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Evaluation of the Use of *Thonningia sanguinea* (THOS) Meal in Different Rations on the Morphological Parameters of Local Breed Chicken Farmed in Côte d'ivoire

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ABSTRACT

Background and Objective: The use of *Thonningia sanguinea* (THOS) in domestic animal feed not only enhances the available natural resources and contributes to food self-satisfaction, but also makes local poultry farming profitable. Thus dietary supplementation of extract of *Thonningia sanguinea* on the morphometric parameters of local chicken *Gallus gallus domesticus* raised in confinement was the subject of this study. **Materials and Methods:** Four batches of local breed chickens (60 per batch) and four feeds were set up, in particular a control feed (THOS 0%) and three supplemented feeds (THOS 5%, THOS 10% and THOS 15%). The data on the measurement of the subjects was collected from week 12, then weeks 16, 20, 24 and 30. **Results:** The measurements of the legs show that the chickens fed with THOS 5% and those fed with THOS 10% had skeletal and muscle development faster than chickens fed the control diet and those on THOS 15% between 12 and 16 weeks of age. Beyond 20 weeks of age, chickens fed THOS 5% show skeletal development and muscles greater than chickens fed the other supplemented feeds. **Conclusion:** This study showed that supplementation with *Thonningia sanguinea* powder at 5% in the feed allows local chicken growth, both muscular and skeletal and can be recommended in poultry farming.

KEYWORDS

Thonningia sanguinea, morphometric characters, local chicken, feeds, skeletal development, poultry

INTRODUCTION

Traditional poultry farming plays an essential socio-economic and nutritional role in sub-Saharan African society. The development of this activity in these countries is generally hampered by several constraints including food[1]. This probably stems from the availability and cost of quality foods[2].

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However, the diverse use of available natural resources at a lower cost as an alternative to this constraint could contribute to formulating rations intended for domestic animals in this case traditional poultry farming. Thus, several studies have been carried out to respond to this constraint through the use of various and alternative natural resources to improve the zootechnical parameters of traditional breeding. Indeed, poultry feed could be favored by the use of agricultural raw materials from the farm or other plants from the surrounding environment that have therapeutic properties as food additives[3]. For example, the use of termite meal[4], long turmeric[5], cowpea[6], *Moringa oleifera* leaves[7] and *Thonningia sanguinea*[8] improved the zootechnical performance (mortality, live weight and average daily gain) of chickens.

In the quest to contribute to the satisfaction of self-sufficiency in animal protein, this study is part of the valorization of the natural resources available in Côte d'Ivoire. It consists of evaluating the effect of partial substitution of corn with *Thonnigia sanguinea* powder (THOS) on the morphometric parameters of local breed *Gallus gallus domesticus* chickens raised in Côte d'Ivoire.

MATERIALS AND METHODS

Study site: The experiment was carried out on the breeding station, named "N'DRI Farm" followed in the village of Tiéplé. Tiéplé is one of the villages in the sub-prefecture of Bouaké, the second largest city in Côte d'Ivoire and located in the center of the country. Indeed, Tiéplé is on the south side of the city of Bouaké about 15 km away and on the east side of Djebonoua about 8 km away. Tiéplé geographic coordinates are 07°41'7"N Latitude and 5°01'50"W Longitude. The study was carried out from January, 2020 to December, 2021.

Biological material: The animal material consisted of 240 local breed chickens (*Gallus gallus domesticus*) from Tiéplé farm. The breeders of these chickens were purchased in the villages of the "Gbéké" region. The bracts and inflorescences of *T. sanguinea* (Fig. 1) codified THOS by the Laboratory of Biochemical Pharmacodynamics of UFR Biosciences (UFHB) constituted the plant material.

A sample of this plant has been deposited in the herbarium of the National Center of Floristic under reference N°8355. *Thonningiac sanguinea* was collected between March and October during the years of the experiment. The size of the rhizomes varies from 2 to more than 16 cm and those of the Inflorescences from 3 to 16 cm.

Technical material: It consists of a scale that was used for different weighing of food. Also, a caliper was used to measure the different lengths of the keel bone, drumstick, tarsus and tarsus diameter.

Fig. 1: Rhizomes and Inflorescences of *Thonningia* sanguinea harvested

Besides, a measuring tape was also used for the measurements of the towers of the pestle and the wishbone. The wishbone angle was measured using an angle meter or a goniometer.

Methods: Formulation methods, feed composition and animal management have been described by Ahouchi *et al.*[8].

Morphometric parameters: Morphological measurements were made at 12, 16, 20, 24 and 30 weeks of age. Excluding 30 weeks, the measurements were carried out on 240 with 60 animals per food treatment. At 30 weeks, measurements were taken on 80 chickens, i.e. 20 chickens per batch "THOS 0, THOS 5, THOS 10 and THOS 15%". These measurements were made individually on animals in order to better follow their evolution.

Wishbone angle, length and circumference measurement: The keel or Wishbone Angle (cm) is measured using a goniometer angle meter: The animal is lying on its back in the angle meter perpendicular to the axis of the body. The blade of the angle meter is then tilted to the anterior end of the wishbone and the value of the angle is read directly on the scale of the blade. Wishbone length is the distance measured with a caliper between the two peaks of the sternum when the bird is lying on its back. The Wishbone circumference (cm) is measured using a tape measure at the level of the anterior end of the breastbone.

Measurement of the length and circumference of the drumstick: The length of the drumstick was taken between the coxo-femoral joint and that of the femoro-tibial with a caliper. Drumstick circumference (cm) was measured using a tape measure at the maximum diameter of the drumstick muscle.

Tarsal length and diameter measurement: The tarsal length (cm) measured using a caliper is the length between the femoro-tibial joint and that of the tarso-metatarsal (zone of emission of the fingers). In other words, it is the distance between the external parts of the drumstick-leg articulation and the plantar sole, measured when the segments of the limb form a right angle between them. The tarsal diameter is the diameter of the middle of the metatarsal bone, without pressing the skin.

Statistical analysis: The data was analyzed by the R software version 4.0.0. The means of the different treatments were compared using the One-factor Variance Analysis test (ANOVA) at the 5% threshold. The test of the least significant difference (Tukey's test) was used to better appreciate the differences observed in the morphometric parameters.

Ethical consideration: Takes into account the fundamental rights and welfare of the animals involved in our research. All proceedings were conducted following ethical and legal standards. For the animals followed the protocols approved by our ethics committee. This research protocol has been reviewed and approved by the ethics committee of our institution. All the applicable guidelines and regulations were compiled.

RESULTS

Effects of dietary treatments on leg and keel bone measurements: Table 1 presents the results of the leg measurements for the chickens fed the experimental diets. There is a significant difference ($p<0.05$) between the chickens for most of the parameters studied.

The chickens fed with THOS 5% and THOS 10% show identical and superior values to those of the chickens fed with THOS 0% and THOS 15% in terms of the length and the diameter of the tarsus at 12 weeks of age. This trend was also observed at 16 weeks of age at the lengths of drumstick and tarsus.

Table 1: Effect of the incorporation of *Thonningia sanguinea* powder in the ration on the morphometric measurements of the paw of local chickens

Setting	THOS 0%	THOS 5%	THOS 10%	THOS 15%	P>F
Drumstick length S12 (mm)	74.89±8.32	77.08±8.14	77.31±8.91	74.14±7.61	0.273
Drumstick circumference S12 (cm)	4.72±0.59	4.42±0.80	4.46±0.65	4.33±0.63	0.154
Tarsus length S12 (mm)	35.00±3.91^{a}	43.95±5.85^{c}	43.79±3.77^{c}	38.78±5.08^{b}	<0.001
Tarsus diameter S12 (mm)	4.52±0.54^{a}	5.27±0.64^{b}	4.92±0.48^{b}	4.40±0.51^{a}	<0.001
Drumstick length S16 (mm)	81.78±11.03^{a}	93.75±6.99^{b}	87.57±9.37^{ab}	82.23±10.85^{a}	<0.001
Drumstick circumference S16 (cm)	5.10±0.00^{b}	5.40±0.55^{b}	5.31±0.59^{b}	4.72±0.68^{a}	<0.001
Tarsus length S16 (mm)	43.78±5.36^{ab}	50.23±6.90^{c}	47.47±4.89^{bc}	41.94±6.75^{a}	<0.001
Tarsus diameter S16 (mm)	5.19±1.06	5.88±0.74	5.11±0.61	4.66±0.75	<0.001
Drumstick length S20 (mm)	107.98±5.07^{b}	105.27±6.50^{b}	95.79±8.73^{a}	94.34±12.57^{a}	<0.001
Drumstick circumference S20 (cm)	6.63±0.62^{b}	5.78±0.65^{a}	5.35±0.52^{a}	5.40±0.80^{a}	<0.001
Tarsus length S20 (mm)	62.36±2.52^{c}	57.11±5.85^{b}	49.27±4.59^{a}	48.92±6.45^{a}	<0.001
Tarsus diameter S20 (mm)	8.41±0.50^{c}	6.49±0.60^{b}	5.47±0.77^{a}	5.64±0.67^{a}	<0.001
Drumstick length S24 (mm)	120.87±5.21^{c}	114.55±5.85^{b}	100.35±13.55^{a}	114.21±9.29^{a}	<0.001
Drumstick circumference S24 (cm)	7.69±0.92^{c}	6.76±0.59^{b}	5.53±1.02^{a}	6.29±0.32^{b}	<0.001
Tarsus length S24 (mm)	68.92±3.28^{c}	58.25±3.63^{b}	50.04±7.46^{a}	56.80±5.33^{b}	<0.001
Tarsus diameter S24 (mm)	7.78±1.03^{c}	7.84±1.73^{c}	5.29±1.01^{a}	6.31±0.57^{b}	<0.001
Drumstick length S30 (mm)	119.09±8.50	122.06±37.84	115.57±10.65	119.24±9.55	0.006
Drumstick circumference S30 (cm)	8.12±0.71^{c}	7.86±0.75^{c}	6.80±0.84^{a}	7.31±0.57^{b}	<0.001
Tarsus length S30 (mm)	70.74±5.71^{b}	64.23±5.67^{a}	61.94±7.03^{a}	62.46±5.68^{a}	<0.001
Tarsus diameter S30 (mm)	6.85±0.52^{b}	8.09±0.46^{c}	6.47±0.79^{ab}	6.26±1.10^{a}	<0.001

M±SD: Mean±Standard Deviation and S: Week. ^{abc}On the same line, the assigned values of the exponents are significantly different for p<5%

Table 2: Effect of the incorporation of *Thonningia sanguinea* powder in the ration on the morphometric measurements of the keel bone of local chickens

Setting	THOS 0%	THOS 5%	THOS 10%	THOS 15%	P>F
Wishbone angle S12 (cm)	21.70±0.99^{a}	23.30±0.55^{c}	23.22±0.63^{c}	22.20±0.60^{b}	<0.001
Wishbone length S12 (mm)	58.86±8.22^{a}	67.69±6.27^{b}	67.11±6.18^{b}	61.39±6.56^{a}	<0.001
Wishbone circumference S12 (cm)	14.66±1.76	14.08±1.57	13.77±1.36	13.77±1.69	0.108
Wishbone angle S16 (cm)	22.90±0.87^{a}	23.78±1.18^{c}	23.52±0.93^{bc}	23.12±0.45^{ab}	<0.001
Wishbone length S16 (mm)	68.69±7.58^{a}	79.44±7.64^{c}	75.12±6.91^{bc}	71.58±8.06^{ab}	<0.001
Wishbone circumference S16 (cm)	16.45±1.47^{b}	16.28±1.49^{b}	15.85±1.66^{ab}	14.87±1.27^{a}	<0.001
Wishbone angle S20(cm)	32.03±2.08^{c}	25.08±1.77^{b}	23.28±0.47^{a}	23.87±1.25^{a}	<0.001
Wishbone length S20 (mm)	85.33±4.49^{b}	88.16±8.76^{b}	79.21±8.11^{a}	77.29±10.11^{a}	<0.001
Wishbone circumference S20 (cm)	22.31±1.20^{c}	18.62±1.23^{b}	16.79±1.46^{a}	17.13±1.97^{a}	<0.001
Wishbone angle S24 (cm)	36.06±2.44^{c}	26.88±1.13^{b}	24.35±1.72^{a}	26.00±1.14^{b}	<0.001
Wishbone length S24 (mm)	99.12±5.60^{c}	97.09±5.56^{c}	79.32±12.82^{a}	89.13±6.68^{b}	<0.001
Wishbone circumference S24 (cm)	23.55±1.45^{d}	20.70±1.14^{c}	17.62±3.01^{a}	19.13±1.30^{b}	<0.001
Wishbone angle S30 (cm)	36.70±1.68^{c}	31.20±1.19^{b}	27.43±2.80^{a}	30.63±2.78^{b}	<0.001
Wishbone length S30 (mm)	105.99±4.30^{b}	101.12±5.14^{b}	94.18±11.65^{a}	94.65±5.56^{a}	<0.001
Wishbone circumference S30 (cm)	24.77±1.49^{d}	23.42±1.82^{c}	19.98±2.15^{a}	22.10±1.69^{b}	<0.001

M±SD: Mean±Standard Deviation and S: Week. ^{abc}On the same line, the assigned values of the exponents are significantly different for p<5%

Chickens fed with the THOS 0% control diet and those fed with THOS 5% recorded the best results for drumstick length at 20 weeks, while for drumstick circumference at 20 weeks and tarsus length at 30 weeks. Chickens fed THOS 0% had the best trends. For parameters such as tarsus length and diameter at 20 weeks and drumstick length at 24 weeks, chickens from the control ratio recorded the best performance. However, the animals on the THOS 5% ration recorded the highest averages among the chickens fed the rations containing the THOS powder. In the 24th week, the chickens on the THOS 5% and 15% THOS rations recorded the highest averages among the chickens fed the experimental diets for the circumference of the drumstick and the length of the tarsus. In addition, chickens fed with THOS 0% and THOS 5% similar and superior values to those of chickens reared with THOS 15% which were also greater than those of THOS 10% for the diameter of the tarsus at 24 weeks and the round of pestle at 30 weeks.

Effects of dietary treatments on breast bone measurements: Table 2 presents the results of the keel bone measurements for the chickens fed with the experimental foods. There is a significant difference

($p<0.05$) in the chickens for most of the parameters studied. For parameters such as keel bone angle at 12 and 16 weeks and keel bone length at 16 weeks, chickens reared with THOS 5% and those fed with THOS 10% recorded the best performances ahead of chickens fed with the diet control and those of THOS 15%. Moreover, for all the variables, the chickens fed with THOS 5% either had averages similar to those of chickens fed with THOS 0% or were lower than theirs. However, while chickens fed THOS 10% recorded the lowest averages.

DISCUSSION

This study on the supplementation of *Thonningia sanguinea* powder in food on the morphometric parameters of the local *Gallus gallus* chicken raised in confinement consisted of measuring a certain number of measurement indicators. Those of the leg show that chickens fed 5% THOS and those fed 10% THOS had faster skeletal and muscle development than chickens fed the control diet and those fed 15% THOS between 12 and 16 weeks of age. This can be seen in the higher averages for the length and circumference of the drumstick and the length and diameter of the tarsus for the different batches mentioned above. Beyond 20 weeks of age, chickens reared on the control diet showed faster growth in most cases. However, when the chickens fed with the experimental foods were compared with each other, those fed with THOS 5% showed a greater development than the chickens fed with the other rations.

The average drumstick lengths recorded in this study at 30 weeks of age (115.57 to 122.06 mm) were greater than those recorded by Lyde *et al.*[9] (111.29 mm) on local chickens from the same locality, from Guni *et al.*[10] in Tanzania (6.19±0.03 to 7.96±0.05 cm), from Hassaballah *et al.*[11] in Chad (13.7±0.25 cm). In addition, Tanzania enjoys a humid tropical and humid equatorial climate. The climate being less hot, the chickens presented less long drumsticks with 42.46 mm less. This tendency, which would be an adaptation to heat, was inversely observed in Saharan chickens from Chad with a drumstick superiority of 14.94 mm. The results of the mean tarsal lengths at 30 weeks of age in this study (61.94 to 70.74 mm) were in the same order as those of Keambou *et al.*[12] (6.36 cm to 7.80 cm) west of Cameroon, Lyde *et al.*[9] (63.49mm) on local chickens from the same locality from Côte d'Ivoire.

Mahammi *et al.*[13] at adulthood (30 weeks) presented tarsus lengths similar to that of local hens in Oranie (67.54 mm)[14] and roosters (62.1 mm) in Burkina Faso[15]. Francesch *et al.*[16] reported similar tarsus lengths observed in cocks (73 mm) to those of subjects on the control diet (THOS 0%) and females (58 mm) to that of chickens having received the powder from THOS. These values were obtained by these authors'previous studies in a scavenging system where the animals move constantly in search of food in the environment. Indeed, the stray food habit is mainly captured around the dwelling huts and composed mainly of crop residues and supplemented with animal proteins such as earthworms, insects and other corpses.

However, the average tarsus diameter (6.26 to 8.09 mm) was lower than that found by Lyde *et al.*[9] (12.03 mm) on local chickens from the same locality and in Spain 1.27±0.013 cm in the Penedesenca partridge and 1.3±0.013 cm in the Empordanesa blonde hen.

Breast measurements reveal that chickens fed 5% THOS and those fed 10% THOS had greater muscle development than chickens raised on 0% THOS and those raised on 15% THOS between 12 and 16 weeks of age. However, the trends changed with age and for the most part muscle development was either greater with the control diet or about the same as with THOS 5%. However, chickens reared with THOS 5% grew faster than chickens reared with the other experimental feeds. At maturity (30th week) the chickens having consumed the THOS 5% ration presented a better development of the breast bone, part appreciated by the consumers. Chickens on the 5% THOS ratio showed a significantly greater mean keel length of 7 mm than those on 10% THOS and 15% THOS at 30 weeks of age. This study highlighted the

effect of food on the development of domestic animals, especially local chickens during their growth. The feed containing 5% THOS powder has been ideal for ensuring proper muscle growth and development. The present experiment can be proposed in other livestock speculations.

CONCLUSION

This study showed that supplementation with *Thonningia sanguinea* powder in the feed allows the growth of the local chicken both from the point of view of the muscles and the skeleton. Given the low rate of incorporation of THOS to stimulate muscle development in local chickens and given its availability in nature, the use of feed supplemented with 5% THOS can be encouraged in poultry farming. The effect of the incorporation of the ratio on the morphometric parameters remains even less targeted by the studies. Thus, these studies can also be encouraged in order to understand the development of chickens during their growth.

SIGNIFICANCE STATEMENT

Research on domestic animal feeding involving local chicken has always been a worrying subject in scientific work. In fact, several studies have advanced to implement efficient rations at lower cost. However, the evaluation of the performance of these rations was mainly focused on zootechnical parameters. Thus, the present study will contribute to describing the different conformational modifications of chickens during the breeding phases in order to better understand their adaptations to the tropical environment and to valorize the country's natural bioressources. The natural resources available across the country can help increase domestic poultry production. This study will make it possible to increase the production of breeder's mainly in rural areas and therefore contribute to the fight against poverty.

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