM. The inclusion level of MSFLM can be further enhanced when ensiled and this could replace other conventional protein ingredients appreciably at levels of about 15% in layers rations. There is no doubt that ensiling *Helianthus annuus* leaves before sun drying into *Helianthus annuus* leaf meal had beneficial nutritional quality as manifested in the investigated performance characteristics in this present study.

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