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# Determination of optimum blood meal level for performance of broilers under Sudan condition

Sami Ahmed Mohammad Arabi * and Reem Adam Ibrahim Adam

*Department of Animal Production, Faculty of Environmental Science and Natural Resources, University of ElFashir, P O Box 125, ElFashir Sudan.*

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## Abstract

Different unconventional feed stuffs are used in poultry production to decrease ration cost and the environmental, nutritional and economic benefits derived from the maximal utilization of animal blood. This study was established to assess the effect of feed partially replaced dried blood content supplemented on growth performance responses and carcass. In a feeding trial, 240 commercial broiler chicks a day old, with an average starting weight of 48.40± 1.50 g, Lehmann breed unsexed commercial broiler were randomly allocated to one of four dietary treatments in a completely randomized design. The dietary treatments consisted of the control diet, and three diets which contained varying levels of Sun-dried blood meals SDBM (3, 4 and 5 %) respectively. The experimental diets were formulated to be both isonitrgenous (22.5% CP) and isocaloric (3.10 Mcal /kg). Feed and water were provided adlibitum for a period of 6 weeks. Data for the entire 42 days growth assay indicate the concentration of SDBM in the diet had impact on feed intake. However, birds fed SDBM at 3 or 5% had better weight gains and feed efficiency ($p < 0.05$) than birds fed 4% SDBM and the SDBM free diet. Carcass yields were similar. Mortality was also unaffected by dietary treatments. In addition, Analysis of productive parameters indicated that dietary SDBM up to 5% had a positive effect on growth performance and that partial replacement of protein sources (blood meal and groundnut cake) with SDBM was possible.

**Keywords:** Blood meal; Performance; Carcass yields; Growth performance

## 1. Introduction

The world is experiencing a growing population and rising incomes. This has led to increasing demand for food products, especially meat, milk and eggs. Together with innovations on the supply side, this has caused rapid growth of the livestock sector as a whole. Human population growth, urbanization and income improvements are causes of increased demands for foods of animal origin in the developing countries (1; 34).The number of slaughtered animals has increased with animal production growth, generating large volumes of animal residues. After being submitted to treatments, these residues may be used as an alternative feedstuff in broiler diets, reducing feed costs. The most common animal byproducts used in broiler diets are meat and bone meal, blood meal, feather meal, and poultry offal meal. These feedstuffs contain high protein levels and may partially replace soybean meal. In addition of being a protein source, meat and bone meal is also a significant source of totally available calcium (Ca) and phosphorus (P), whereas in plant feedstuffs, phosphorus is only 33% bioavailable to animals due to the presence of phytate (8). Blood proteins provide an economic and readily available alternative source of proteins and irons for use in foods and dietary supplements to address a wide range of functional and nutritional needs. Its additional benefits as a source of bioactive peptides with anti-hypertensive, anti-bacterial, analgesic, and anti-nociception properties have the potential to provide safer and cheaper alternatives to conventional drugs, which tend to be expensive and have unwelcome side effects.

*Corresponding author: Sami Ahmed Mohammad Arabi; Mobile: +249-912554816
Department of Animal Production, Faculty of Environmental Science and Natural Resources, University of ElFashir, P O Box 125, ElFashir Sudan.

Efforts to ensure large scale utilization of blood proteins as food additives should be encouraged because of the economic, nutritional, health and environmental benefits conveyed (17). Blood meal, a lysine-rich ingredient (6–8% lysine) (7) blood meal meets the requirements by two ways. Firstly, it can meet the protein requirement of birds. Secondly it serves the deficiency of lysine. It contains about 800g/kg of protein and small amounts of ash and oil and about 100g/kg of water (9) Bovine blood is an abattoir(slaughter house) by-product that offers a tremendous potential as a cheap and locally available alternative feedstuff for poultry (3).Modern poultry production is capital intensive. Feed cost represents the greater percentage of production costs, approximately 70-80 percent of variable cost (12; 37). Most of the conventional protein sources such as groundnut cake, sesame seedcake, soybean meal, and fish meal might sometimes be limited in poultry feeding due to their unavailability and costly prices (13). The quality of animal protein sources is primarily dependent upon the composition of raw material used for processing (18).This study was therefore conducted to evaluate the effects of different levels of blood meal on productive performance, carcass characteristic and economics of production of broilers.

## 2. Material and methods

### 2.1. Experimental

This study was carried out at the poultry unit of teaching and research farm of Faculty of Environmental Science and Natural Resources, University of ElFashir, Northern Darfur State, Sudan.

### 2.2. Source of Methods of blood meal Collect

Blood was collected from the carcasses slaughterhouse north of Abu Shook in ElFashir city. Fresh blood drained of the plasma fraction was collected into a clean container. Bovine blood was weighed into a drum. The drum containing the blood was placed on burning firewood and boiled for 90 minutes and was constantly stirred as it boiled until free of steam. The boiled blood was preserved by sun drying for two to three days on a clean drying slab to moisture content below 15%, milled, bagged and store.

### 2.3. Experimental Design and Treatments

The experimental design used was Completely Randomized Design (CRD). The Broiler chicks were randomly assigned to four (4) treatments. Each of the treatments was replicated three times with six (6) birds per replicate. Four isonitrogenous diets (22.5% CP) were formulated at 0, 3.0, 4.0 and 5.0 % replacement levels designated as treatments T1, T2, T3 and T4, respectively. The compositions of diets are as shown in Tables 1.

### 2.4. Experimental diets

The diets formulated and manufactured to supply the broilers' nutritional requirements, were fed as a mash and calculated according to (27) which is presented in Table 1. Four experimental diets were formulated in each treat such that the control diet (T1) contained 0 % blood meal, diet 2 (T2) contained 5 % blood meal, diet 3 (T3) contained 4.0 % blood meal and diet 4 (T4) contained 3.0 % blood meal.

The diets of each phase were isoproteinous and isocaloric providing between 22.51, 22.50, 22.55 and 22.51%crude protein (CP), and 3030.52, 3028.3, 2997.06 and 3090.27 Kcal/Kg metabolizable energy (ME) for one phase, the ingredient and calculated chemical compositions of diets are presented in Table: 1 according to (4). Vaccination and medical program were done according to the different stages of age under supervision of a veterinarian. Chicks were grown in brooders with raised on deep letter and were reared under the same managerial and hygienic conditions. The lighting pattern was 23 hr light: 1 h dark. Feed and water were *ad-libitum* throughout the experimental period (1-6 weeks of age). All chicks received feeds from placement until 42 days of age in mash form, according to its treatment.

### 2.5. Collecting and processing of blood

Fresh blood was collected according (5).

### 2.6. Experimental Birds and management

Seventy-two unsexed one-day-old commercial broiler chickens (Lehmann strain) were individually weighed and allotted randomly to the four dietary treatments. Each treatment was replicated three times. The birds were placed and reared in deep litter pens each measuring 1.4 meter ×1.4 meter, a floor space of 0.25 meter$^2$per bird. The study was conducted for 42 days. Birds had free access to feed and water throughout the experimental period. Chickens were vaccinated against Gumboro and Newcastle diseases.

**Table 1** Ingredient and calculated chemical composition of the experimental broiler diets.

| **Ingredients** | **Blood Levels %** | | | |
|---|---|---|---|---|
| | T1 | T2 | T3 | T4 |
| | 5% | 4% | 3% | 0% |
| Fetarita Dura (Sorghum) | 70.00 | 69.50 | 67.00 | 64.70 |
| Ground nut cake | 18.00 | 20.50 | 23.00 | 28.00 |
| Concentrate | 3.00 | 3.00 | 3.00 | 5.00 |
| Lime stone | 1.00 | 1.00 | 1.00 | 1.00 |
| Blood meal | 5.00 | 4.00 | 3.00 | - |
| Wheat Brand | 2.00 | 1.00 | 2.00 | - |
| Vitamin* & mineral | 0.25 | 0.25 | 0.25 | 0.10 |
| L-Lysine | 0.25 | 0.25 | 0.25 | 0.10 |
| Choline | - | - | - | 0.10 |
| DL-Methionine | 0.25 | 0.25 | 0.25 | 0.50 |
| Salt(NaCl) | 0.25 | 0.25 | 0.25 | 0. 50 |
| Total | 100 | 100 | 100 | 100 |
| Calculated analysis | | | | |
| Crude protein% | 22.50 | 22.55 | 22.51 | 22.51 |
| ME, kcal/kg | 3028.13 | 2997.06 | 3090.27 | 3030.52 |
| Total Phosphorous% | 0.600 | 0.600 | 0.600 | 0.700 |
| Calcium | 0.578 | 0.523 | 0.578 | 0.678 |
| Phosphorous | 0.374 | 0.326 | 0.372 | 0.7 0 |
| Ether Extract | 3.979 | 3.238 | 3.966 | 3. 30 |
| Fiber | 4.458 | 3.486 | 4.445 | 3.8 0 |
| Ash | 4.051 | 3.323 | 4.154 | 5.011 |

*Guaranteed levels of vitamin and minerals supplements per kg product: vitamin A: 300.000 UI; vitamin $D_3$: 100.00 UI; vitamin E. 4.00mg; vitamin K: 98 mg; vitamin B2: 1.320MG; vitamin B12: 4.000mg; Pantothenate: 2.000mg; niacine: 20.000mg; Folic acid: 100 mg; choline: 50.000 mg; Copper: 15.000 mg; idoines: 250mg; selenium: 50 mg; manganese: 24.000mg; zinc: 20.000 mg; iron.: 10.000mg; coccidies: 25.000mg; antioxydants; 125mg.

### 2.7. Parameters measured

Birds were individually weighed and feed consumption per pen was recorded weekly. Feed: gain ratio was determined weekly for individual replicates of each dietary treatment. Records of mortality were also kept. At 42 days of age, four broilers from each of the 12 replicates were selected at random, starved of feed for ca. 18 h to empty their crops, killed by cutting the jugular vein, exsanguinated, defeathered and eviscerated. Carcass yield was calculated from eviscerated weight and live weight. The following traits were evaluated:

Carcass yield (CY), breast bone-in (BBI), deboned breast (DBB), and thighs +drum (T+D) yields. Carcass yield was calculated relative to live weight before slaughter [%CY= (carcass weight with no feet, neck, and head x 100)/ live weight] and parts yield relative to carcass weight [Parts yield %= (parts weight x 100)/ carcass weight].

### 2.8. Statistical analysis

The data collected from the treatments were subjected to analysis of variance and whenever appropriate the mean separation procedure of Duncan was employed (33). Data were analyzed by ANOVA using the LSD procedure of SAS (version 9.1, SAS Institute Inc., Cary, NC; (22).

## 3. Results and discussion

Means and their corresponding standard errors for performance values of broiler chicks fed different levels of blood meal for 42 days measurements are presented in Table 2.Among the measurements, feed intake, live weight, feed conversion ratio, and weight gain were significantly (P<0.05) influenced by treatment. This was also applicable to breast, thigh and drumstick weight though the yields. The weight gain of broilers respectively was 2304vs. 2399.60vs. 2263.02 and vs. 1970g and their yields 73.18%vs. 76.65%vs 75.74% and vs. 77.75% for the carcass, the values of breast and thigh weight were434.33, 104.78vs 403.33, 91.22vs 432, 94.78 and vs. 409.30 86.9 g respectively. The results showed significant (p<0.05) increase in body weight, body weight gain and improvement in feed conversion ratio (FCR) in the group fed diet with 4% and 5% supplemented with blood compared to control, however body weight gain (BWG) was better for birds fed 4% blood meal (BM) comparing to other groups. May these due to digestibility of amino acid or influences body weight results obtained from the broiler starters were similar to the results of (24;25) who observed that there were dietary effects (P <0.05) on feed intake which significantly decreased with increase in blood meal levels. There are some reports indicating that inclusion 1 to 4% blood meal in diets can improve poultry performance (29; 28; 11). In contrast, (30) found that the apparent amino acid digestibility of blood meal for broilers was high (73 to 89 %). (20; 19; 35) postulated that the protein level of the feed during the growth phase influences body weight. Also agreed with the above scholars (24) the group (3%BM) gave best performance in terms of weight gain and carcass yield, average feed consumption of broilers consumed less feed, better feed conversion ratio, dressing percentage. The results were disagree in (15) studied, diets containing more than 3% blood meal unfavorably influenced feed intake and body weight gain of broiler chickens.(36) suggested that blood meal up to 3% can be incorporated in broiler diets without any adverse effect on production parameters during starting and finishing stages of growth. (31) Concluded that quality of feed ingredients impose direct effect on their available amino acids profile. But these results were disagreeing with the findings of (32;10) concluded that the inclusion of 5 and 7.5% BM resulted in better weight gain and feed conversion ratio when compared with the inclusion of 0.0 and 2.5% BM.

**Table 2** Analysis of variance and average (mean ± std. error) performance values of broiler chicks fed different levels of blood meal for 42 days.

| | Groups | | | |
|---|---|---|---|---|
| **Items** | **T1** | **T2** | **T3** | **T4** |
| | 5% | 4% | 3% | 0% |
| Initial weight | 49.70±01.70 | 48.40±01.50 | 47.14±1.90 | 48.30±01.40 |
| Final weight | 2380.90$^{a}$±19.31 | 2465.90$^{a}$±110.32 | 2327.60$^{a}$ ±36.77 | 2012.50$^{b}$ ± 65.47 |
| Weight gain | 2304.30$^{a}$± 29.81 | 2399.60$^{a}$±44.43 | 2263.02$^{a}$±40.00 | 1970.20$^{b}$±27.50 |
| Daily feed intake | 124.71±10.40 | 117.42±05.27 | 112.5±06.98 | 110.20±09.86 |
| Feed intake (Cumulative) | 5237.98±19.31 | 4931.8±28.87 | 4725.1±56.14 | 4628.75±57.92 |
| Feed conversion ratio | 02.27$^{ab}$±0. 143 | 02.06$^{b}$±0 .027 | 02.09$^{b}$±0 .167 | 02.35$^{a}$± 0.663 |

Means in a row do not differ significantly (p>0.05).

Carcass yield and breast, thigh and drum yields are presented in Table 3.carcass cuts best (P< 0.05) when birds were fed blood meal breast meat yield was increased (P< 0.05) in birds fed blood meal 4% flowed by 3% promoted better weight compared with birds in other treatments. Breast meat is the most liked meat from the commercial carcass components for its low fat content and faster rate accumulation of muscle tissues by birds than other parts. (10) Efficiency of feed utilization progressively improved significantly influenced (p< 0.05) when the levels of dietary blood meal were progressively elevated. Birds receiving blood meal had a better feed: gain ratio than that naught blood meal. These results be suitable for the findings of (6; 21) increased dietary amino acid density nutrient density throughout life optimized breast meat yield.(10) indicated that dietary solar-dried blood meal had a positive effect on growth performance and that partial replacement of other protein sources (fishmeal and groundnut cake) with blood meal was possible. (30) The digestion of amino acids transactions in the blood meal is high.

**Table 3** Analysis of variance and average (mean ± std. error) carcass cuts and tissue values (g) of broiler chicks fed different levels of blood meal for 42 days.

| Parameters | Treatments | | | |
|---|---|---|---|---|
| | T1 | T2 | T2 | T4 |
| | 5% | 4% | 3% | 0% |
| Live weight(g) | 2352.30±41.61 | 2447.60±44.61 | 2311.02±41.61 | 2018.20±39.60 |
| Weight gain(g) | 2304.30±45.3 | 2399.60±46.3 | 2263.02±45.3 | 1970.20±44.53 |
| Dressed weight (g) | 1721.33±31.80 | 1876.03±32.80 | 1750.28±31.84 | 1569.22±27.58 |
| Breast weight (g) | 434.33ab±08.14 | 403.33b±00.10 | 432.1±18.95 | 409.30a±5.17 |
| Thigh weight (g) | 104.78±3.03 | 91.22±09.38 | 94.78±10.10 | 86. 9±06.86 |
| Drumstick(g) | 123.98±4.23 | 97.22±227.50 | 114.56±14.46 | 117.78±8.44 |
| Liver(g) | 51.56±2.30 | 56.22±5.78 | 51.67±7.70 | 53.56±4.95 |
| Gizzard(g) | 53.67±2.24 | 44±2.12 | 41.78±3.15 | 53.56±4.36 |
| Breast yield (%) | 22.45±0.172 | 26.83±0.453 | 24.38±0.172 | 23.22±0.453 |
| Thigh yield (%) | 5.27±0.972 | 3.97±0.816 | 4.96±0.533 | 5.84±0.627 |
| Drumstick yield (%) | 4.40±0.546 | 4.0±0.791 | 4.24±0.292 | 7.71±0.625 |
| Carcass yield (%) | 73.18±1.35 | 76.65±1.80 | 75.74±1.60 | 77.75±1.70 |
| Liver yield (%) | 2.19±4.33 | 2.30±4.34 | 2.24±4.26 | 2.65±4.36 |
| Gizzard yield (%) | 2.28±0.08 | 1.80±0.09 | 1.81±0.09 | 2.65±4.36 |

NS = not significantly different (p>o.05). Means in a row do not differ significantly (p>0.05).

(20) Investigated that the reduced dietary nutrient density regimen currently employed by some integrators is not an effective means of increasing profitability, especially when producing large, high-yield broilers for markets geared toward saleable white meat. (2) Reported that carcass traits (carcass, giblets and dressing percentages) were not affected due to either the different dietary energy and protein levels or their interactions. High energy diets can be used advantageously, providing that the amino acid content is increased pro rata in order to ensure an optimum calorie to protein ratio. (16) Demonstrated that carcass fat content can be reduced through the use of higher amino acid densities.

## 4. Conclusion

Based on overall performances of boiler, blood meal is a suitable protein source as meal replacement for broiler. Growth, nutrient utilization and body composition were improved significantly influenced by gradually replacing blood meal. Further studies are proposed to determine the long-term impact on the performance of birds that feed the system of replacement of broiler blood meal under farm conditions.

## Compliance with ethical standards

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*Disclosure of conflict of interest*

No conflict of interest

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