

Original Article

Body weight and growths curve parameters evaluation of three chicken genotypes (*Gallus gallus domesticus*) reared in claustration

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ABSTRACT

Objective: The current study was undertaken to evaluate intensively reared indigenous slow-growing normally feathered (I-nana), commercial heterozygous naked neck (C-Nana), and commercial normally feathered (C-nana) chicken for their body weight and growth curve parameters.

Material and methods: A total of 132 birds were used in this study. Specifically, chickens flock consisting of 21 I-nana (8 males and 13 females), 20 C-Nana (8 males and 12 females) and 91 C-nana chickens (32 males and 59 females) were marked individually and reared together in a single room under uniform feeding, care and management. Body weight of individual hen and rooster of each genotype was measured weekly up to 12 weeks of age and then at 30 weeks of age. Parameters of growth curve were determined using Gompertz's equation.

Results: Commercial heterozygous naked neck and commercial normally feathered chickens exhibited significantly ($P < 0.01$) higher daily weight gain (DWG) than indigenous normally feathered counterparts at the first two phases of growth during 12 weeks of age (the DWG1-3wk for C-Nana, C-nana and I-nana were 04.46 ± 0.93 gm, 05.01 ± 1.10 gm and 02.38 ± 0.78 gm, respectively, and DWG3-12 wk for C-Nana, C-nana and I-nana were 16.60 ± 3.70 gm, 16.23 ± 3.4 gm and 08.01 ± 1.74 gm, respectively). However, at the third phase of growth 12 through 30 weeks of age, the normally feathered indigenous chickens (I-nana) had a significantly ($P < 0.01$) higher DWG12-30 wk (02.91 ± 0.81 gm) when compared with C-nana (02.53 ± 1.25 gm). The growth curves of chickens showed out distinctive inflexion points at 46.91d, 50.68d and 51.22d ($P < 0.01$) for three different C-nana, C-Nana and I-nana genotypes, respectively. The maturation rate per day was low for indigenous normally feathered birds (0.0282 gm), medium for commercial heterozygous naked neck and high for commercial normally feathered (0.0304 gm) chickens. The asymptotic weights were 823.7 gm, 1594.2 gm and 1506.9 gm for normally feathered indigenous, commercial naked neck and normally feathered chickens, respectively ($P < 0.01$). Initial specific growth rate of commercial normally feathered (0.1676 gm) and naked neck (0.1479 gm) chickens were higher than that of normally feathered indigenous counterparts (0.1196 gm).

Conclusion: The findings of the study reveal that the growth of normally feathered indigenous genotype was lower than those of commercial naked neck and commercial normally feathered chickens. However, the indigenous feathered chickens showed higher growth rate during the last phase of growth compared with the commercial feathered chickens. The estimate of the curve parameters seems to be an important tool for the selection of slow-growing traditional chickens for improvement.

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KEYWORDS

Growth; Indigenous chickens; Naked neck, Normally feathered

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INTRODUCTION

Modern poultry breeding would be an interesting solution for mitigating the problems of animal protein supply in every town having increase demography. Chicken production in developing countries serve as important source of animal protein and source of income especially for women ([Zaman et al., 2004](#)). Traditional poultry breeding promotion and the improvement of zootechnical performances would contribute to the national economic development and the keeping of poultry biodiversity ([Bouchardeau and Calet 1970](#); [FAO, 1998](#)). In Cote d'Ivoire, traditional poultry breeding is principally based on extensive type and used by almost all farmers ([Aboe et al. 2006](#); [Traoré, 2006](#)).

Traditional poultry breeding is characterized by unsophisticated technic and thereby requires fewer investments. Furthermore, in Cote d'Ivoire like in the majority of developing countries, local birds are highly appreciated by the consumers due to the appetizing of meat and eggs. However, the development and the productivity of traditional poultry is limited by constraints such as predation and diseases very often linked to the breeding mode, irregularity of feed supply in proximate environment, absence of settlement and mainly the low genetic potentiality. Low productivity of local birds is pointed out by low body weight (1027 ± 72.0 gm and 903 ± 19.8 gm, for male and for female, respectively, at old age ([Moula et al., 2012](#)). The best method for a constant improvement of these parameters is selection.

In poultry breeding, selection of strain for meat production is based on weight at an age given, very often the age of felling ([Mignon-Grasteau and Beaumont, 2000](#)). They suggested that the improvement of weight at a certain age would alter heavily the entire growth curve and after induce side effect onto fattening stage, the reproduction, the movement troubles or also sexual dimorphism, thereby necessitating consideration of the totality of growth curve.

Many mathematical functions like Richards model ([Knizetova et al., 1991](#)), Janoschek model ([Gille and Salomon, 1994](#)), logistic model ([Grossman and Bohren, 1985](#)), Gompertz model ([Barbato, 1991](#); [N'dri et al. 2006](#)) were used for describing growth of poultry. Indeed, the mathematical model permits to recap the information in some parameters and strategic points ([Knizetova et al. 1997](#)) and to describe the range of weights according to age. Thus it is possible to compare animals at the same physiological stage where the growth speed is maximal,

which is not possible to measure through the traditional body weight study ([Mignon-Grasteau and Beaumont, 2000](#)). Moreover, the non-linear investigation of the growth process has some advantages in not only mathematically explaining growth, but also estimating the relationship between feed requirement and body weight, and plays a crucial role in animal husbandry ([Sengül and Kiraz, 2005](#)).

Many broiler growth data analyses have been conducted using the well-known Gompertz growth function, which describes a single sigmoidal growth phase ([Wang and Zuidhof, 2004](#)). In recent years, there are many studies that have been performed with respect to growth analysis in slow-growing broilers. [Santos et al. \(2005\)](#) used the Gompertz model to analyze growth in two slow-growing broiler lines housed in two different systems. [Dourado et al. \(2009\)](#) used the Gompertz model to examine growth of slow-growing broilers reared in the free range system. Indeed, [N'dri et al. \(2006\)](#) made estimates of genetic parameters for Gompertz model parameters in slow-growing broilers reared in the label rouge system. Gompertz, Logistic and Richards model were fitted by [Norris et al. \(2007\)](#) to estimate and compare the growth curve parameters for body weight of indigenous Venda and Naked Neck chickens. The objective of the present study was therefore undertaken to assess the growth of indigenous normally feathered chicken genotype and compare them with those of the two slow-growing commercial naked neck and normally fully feathered chickens.

MATERIALS AND METHODS

Study area: The study was carried out in a poultry farm at Bouake, located in the central region of Côte d'Ivoire, in the locality of Tieple at 15 km from Bouake capital of Gbeke's Region. Tieple is situated on latitude $07^{\circ}41'7''$ N, longitude $5^{\circ}01'50''$ W. This locality is characterized by a vegetation of wooded savanna and is influenced by a humid tropical climate. The temperature of the area ranged between 22°C to 35°C with humidity's rate who ranged between 50% and 60%. The rainfall of 1200 mm/year is average

Experimental birds and their management (32 males and 59 females): A total of one hundred and thirty-two slow-growing chickens (*Gallus gallus domesticus*) consisting of 21 (8 males and 13 females) indigenous local birds (L) and 111 commercial hybrids (20 (8 males and 12 females) heterozygous naked neck birds (C-Nana) and 91 (32 males and 59 females) normally fully feathers birds (C-

nana) were used for the investigation. Specifically, two types of slow-growing chickens, a local indigenous unselected and two commercial selected birds (heterozygous naked neck birds and normally fully feathered birds) with less rapid growth compared to those of broilers chickens, are used (figure 1). Commercial birds were obtained from imported parents whereas Indigenous local birds were obtained from collected eggs issued from farmers. All birds were obtained from the same commercial hatchery in Abidjan at 1-d-old. All genotypes were submitted to similar treatment throughout the study period. Birds (both sex together) were weighed, identified with number (at 4 weeks of age) and raised together in a single room on wood chip litter with 10 birds/m² stocking density and they were not allowed go out for grazing. Routine vaccinations of birds (7, 15 and 21 days), against common infectious diseases at the recommended doses were carried out. These are vaccinations against Newcastle, Gumboro and fowl pox diseases were carried out while prophylactic antibiotics and anticoccidial drugs were appropriately administered. Other routine management practices were also carried out. Commercial feed and clean water were provided ad libitum and the birds were provided 12 h of natural light.

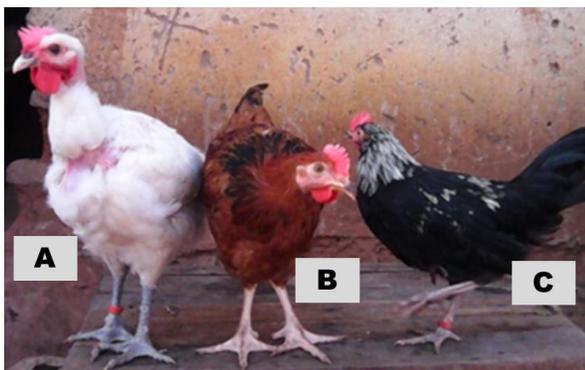


Figure 1. Three genotypes of chickens. (A) Commercial heterozygous naked neck (C-Nana), (B) Commercial fully feathered (C-nana), (C) Indigenous fully feathered local (I-nana)

Recorded traits: The birds were weighed at the commencement of the experiment and subsequently on weekly basis. The weights obtained were used to calculate daily weight gain as shown below:

$$DWG = \frac{\Delta w}{\Delta t} = \frac{W_f - W_i}{t_f - t_i}$$

Where,

W_f: Body weight at the end of considered period;

W_i: Body weight at the beginning of the considered period;

t_f - t_i : days number between the two considered periods t_i and t_f.

Daily mean weight gain measure animals' mean rate of growth on done period. Growth curve's parameters were determinate with only body weight up to 12 weeks of age (W12). They were obtained using Gompertz's equation [Laird et al. \(1965\)](#).

Statistics analysis: Data's recorded were encoded in data base conceive on the spreadsheet programmer Excel 2010. The weights' averages calculated were confronted among them by Tukey's test. Genotype and sex effects were analyzed using two factors analysis variance (ANOVA 2) of R software. Statistical analysis of data was realized with SAS software concerning growth curve parameters.

RESULTS

Weight and daily weight gain

The results of variance analysis were showed a significant effect of genotype ($P < 0.001$) onto growth parameters (**Table 1**). At birth (W₁), commercial birds (heterozygous naked neck and fully feathered genotypes) showed out high body weight. Indigenous local normally feathered birds (I-nana) presented the low body weight. At 8 weeks of age, the commercial heterozygous naked neck birds (C-Nana) exhibited high body weight (847.05 gm) following by commercial fully feathered (705.07 gm), I-nana showing the lowest value of body weight (422.80 gm). That tendency was conserved during the rearing. In fact at 30 weeks of age, the body weights were respectively 1987.50 gm, 1381.40 gm and 929.41 gm. Concerning weight gain between 12 and 30 w of age, C-Nana birds presented the high gain such as (866.10 gm). However, I-nana locals' birds recorded better gain than Commercial fully normally feathered (375.01 gm vs. 278.72 gm).

Regarding daily growth rate, at the first times of rearing (DWG_{1-3wk}), commercial animals, C-Nana and fully normally feathered genotypes (C-nana) were exhibited high value respectively (4.46 gm.d⁻¹ and 5.01 gm.d⁻¹) for the period going from 1day to 3 weeks of age, 16.60 gm.d⁻¹ and 16.23 gm.d⁻¹ about the period going from 3 weeks at 12 weeks of age respectively for C-Nana and C-nana birds. For the two period, Indigenous local chickens exhibited lower gains. However, at the third time of

Table 1. Average weight and evolution of growth rate (gm.d⁻¹) by period and by genotype

Parameters	C-Nana (Mean ± SE) [†]	C-nana (Mean ± SE)	I-nana (Mean ± SE)	Genotype effect
W ₁ (gm)	33,80±3,76 ^a	32,00±4,53 ^b	26,00±3,11 ^c	***
W ₃ (gm)	125,6±4,461 ^a	128,3±2,29 ^a	73,85±3,51 ^b	***
W ₈ (gm)	847,05±155,37 ^a	705,07±108,58 ^b	422,80±78,45 ^c	***
W ₁₂ (gm)	1121,40±224,96 ^a	1103,08±203,47 ^b	554,40±104,22 ^c	***
W ₃₀ (gm)	1987,50±664,20 ^a	1381,40±219,58 ^b	929,41±236,55 ^c	***
WG ₁₂₋₃₀ (gm)	866,10±224,96 ^a	278,72±168,05 ^c	375,01±104,22 ^b	**
DWG _{1-3wk} (gm.d ⁻¹)	04,46±0,93 ^b	05,01±1,10 ^a	02,38±0,78 ^c	***
DWG _{3-12wk} (gm.d ⁻¹)	16,60±3,70 ^a	16,23±3,4 ^b	08,01±1,74 ^c	***
DWG _{12-30wk} (gm.d ⁻¹)	06,71±1,74 ^a	02,53±1,25 ^c	02,91±0,81 ^b	***

[†]SE = Standard Error; W₁: Weight at 1d of age; W₃; W₈: Weight at 3w; W₁₂: Weight at 12w; W₃₀: Weight at 30w; WG₁₂₋₃₀: Weight gain between 12 and 30 weeks; DWG_{1-3wk}: daily Weight Gain on the period of 1d to 3week; DWG_{3-12wk}: daily Weight Gain on the period of 3 to 12week; DWG_{12-30wk}: daily Weight Gain on the period of 12 to 30 week; On the same line, affected values having the same letter aren't significantly different (* P>0.05, ** P>0.01, *** P>0.001). C-Nana: Commercial heterozygous naked neck; C-nana: Commercial normally feathered and I-nana: indigenous normally feathered birds

Table 2. Average weight and evolution of growth rate (gm.d⁻¹) by period, by genotype and by sex

Parameters	C-Nana (Mean±ES) [†]		I-nana (Mean±ES)		C-nana (Mean±ES)		Genotype effect	Sex effect
	Cock	Hen	Cock	Hen	Cock	Hen		
W ₁ (gm)	34,87±4,02 ^a	33,08±3,57 ^a	27,86±1,95 ^b	25,07±3,22 ^b	27,25±9,5 ^b	32,21±4,15 ^a	***	*
DWG _{1-3wk} (gm.d ⁻¹)	04,81±0,83 ^a	04,08±0,89 ^a	02,71±0,59 ^b	02,04±0,78 ^b	05,48±1,04 ^c	04,54±1,08 ^d	***	*
DWG _{3-12wk} (gm.d ⁻¹)	18,94±4,1 ^a	15,04±2,60 ^b	08,59±0,91 ^c	07,69±2,01 ^d	17,45±3,12 ^c	16,41±3,33 ^f	***	*
DWG _{12-30wk} (gm.d ⁻¹)	09,45±1,90 ^a	07,67±1,14 ^b	03,51±0,42 ^c	03,17±0,91 ^c	03,94±1,28 ^c	03,29±1,22 ^c	***	*

[†]SE = Standard Error; W₁: Weight at 1d of age; DWG_{1-3wk}: daily Weight Gain on the period of 1d to 3week; DWG_{3-12wk}: daily Weight Gain on the period of 3 to 12 week; DWG_{12-30wk}: daily Weight Gain on the period of 12 to 30 week; On the same line, affected values having the same letter aren't significantly different (* P>0.05, ** P>0.01, *** P>0.001). C-Nana: Commercial heterozygous naked neck; C-nana: Commercial normally feathered and I-nana: indigenous normally feathered birds.

Table 3. Growth curve's parameters of different genotypes

Parameters	I-nana (Mean±SE) [†]	C-Nana (Mean±SE)	C-nana (Mean±SE)	Genotype effect
A (gm)	823,7±54,50 ^b	1594,2±84,77 ^a	1506,9±73,58 ^a	***
B	4,2394±0,05 ^b	4,7875±0,04 ^a	4,9282±0,06 ^a	***
K (gm.d ⁻¹)	0,0282±0,001 ^b	0,0309±0,001 ^a	0,0340±0,001 ^a	***
L (gm.d ⁻¹)	0,1196	0,1479	0,1676	
T _i (d)	51,22	50,68	46,91	

[†]SE = Standard Error; A: asymptotic weight; B: constant of integration; K: maturation rate; L: initial specific growth rate (L=B×K); T_i: Age at the inflexion (T_i=1/k × ln(L./k); On the same line, affected values having the same letter aren't significantly different (* P > 0.05, ** P > 0.01, *** P > 0.001); d: day;

rearing (DWG_{12-30wk}), C-Nana kept this evolution, when indigenous local animals showed out a growth rate superior than the C-Nana, such as a value 6.71 gm.d⁻¹, 2.91 gm.d⁻¹ and 2.53 gm.d⁻¹ respectively for the C-Nana, I-nana, and C-nana.

In **Table 2**, variance analysis pointed out the significant (P<0.05) effect of sex on W₁, DWG_{1-3wk}, DWG_{3-12wk}, and DWG_{12-30wk}. For body weight on day 1 (W₁), the sex effect was only due to difference between the males and the females on the commercial fully feathered genotypes (C-nana). The males of C-nana have presented an average weight (27.07 gm) inferior to the female weight (32.21 gm). Similar results were obtained for daily weight gain between 1 day and 3 weeks of age. No differences were observed between males and females of the two genotypes but for the C-nana, males exhibited higher value (5.48 gm.d⁻¹) than those of female chickens (4.54

gm.d⁻¹). Among males of the three genotypes, the C-nana exhibited higher value (5.48 gm.d⁻¹) than those of C-Nana birds (4.81 gm.d⁻¹). The smallest value was noticed on indigenous local chickens (2.71 gm.d⁻¹). Similar results were observed in female birds within the genotypes. The DWG_{1-3wk} was respectively of 4.54 gm.d⁻¹, 4.08 gm.d⁻¹ and 2.04 gm.d⁻¹ for C-nana, C-Nana and I-nana chickens respectively. Indeed, for all genotypes, the males exhibited higher DWG_{1-3wk} than those of the female birds.

In the case of DWG_{3-12wk}, difference between males and females was observed for all the genotypes. The males of C-Nana chickens exhibited superior gain (18.94 gm.d⁻¹) than those of the males C-nana birds (17.45 gm.d⁻¹) whereas females C-nana had superior DWG_{3-12wk} (16.41 gm.d⁻¹) to those of females C-Nana. Concerning the DWG_{12-30wk}, effect of sex was due to difference of gain

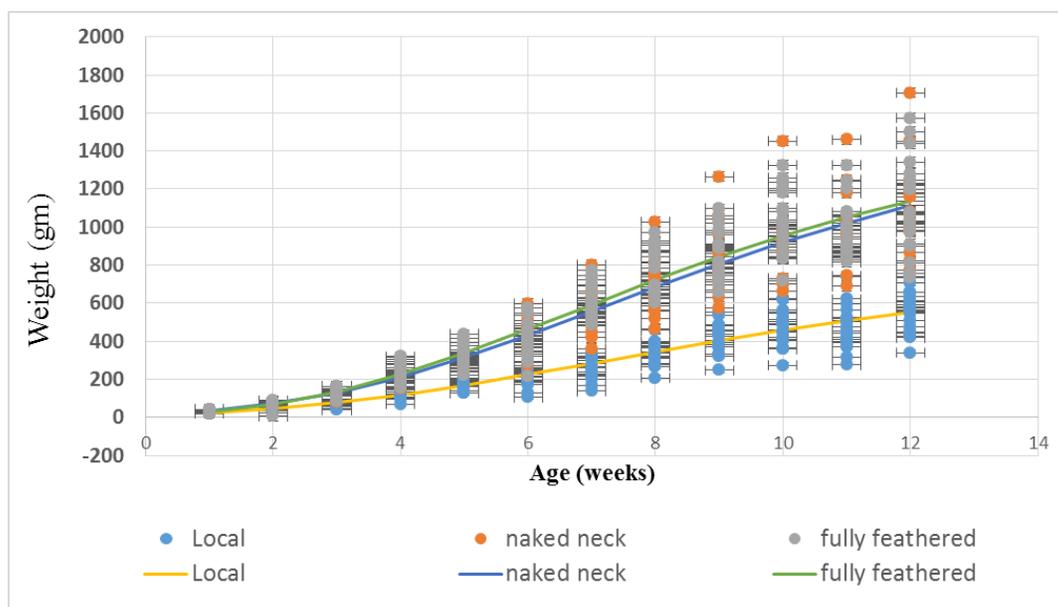


Figure 2. Curves of growth measured and estimated for the genotypes "Indigenous local normally chickens" (I-nana), "commercial heterozygous naked neck" (C-Nana) birds and "commercial fully feathered" birds (C-nana).

observed only between males and females chickens (9.45 gm.d⁻¹ vs 7.67 gm.d⁻¹, respectively) on C-Nana. Otherwise, I-nana and C-nana chickens exhibited the same gain between males and females, such as 3.51 gm.d⁻¹, 3.94 gm.d⁻¹ respectively for the males and 3.17 gm.d⁻¹, 3.29 gm.d⁻¹ for the females.

Growth curve's parameters and growth's curve

Variances analysis indicated that genotypes effect was highly significant ($P < 0.001$) for growth curve's parameters (**Table 3**). Commercial chickens (C-Nana and C-nana) growth curve's parameters are higher than those of local bird parameters excepted at inflexion age. C-nana chickens have an initial specific growth rate (0.1676 gm.d⁻¹) and a maturation speed (0.0340 gm.d⁻¹) which is slightly superior to that of C-Nana chickens, 0.1479 gm.d⁻¹ and 0.0309 gm.d⁻¹ respectively for an initial specific growth rate and maturation rate. Whereas, I-nana chickens rapidly reached their inflexion age than their counterparts (C-Nana chickens and C-nana).

Growth curve had showed (**Figure 2**) that there is no significant difference into curve parameter of growth between commercial (C-Nana and C-nana), which are without surprise, because of their rapid growth compare to indigenous local races. In fact, absence of difference between C-Nana and C-nana birds has found as well as the parameters measures and the parameters estimated.

DISCUSSION

The genetic characterization of indigenous breeds is important, not only for conservation purposes but also for the development of breeding programs. Generally, indigenous local birds appeared to grow slower than commercial birds and this difference increases with age. Similarly, many authors have also reported this kind of results ([Yapi-Gnaoré et al., 2011](#)), [Ait Kaki and Moula \(2013\)](#). In addition, sexual dimorphism was also observed in this study for all genotypes. The body weight and body weight gain were in favor of the cocks. This is due to the marked sexual dimorphism between the two sexes in favor of the cocks ([Mignon-Grasteau and Beaumont, 2000](#)). Specifically, for indigenous local birds, results are similar to those of ([Guèye et al., 1998](#); [Mallia \(1998\)](#), [Missohou et al. \(1998\)](#), [Msoffe et al. \(2002\)](#) and [Keambou et al. \(2007\)](#)). These authors found that males had larger body measurements than females and weigh significantly higher than they do. This dimorphism could be a selection criterion for the production of local chicken broiler.

Comparison of daily weight gain (DWG) showed a significant variability among the local chicken's breeds and commercial chickens as well as among the males and the females in each genotype. Local chickens have never been the object of selection based on the weight. That indicates why indigenous chickens presented low

performances compared to commercial chickens. The fact that DWG of I-nana and C-nana chickens, at the third time of rearing, are the same is justified by the estimated growth parameters.

For better characterization of growth of these animals, growth curve parameters were also elaborated. Curve parameters provide information on growth characteristics. [Ricklefs \(1985\)](#) pointed out that the purpose of curve fitting is to describe the course of mass increase with age by simple equations with few parameters. Growth curves can be used for pre-selection. [Eleroğlu et al. \(2014\)](#) suggested that the asymptotic or mature weight, rate of attainment of mature weight and the standardized age at which an animal attained the inflection point of the curve are parameters that could be manipulated by geneticists. Moreover, Gompertz curve characteristic were around the inflection point, where maximum growth rate is achieved [Fialho \(1999\)](#). Generally, commercial birds showed the highest growth potential due to genetic potential and exhibited the same parameters of growth curves.

Indigenous local chickens took relatively longer time (51.22 days) to reach the point of inflexion than the commercial genotypes (50.68 and 46.91 days respectively for C-Nana birds and C-nana). The same result was pointed out in [Yapi-Gnaoré et al. \(2011\)](#). Indigenous local chickens reached the point of inflexion later than the SASSO T44 population (78.4-83.3 vs 74.2-79.8 days). Values of point of inflexion found in this study were lower than those presented by [Yapi-Gnaoré et al. \(2011\)](#). However, these results exhibited no significant differences ($P>0.05$) for the age at inflexion among indigenous local chicken populations. The point of inflexion obtained in our study were also lower than those of others authors [Knizetova et al. \(1985\)](#). The range of inflexion point age values was estimated as 63.7, 79.8 and 81.5 days of age, for White Cornish, White Leghorn, and New Hampshire cockerels, respectively. Our point of inflexion age was higher than results of some research using local genotypes or inbred lines and the slow-growing broilers (44.00 and 49.62 days of age) using Gompertz model ([Goliomytis et al., 2003](#); [Santos et al., 2005](#); [N'dri et al., 2006](#); [Dourado et al., 2009](#)). The value of T_1 (51.22 days) exhibited for indigenous local chickens was ranged in the values found by [Mignon-Grasteau and Beaumont \(2000\)](#) for unselecting strains (46 à 68 days). On the other hand, the point of inflexion for chickens in the present study was estimated similarly for the two commercial birds or selected populations similarly to those seen in [Yapi-Gnaoré et al. \(2011\)](#) with indigenous

local ecotypes (savannah and forest). Furthermore, according values of commercial birds, these were in the same range of those of Slow-growing broilers obtained by [Narinc et al. \(2010\)](#) in Hubbard.

Concerning initial specific growth rate (L), values of I-nana birds were 0.0283 and 0.048 gm.d⁻¹ lower than those of C-Nana and C-nana respectively. Local genotype exhibited the lowest L (0.1196), thus resulting in lowest DWG_{1-3wk} compared to those of commercial chickens. In commercial birds, the C-nana had showed out numerically the higher L (0.1676 gm.d⁻¹) than the one of C-Nana birds L (0.1479 gm.d⁻¹). Initial specific growth rate (L) of I-nana in our study was higher than the result of [Yapi-Gnaoré et al. \(2011\)](#) which varied from 0.0786 to 0.0859 gm.d⁻¹.

For maturation growth rate (K), the value was close to the range estimated by [Ait Kaki and Moula \(2013\)](#) onto the chickens of Kabyle (0.0260 and 0.0294 gm.d⁻¹) in Algeria and superior to the results of [Yapi-Gnaoré et al. \(2011\)](#) on the indigenous local chickens (0.0189 à 0.0205 gm.d⁻¹) in Cote d'Ivoire. Indigenous local animals in our study reached maturity later than commercial birds. However, the age of maturity of indigenous local chickens in this study is lower than the age of maturity of local chicken found by [Yapi-Gnaoré et al. \(2011\)](#). The difference between our results compared to those of these last authors would be explained by the rearing system. Indeed, our animals were reared in claustration, on floor, where foods were provided *ad libitum* whereas their animals were reared with access to open-air. In this last system, animals used the part of energy to seek and take away feed into the soil.

The results of [Ait Kaki and Moula \(2013\)](#) (675.3 gm to 886 gm) on Kabyle traditional chickens regarding the asymptotic weight appear to be consistent with the findings of the present research obtained with indigenous local chicken (823.7 gm). But our result was lower than those of [Yapi-Gnaoré et al. \(2011\)](#) who reported 1501.2 and 2219.5 gm on local chicken in Cote d'Ivoire.

These commercial birds developed themselves more rapidly, resulting in superior DWG and arrive to inflexion age before the local genotype because heavy animals arrive to the age of inflexion more rapidly ([Mignon-Grasteau and Beaumont, 2000](#)). Indigenous local chickens' growth continued but those of imported chickens were stopped regarding DWG_{12-30wk}. For this period, the gain was 02.91 gm and 02.53 gm, respectively for I-nana and C-nana genotype. The highest gain (06.71)

of C-Nana birds could be due to the presence of Na gene that is responsible for the lack of feather in the neck and favored better growth of carriers Na gene (N'Dri et al., 2006). Thereby, selection for high body growth tends to ameliorate L and K with better Ti. Positive correlation was found between L and K. Line selected for higher body weight exhibited higher initial specific growth rate (L), higher maturation rate (K) and reached the inflection early (Mignon-Grasteau and Beaumont, 2000).

No significant difference into curve parameter of growth of commercial birds (C-Nana and C-nana) was noticed according to growth curve and growth curve parameters. This result is without surprise, because of their rapid growth compare to indigenous local races. Indeed, better adequation was exhibited between recorded measures and estimated growth curve.

CONCLUSION

The objective of the present study was to assess the growth of indigenous local chicken genotype and compare them with those of the two slow-growing commercial chickens. Growth advantages were in favor of commercial birds. However the estimate of the parameters of the curve by Gompertz confirmed the slow growth rate of the local chickens which enables him to set up all the elements responsible for its organoleptic qualities. The estimate of the curve parameters by Gompertz also appeared of capital importance for traditional chicken because it will make it possible to provide the foundations of its selection.

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CONFLICT OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

AUTHORS' CONTRIBUTION

NAL designed the study. AAB supervised the overall research work and provided valuable suggestions throughout the experiment. KBHW and AVS set up the breeding and collected data with NAL. NAL and KBHW analyzed the data. All the authors contributed in writing

and reviewing the manuscript, and approved the final manuscript.

REFERENCES

1. Aboe PAT, Boa-Amponsem K, Okan Tah SA, Butler E A, Dorward PT, Bryant MJ. Free-range village chickens on the Accra Plains, Ghana: their husbandry and productivity. *Tropical Animal Health and Production*. 2006; 38:235–248. <https://doi.org/10.1007/s11250-006-4356-x>
2. Ait Kaki A, Moula N. Performances de productions de la poule locale kabyle. *Revue Agricuture*. 2013; 5:1–4.
3. Barbato GF. Genetic architecture of growth curve parameters in chickens. *Theoretical and Applied Genetics*. 1991; 83:24–32. <https://doi.org/10.1007/BF00229222>
4. Bouchardeau A, Calet C. Vers une politique de qualité pour les volailles. *Revue de l'élevage bétail et basse-cour*. 1970; 475:23–34.
5. Dourado LRB, Sakomura NK, Nascimento DCN, Dorigam JC, Marcato SM, Fernandes JBK. Growth and performance of naked neck broiler reared in free-range system. *Ciência e Agrotecnologia*. 2009; 33:875–881. <https://doi.org/10.1590/S1413-70542009000300030>
6. Eleroğlu H, Yıldırım A, Şekeröğlu A, Çoksöyler FN, Duman M. Comparison of growth curves by growth models in slow-growing chicken genotypes raised the organic system. *International Journal of Agriculture & Biology*. 2014; 16:529–535.
7. FAO (Food and Agriculture Organization). Programme mondial de gestion des ressources génétiques d'élevage. Conservation de la diversité des animaux domestiques : Initiative pour la Diversité des Animaux Domestiques. Rome. 1998; p. 20.
8. Fialho FB. Interpretation of the Gompertz growth curve. Embrapa-CNPISA Technical Communication. 1999; 237:1–4.
9. Gille U, Salomon FV. Heart and body growth in ducks. *Growth, Développement and Aging*. 1994; 58:75–81.
10. Goliomytis M, Panopoulou E, Rogdakis E. Growth curves for body weight and major component parts, feed consumption, and mortality of male broiler chickens raised to maturity. *Poultry Science*. 2003; 82: 1061–1068. <https://doi.org/10.1093/ps/82.7.1061>
11. Grossman M, Bohren BB. Logistic growth curve of chickens: heritability of parameters. *The Journal of Heredity*. 1985; 76:459–462. <https://doi.org/10.1093/oxfordjournals.jhered.a110145>
12. Guèye EF, Ndiaye A, Branckaert RDS. Prediction of body weight on the basis of body measurement in mature indigenous chickens in Senegal. *Livestock Research for Rural Development*. 1998; 10: Article 28.

13. Keambou TC, Manjeli Y, Tchoumboue J, Teguia A, Iroume RN. Caractérisation morphobiométrique des ressources génétiques de poules locales des hautes terres de l'ouest Cameroun. *Livestock Research for Rural Development*. 2007; 19: Article 107.
14. Knizetova H, Hyanek J, Hajkova H, Knize B, Siler R. Growth curves of chickens with different type of performance. *Z. Tierzucht. Zuchtungsbiol.* 1985; 102: 256–270.
15. Knizetova H, Hyanek J, Knize B, Roubicek J. Analysis of growth curve of fowl. I. Chickens. *British Poultry Science*. 1991; 22:1039–1053.
<https://doi.org/10.1080/00071669108417428>
16. Knizetova H, Hyankova L, Dedkova L. Divergent selection for shape of growth in Japanese quail. *Proc. 12th Int. Symp. Aviagen, Prague, 1-3 Septembre. 1997*; 91-98. <https://doi.org/10.1080/00071669108417428>
17. Laird AK, Tyler SA, Barton AD. Dynamics of normal growth. *Growth*. 1965; 29:233–248.
18. Mallia JG. The Black Maltese: a Mediterranean light breed of poultry. *Animal Genetic Resources Information*. 1998; 24:41–48.
<https://doi.org/10.1017/S1014233900001127>
19. Mignon-Grasteau S, Beaumont C. Les Courbes De Croissance Chez Les Oiseaux. *Inra Production Animale*. 2000; 13:337–348.
20. Missohou A, Sow RS, Ngwe-Assoumou C. Caractéristiques morphobiométriques de la poule du Sénégal. *Animal Genetic Resources Information*. 1998; 24:63–69.
<https://doi.org/10.1017/S1014233900001140>
21. Moula N, Farnir F, Salhi A, Iguer Ouada M, Leroy P, Antoine-Moussiaux N. Backyard poultry in Kabylie (Algeria): from an indigenous chicken to a local poultry breed? *Animal Genetic Resources*. 2012; 50:97–106.
<https://doi.org/10.1017/S207863361200001X>
22. Msoffe PLM., Mtambo MMA, Minga UM, Gwakisa PS, Mdegela RH, Olsen JE. Productivity and natural disease resistance potential of free-ranging local chicken ecotypes in Tanzania. *Livestock Research for Rural Development*. 2002; 14(3).
<https://www.lrrd.cipav.org.co/lrrd14/3/msof143.htm> (Accessed on January 2018)
23. N'dri AL, Mignon-Grasteau S, Sellier N, Beaumont C, Tixier-Boichard M. Influence of naked neck gene on heat tolerance, growth, body composition, meat quality and sensory analysis of slow growing broilers. *Livestock Science*. 2006; 110(1-2):35–45.
24. Narinc D, Aksoy T, Karaman E, Ilaslan Curek D. Analysis of fitting growth models in medium growing chicken raised indoor system. *Trends in Animal & Veterinary Sciences Journal*. 2010; 1(1):12–18.
25. Norris D, Ngambi1 JW, Benyi K, Makgahlela MI, Shimelis HA, Nesamvuni EA. Analysis of growth curves of indigenous male Venda and Naked Neck chickens. *South African Journal of Animal Science*. 2007; 37:21–26.
26. Ricklefs RE. Modification of growth and development of muscles of poultry. *Poultry Science*. 1985; 64:1563–1576. <https://doi.org/10.3382/ps.0641563>
27. Santos AL, Sakomura NK, Freitas ER, Fortes CMS, Carrilho ENVM. Comparison of free range broiler chicken strains raised in confined or semi-confined systems. *Revista Brasileira de Ciência. Avícola*. 2005; 7:85–92. <https://doi.org/10.1590/S1516-635X2005000200004>
28. Sengül T, Kiraz S. Non-linear models for growth curves in Large White turkeys. *Turkey Journal of Veterinary and Animal Sciences*. 2005; 29:331–337.
29. Traoré EH. Première évaluation de la structure et de l'importance du secteur avicole commercial et familial en Afrique de l'Ouest : rapport du Sénégal. Organisation des Nations-Unies pour l'Alimentation et l'Agriculture: Rome. 2006; p. 52.
30. Wang Z, Zuidhof MJ. Estimation of growth parameters using a nonlinear mixed Gompertz model. *Poultry Science*. 2004; 83:847–852.
<https://doi.org/10.1093/ps/83.6.847>
31. Yapi-Gnaoré VC, Loukou EN, Konan NYBJ-C, Toure G, Kreman K, Youssao I, Kayang B, Rognon X, Tixier-Boichard M. Poids vif et paramètres de la courbe de croissance des poulets de race locale (*Gallus domesticus*) en Côte d'Ivoire. *Agronomie Africaine*. 2011; 23(3):273–281.
32. Zaman MA, Sorensen P, Howlider MAR. Egg production performances of a breed and three crossbreeds under semi scavenging system of management. *Livestock Research for Rural Development*. 2004; 16: Article 60.
