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EFFECTS OF DIETARY ENERGY AND PROTEIN ON THE SEMEN CHARACTERISTICS AND EGG QUALITY OF TURKEYS (*MELEAGRIS GALLOPAVO*) IN BALI, TARABA STATE

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ABSTRACT

A study was conducted to evaluate the semen characteristics and egg quality on three strains of indigenous Nigerian turkeys, fed different levels of dietary energy and protein at the Teaching and Research farm of the Federal Polytechnic Bali, Taraba State. A total of 120 day-old poults of all the strains of indigenous turkey were used for the experiment. The experiments lasted for 11 months (July, 2018 –August, 2019), where poults were brooded on commercial feed for the period of 8 weeks. At the age of 64 days the birds were randomly allotted into four treatment dietary levels for growers; T1-control (Commercial feeds), T2-low energy high protein(LEHP), T3-high energy low protein(HELP), and T4-high energy high protein(HEHP). At the age of 196 days, eggs laid was recorded from T1 of all the three strains of turkey. Eggs were collected in batches after every 8days for 5 sets only. Eggs were candled for fertility and hatchability at the day 7of laying. Parameters considered were, egg quality, semen characteristics and testicular morphology among the strains and treatments. The egg quality egg quality studied showed Signiant ($P<0.05$) differences among the treatment groups. The results on the gonadal sperm reserves (trestles), extra gonadal sperm reserve (epididymis) and *vas deferens* showed significant ($P<0.05$) differences among the treatment groups except for treatments T1, T3, and T4. In conclusion, the varying dietary levels on different strains of indigenous turkeys used in this study, account for differences in growth rate, egg production and reproductive parameters. The preliminary results reported in this paper are a beginning and more in-depth research is required in that respect.

KEYWORDS

Effects, Dietary, Energy, Protein, Reproduction, Production and Turkey.

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INTRODUCTION

Turkey production is both an important and a profitable agricultural industry, with a rising global demand for its products (Case, Miller and Wood, 2010[1], Ironkwe and Akinola, 2010[2], and Anandh *et al,* 2012)[3]. Local Turkeys are about 1.05 million in Nigeria, being the smallest when compared with other poultry species (FAO STAT, 2011). Free range

system of rearing is most popular for rearing the Local Stock of turkeys, (Peter *et al,* 1997)[4]. These birds are natural foragers and scavengers and always range farther. Indeed, they thrive best where they can move about freely feeding on seeds, fresh grass, locusts, crickets, grasshopper, worms, slugs and snails (Singh and Sharina, 2012)[5].

Improvement in performance of indigenous stock or population's overtime can arise through improvement and feeding conditions and through genetic improvement by use of genetically superior animals (Yakubu *et al,* 2012)[6]. The traits traditionally considered as criteria for selecting breeding stock are important in describing the adaptive attributes and genetic merits of the indigenous birds and in identifying farmers choice of genetic stock used (Dana *et al,* 2010[7], Ilori *et al,* 2011)[8].

Different heritage turkey varieties have been identified based on plumage colouration as primary criterion (Kennamer *et al,* 1992). Though turkey varieties are considered a single breed, research evidence shows that significant differences exist among the populations of heritage and commercial turkey birds (Hartman *et al,* 2006)[9]. Several attempts have been made to examine the differences among turkey varieties at phenotypic, molecular and biochemical levels (Kennamer *et al,* 1992).

Fertility denotes the ability to reproduce in male poultry, according to Yahaya *et al,* (2017)[10], depends on:

- Successful production and maturation of sperm cells within the reproductive tract,
- Initiation of sperm motility at ejaculation
- Temporary sequestration of sperm within the hen's sperm storage tubules,
- Passive transport of sperm through the oviduct above the vaginal sphincter,
- induction of acrosome reaction in response to sperm contact with oocytes perivitelline layer,
- Perforation of the perivitelline layer by spermatozoa at various sites,
- Introduction of condensed DNA into the oocyte via membrane fusion, and
- Combination of one of several male pronucici with the female pronucleu.

The main objective of the study is to evaluate the effects of varying dietary energy and protein levels on reproductive performance of three strains of turkey reared locally in Nigeria. The specific objectives to evaluate the;

- Effects of varying levels of dietary energy and protein during lay on egg quality of breeder hens.
- Effects of dietary energy and protein levels on semen quality and morphology of aged toms.

Experimental site, birds and Management

The experiment was conducted at the Teaching and Research farm of the Federal Polytechnic Bali. A total of one hundred and twenty day-old poults of both sexes in the ratio of 90:30 (Females and Males) of three strains (White, Black/Bronze and Grey/Mottle) were obtained from two hatchery units (Fidan and Sabtch), both in Ibadan, Nigeria. The birds were brooded on commercial chick mash (Vital feeds) for the periods of 8weeks and were fed on commercially growers mash. At the age of 64 days the birds were randomly allotted into four dietary formulated growers mash (experimental diets) for all the three strains with five replicates each in three blocks as follows; experimental diets for growers (control; Lower energy high protein; High energy lower protein, and High energy high protein) and the birds started to receive the graded formulated feeds of varying energy and protein levels. The collection of data on weight gains commences at age 75days and ends at the age of 97 days. At the age 98 days the feeds of birds were changed to layers' experimental diets, similar to previous formulation pattern. Then at the age of 196 days the birds started to drop eggs.

The birds were reared on deep litter in ratio of 1:5 (male to females) for natural mating. Experimental breeder diets (Table No.1) and water were given without restrictions. The birds were weighed at beginning of the experiment and each week to determine the weights change and recorded differences between two consecutive weighing. Feed intake, hen day egg production (HDEP) were

obtained each day, while feed conversion ratio (feed/dozen egg) was recorded.

Data collection and Analysis

A total of 629 eggs were collected and used to evaluate the reproductive performance and egg quality of the experimental flock in 5 batches of 35 days. In each cycle, eggs were collected for seven days from each replicate and labelled accordingly. In every treatment 15 eggs were collected from each replication, to evaluate egg quality. The eggs were collected fresh and to the laboratory for various measurement. Weight were determine using a precision digital electronic weighing balance. The parameters observed were the whole egg weight, yolk and albumen weights. The egg length and width were determined using veneer clipper. All data were properly recorded.

Morphometry and Reproductive organs

Five (5) toms from each group were sacrificed and both testicles were carefully removed and the organs were the partitioned as described by McLelland (1991)[11], weighed using electronic balance and their volumes recorded in directly by water displacement in a graduated centrifuge.

Determination of Gonadal and Extra gonadal sperm reserves

Testicular, epididymal and *vas deferens* sperm reserves were determined using the homogenization haemocrymetric technique (Obidi *et al*, 2008)[12] with modifications. After careful removal of the tunica albuginea with scalpel blade, was weight, homogenized in 20mlsof physiological normal saline with an antibiotic.

Semen evaluation

Ejaculate volume: semen samples were immediately evaluated for volume (ml), by graduated test-tube (Al-Daraj, 2007b)[13]. Mass motility: Massmotilities of spermatozoa (%) were estimated according to index of motilities which ranges 1-100 (Al-Daraj, 2007b)[13]. Sperm concentration: The concentration was estimated by using hen cytometer chamber (Bakst and Cecil, 1993)[14]. Percentage of dead spermatozoa: The percentage of dead spermatozoa was estimated by using the procedure which mentioned by Al-Daraj, (2007) Deformation spermatozoa ratio: The percentage of abnormal spermatozoa was evaluated by using the procedure which described by Al-Daraj *et al,* (2002)[15]. Different levels of dietary energy and protein on semen parameters in layer breeders. Values given are Mean±SE.

MATERIAL AND METHODS

This study has been conducted at poultry farm of Alatefya Researches department/ Agricultural researches directorate/Ministry of sciences and technology, during the period from 20/6/2017 to 28/10/2017. This experiment included a total of 36 local Iraqi turkey males in 32weeks olds. The turkey males were randomly distributed in to four treatments groups, each group contained of 9 birds depend on strain. Each treatment constituted from 3 replicates. All birds housed under same environmental conditions. Feed and water were available for all the period (ad libitum). Birds were fed during the whole period on diet contain 18% crude protein and 2950 Kcal metabolic energy/kg. The flock was reared in a ground cages (pens) during the experiment period. Semen were collected after ganders were trained for two weeks to give semen before the collection began, semen collection by using abdominal massage procedure (Al-Daraji *et al*, 2012).

Treatments groups were as following

Treatment 1(T1): semen collected from red turkey strain.

Treatment 2(T2): semen collected from bronze turkey strain.

Treatment 3(T3): semen collected from white turkey strain.

Treatment 4(T4): semen collected from black turkey strain.

Traits measured

Ejaculate Volume: semen samples were immediately evaluated for volume (ml), by graduated (ml) test tube (Al-Daraji, 2007a).

Mass motility: Mass motilities of spermatozoa (%) were estimated according index of motilities, which ranges 0 - 100 (Al-Daraji, 2007b)[13].

Individual motility: Individual motilities (%) were determined by index of motilities which ranges 0 - 100 (Al-Daraji, 2007b)[13].

Sperm concentration: The spermatozoa concentrations were estimated by using hem cytometer chamber (Bakst and Cecil, 1993)[14].

Percentage of dead spermatozoa: The percentage of dead spermatozoa was estimated by using the procedure which mentioned by Al-Daraji, (2007b)[13].

Deformation spermatozoa ratio: The percentage of abnormal spermatozoa was evaluation by using the procedure which described by Al-Daraji, *et al* (2002)[15].

Spermatocrit: The spermatozoa packed cells volume was determined by using the procedure which described by Al-Daraji, (2007b)[13].

A completely randomized design (CRD) has been used in this study. Statistical analyses for various.

Data collection and analysis

A total of 1189 eggs were used to test the reproductive performance of the experimental flock in eight batches (i.e. eight cycles of 28 days). Once in each cycle eggs were collected for seven consecutive days from each replicate and labeled appropriately. They were sorted on the 7th day to remove cracked and abnormal size eggs before setting in a 220-egg capacity incubator manufactured by ''Arrahamania'' Company, Zaria, Nigeria. Temperature and relative humidity were maintained at 37.6^{o}C and 55 - 60% during the first 1 days and 37.3^{o}C and 55 - 70% during the last 3 days respectively. 19 to 21 it was respectively. Eggs were turned every 90 minutes. Candling was done on the 10th and 18 th day of incubation and all clear eggs and dead embryos removed. Percent fertility and hatchability were calculated as:

All unhatched eggs were inspected for evidence of embryo development and embryo mortality were described as Early (EEM) if observed at day 10, as Mid (MEM) if observed at day 18 and as Late (LEM) if unhatched after day 21. The embryo deaths for each stage (EEM, MEM and LEM) were calculated as a percent of total embryo death in each batch.

Chick quality was measured based on chick weight, chick length and Pasgar score at hatch. Weight was measured using an electronic balance to the nearest 0.01g while chick length was measured from the point of the beak to the middle toe (nail excluded) to the nearest centimeter. Pasgar score was obtained by scoring chick vitality (place the chick on its back, if it sits up immediately - Score 0; if it takes more than 3 seconds to sit up - score 1), quality of navel (when it is completely closed and all the yolk is absorbed - score 0 but if it is open and/or one can see a dried cord - score 1), hock joint (is not enflamed and have a normal colour - score 0, if enflamed and/or red - score 1), beak (if clean and the nostrils are closed - score 0, if dirty and/or has a red dot - score 1) and abdomen (if soft abdomen - score 0, if hard abdomen and/or skin stretched score 1). For each individual, the different scores were added up and then deducted from the maximum score of 10 and the average for each group calculated.

All data collected were analyzed for variance as a Randomized Complete Block Design using the linear function of Statistix 9.0 (2008). Treatment means were compared using least square difference (LSD).

Has been conducted at poultry farm of Alatefya Researches department/ Agricultural researches directorate/Ministry of sciences and technology, during the period from 20/6/2017 to 28/10/2017. This experiment included a total of 36 local Iraqi turkey males in 32weeks olds. The turkey males were randomly distributed in to four treatments groups, each group contained of 9 birds depend on strain. Each treatment constituted from 3 replicates. All birds housed under same environmental conditions. Feed and water were available for all the period (ad libitum). Birds were fed during the whole period on diet contain 18% crude protein and 2950 Kcal metabolic energy/kg. The flock was reared in a ground cages (pens) during the experiment period. Semen were collected after ganders were trained for two weeks to give seme.

RESULTS AND DISCUSSION

Table No.2, shows the egg quality of turkey strains fed different levels of dietary energy and protein. The results revealed significant ($P<0.05$) differences among in the dietary levels, for all the parameters studied, except for shell thickness among the strains. Those under T3 and T4 did not differ in terms of egg weight, but differs ($P<0.005$) significantly from those in T1 and T2, while those in T2, had the lowest

egg weight value. Where the white and mottle strains egg weight did not differ from one another, and the Black exhibited higher egg weight value.

Considering the egg length, T1 and T4 did not differ, but they differ significantly (P<0.05) from T2 and T3. In a like manner Black strain did not differ from White strain in terms egg length, but both strains egg length differs from that of Grey/mottle strain turkey. In terms of egg width T1 (control), exhibited outstanding differences from the remaining treatments, with those in T2 having the lowest width values. Similarly, white and black /bronze egg width did not differ, but differs from grey/mottle egg width.

The shell quality was also evaluated for the influence of different dietary level. It was observed that, there was no significant differences for shell thickness among the treatments groups as well as the strains, except for those in T2, that exhibited very low shell thickness. Shell membrane which is also an important part of the eggs, was evaluated for its thickness. The result obtained indicate that T1and T4 showed significant (P<0.05) differences from T2 and T3, so also the strains. The egg yolk and albumen parameters followed similar trends, with T1 and T4 showing significant (P>0.05) differences. Summing the overall assessment, bronze strain appears to respond favorably to the dietary levels of feeds, while T1 and T4, who has the both nigh energy and protein gives a promising results. However, HELP diets could as well be utilized in terms of cost and profit.

Semen quality (Table No.3) under the influence of dietary energy and protein in laying. Breeder turkey revealed that T1, T2 and T4didnot differ from each other, but all differs (P<0.05) significantly from T2 in all the parameters observed. This suggest that, the high percentage crude protein content had influence on the semen characteristics. However, this finding contrast the earlier work by AL-Janabi *et al*, (2018)[16], who studied semen characteristics in four different strains of turkeys in Iraq and postulated that there were significant differences among the strains in terms of semen volume, motility and percentage dead spermatozoa. While the abnormal spermatozoa ratio did not had effects on strains. However, the differences obtained could be as result of differences in locations and more importantly dietary levels of feeds was evaluated in the present work.

It was observed that (Table No.4), the testicular or epididymal and *vas deferens* sperm reserves of the Toms improved significantly with increased levels of protein in diet. This is because, although same amount of feed was supplied, the protein content was varied, leading to the variation observed. Although some authors that worked in different species reported results dissimilar from those of this work: Etches (1996)[17] in cockerels, Jibril *et al,* (2011)[18] in rams. Others authors have reported similar results in rabbits (Ladokun *et al*, 2006)[19] and drakes (Ghonim *et al*, 2010). These apparent differences and similarities are perhaps because optimal crude protein requirement differs between species (Deviche *et al*, 2011)[20]. The reserves are similar to results of Cecil *et al.* (1988)[21] who reported a mean sperm reserve of 0.2-0.28 ($x10^9$cells/gm), 0.1-0.2($x10^9$ cells/gm) and 3.2-3.95 ($x10^9$cells/gm) for testicles, epididymis and vas deferens sperm reserves respectively in exotic breed of turkey. The similarity between the results of this study and those of Cecil *et al*, (1988)[21] and Yahaya *et al*, (2017)[10] suggest that with optimum environmental conditions such as adequate feed supply, the Nigerian indigenous turkey breed can parallel their exotic counterpart in reproductive capacity. Furthermore, in some of the cases the feeds containing 22% and 26% protein showed no significant differences between their results, but they both differ significantly (P<0.05) from the 17% diets. This suggests that optimum protein level in the diet for reproductive health in the indigenous Toms is obtained at a point between 17% and 22%.

Table No.1: Experimental diets for laying Turkeys

S.No	Ingredients	Control	LEHP	HELP	HEHP
1	Maize	57.1	55.2	59.1	58.3
2	Maize bran	13	15.3	14.5	6.3
3	Soybean	20.7	22	17	26
4	Bone meal	3	3	3	3
5	Limestone	6	6	6	6
6	Salt	0.2	0.2	0.2	0.2
7	Methionine	0.2	0.2	0.2	0.2
8	Calculated Analysis	-	-	-	-
9	ME(Kcal kg)	2500	2300	2700	2700
10	Crude Protein	16.5	18.2	13.7	18.2
11	Calcium	3.5	3.3	3.6	3.5
12	Phosphorus	0.4	0.74	0.76	0.71
13	Methionine	0.38	0.35	0.35	0.45
14	Lysine	0.8	0.69	1.02	1.02

LEHP-Low energy high protein, HELP-High energy low protein, and HEHP-High energy high protein

Table No.2: Egg Quality of Turkey Breeders

Variable	N	Egg weight	Egg length	Egg width	Shell thick	Mem thick	Yolk weight	Yolk length	Albumin weight	Albumin length
Overall	60	45.72	37.96	23.64	0.72	0.52	23.60	27.82	17.02	61.14
Breed										
White	20	43.43^{b}	39.77^{a}	24.08^{a}	0.72^{a}	0.55^{a}	27.45^{a}	31.70^{a}	28.86^{a}	$G5.15^{a}$
Black/Bronze	20	48.44^{a}	38.82^{a}	25.09^{a}	0.73^{a}	0.45^{b}	21.08^{b}	27.78^{b}	23.14^{b}	59.36^{b}
Grey/Mottle	20	45.29^{ab}	35.28^{b}	21.76^{b}	0.73^{a}	0.54^{a}	21.79^{a}	24.00^{c}	19.03^{c}	58.90^{b}
Treatment										
Control	15	53.37^{a}	44.10^{a}	27.13^{a}	0.74^{a}	0.55^{a}	29.18^{a}	33.84^{a}	16.79^{b}	74.91^{a}
LEHP	15	37.26^{c}	27.58^{c}	18.91^{c}	0.54^{b}	0.43^{c}	16.17^{c}	16.83^{c}	13.36^{b}	43.23^{c}
HELP	15	42.72^{b}	38.49^{b}	23.46^{ab}	0.84^{a}	0.48^{b}	21.20^{b}	29.09^{b}	14.50^{b}	60.01^{b}
HEHP	15	44.41^{b}	41.67a	25.06^{b}	0.74^{a}	0.54^{a}	27.09^{a}	31.51^{ab}	23.42^{a}	66.39^{b}

a,b,c means bearing different superscript within the row are significantly different

LEHP-Low energy high protein, HELP-High energy low protein, and HEHP-High energy high protein

Table No.3: Effects of Dietary Energy and Protein on Semen Parameter in layer breeder Turkey

S.No	Parameters	Control	LEHP	HELP	HEHP
1	Semen volume (%)	. 0.55± 0.02	0.52 ±0.12	0.42 ±0.02	0.51 ±0.02
2	Appearance	3.93 ±0.12	3.75 ±0.22	3.32 ±0.12	3.92± 0.11
3	Sperm Motility	63.25± 1.03	61.12 ±0.01	57.75 ±0.99	63.33 ±1.28
4	Sperm Conc. (.x106)	5.00± 0.11	4.85 ±0.23	4.24 ±0.12	4.78 ±1.04
5	Live Sperm	88.77 ±0.87	88.62 ±0.72	82.97 ±0.89	89..55 ±0.67
6	Abnormal Sperm	3.86± 0.31	3.93 ±0.27	2.93 ±0.69	3.64 ±0.44

LEHP-Low energy high protein, HELP-High energy low protein, and HEHP-High energy high protein

Table No.4: Mean± SD Gonadal (Testicular) and extra gonadal (epididymal and Vas deferens) Sperm Reserves of Turkey toms fed different Energy and Protein levels

S.No	Parameters	Control	LEHP	HELP	HEHP
1	Number of Toms	5	5	5	5
2	Testicles ($x10^9$/gm)	0.22± 0.32	0.21±0.00	0.19±0.00	0.21±0.00
3	Epididymis ($x10^9$)	0.19± 0.10	0.12±0.01	0.08±0.00	0.18±0.00
4	Vas deferens ($x10^9$)	3.25±0.40	2.82±0.50	2.00±0.13	3.75±0.60

LEHP-Low energy high protein, HELP-High energy low protein, and HEHP-High energy high protein

CONCLUSION

In conclusion, the varying dietary levels on different strains of commercial turkeys used in this study, account for differences in growth rate, egg production and reproductive parameters, suggesting that this differences would serve as reference point for intending turkey farmers as well as academia and could be useful for future breeding programme to improve the existing productive and reproductive performance among turkey strains particularly in the southern Guinea savannah of Nigeria. No scientific studies were carried out on turkey production and reproduction performance under guinea savannah condition. The preliminary results reported in this paper are a beginning and more in-depth research is required.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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