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# Variability of Carcass Traits of Local Poultry Populations of *Gallus gallus* Species of Benin

U.P. Tougan[1], M. Dahouda[2], C.F.A. Salifou[1], S.G. Ahounou[1], M.T. Kpodekon[1], G.A. Mensah[3], D.N.F. Kossou[1], C. Amenou[1], C.E. Kogbeto[1], A. Thewis[4] and I.A.K. Youssao[1]
[1]Department of Animal Production and Health, Polytechnic School of Abomey-Calavi, 01 BP 2009, Cotonou, Republic of Benin, Benin
[2]Department of Animal Production, Faculty of Agronomic Science, University of Abomey-Calavi, 01 BP 526, Republic of Benin, Benin
[3]Agricultural Research Center of Agonkanmey, National Institute of Agricultural Research of Benin, 01 BP 884, Cotonou 01, Republic of Benin, Benin
[4]Animal Sciences Unit, Gembloux Agro Bio Tech, University of Liege, ULg-Gx ABT-Passage des Deportes, 2-5030, Gembloux, Belgium

**Abstract:** The local poultry population of Benin is composed of various ecotypes including chickens Holli, Sahoue, Fulani, North and South. To better characterize them, our study aims to assess their carcass traits according to genetic type, breeding system and slaughter age. Thus, 260 chickens of which 52 chickens of each ecotype were divided in two lots and reared respectively under traditional and improved breeding system. For each breeding system, 26 cockerels of each ecotype were slaughtered at 20, 24 and 28 weeks old for carcass traits study. The results show that the live weight, the carcass weight, the weight of the cuts of thigh-drumsticks and wings of Holli chickens were the highest ($p<0.001$). The lowest live weight and carcass weight were noted in South ecotype ($p<0.001$). The carcass yields of the five genetic types of chicken were similar ($p>0.05$). The breast weight of Holli and Fulani were similar ($p>0.05$) but heavier ($p<0.001$) than the one of Sahoue, North and South ecotypes. The live weight and the carcass weight of chickens reared under improved breeding system were higher than those of traditional system ($p<0.01$). The carcass drip loss was more important in chickens bred under traditional system ($p<0.001$). The live weight and the carcass cuts value were significantly affected by slaughter age ($p<0.001$). The best carcass yields were recorded at 24 weeks ($p<0.001$) for both rearing systems. Therefore, the ideal slaughter age of indigenous chickens of Benin is 24 weeks.

**Key words:** Indigenous chicken, ecotype, carcass traits, Benin

## INTRODUCTION

The traditional poultry breeding based on the exploitation of local chickens under traditional farming system is the main source of chicken production in developing countries, namely in Africa and Asia (Mlozi *et al*., 2003; Ahuja and Sen, 2007). These local chickens represent more than 80% of the total poultry population in West Africa (Singh *et al*., 2011). The aims of production of this breeding system are mainly the meat production and secondarily the egg production. The scavenging of birds in free range is the rule in this system, as well as the diversity of species in the same farm. In Benin, the national poultry livestock on 2011 is estimated to 17087000 heads with 81% of local chickens for 6000000 inhabitants (CountryStat, 2012). Despite this numerical importance, local production of poultry meat remains below the needs expressed by consumers and this gap is filled by imports that increase from year to year. In 10 years, the volume of imports of poultry meat increased from 19,361 metric tons in 2000 to 49,634 metric tons in 2010 (CountryStat, 2012). Despite the low domestic production of local chickens (2,020 tons in 2010), the local chicken meat is preferred by consumers in comparison with imported frozen chicken meat (Youssao *et al*., 2013). The “cock” operation carried out in Benin in 1963 and that consists in introducing exotic roosters bred in the village poultry farms to improve performances of local chicken populations by crossing had not been accepted by Holli, Sahoue and Fulani sociocultural groups (Bonou, 2006). Today, this operation creates genetic erosion within the local poultry population of the others sociocultural groups who agreed. However, the reluctance of populations of Holli, Sahoue and Fulani sociocultural groups had promoted conservation and perpetuation of varieties or breed of chickens owned by these sociocultural groups, which

**Corresponding Author:** Issaka Youssao Abdou Karim, Department of Animal Production and Health, Polytechnic School of Abomey-Calavi, 01 BP 2009, Cotonou, Republic of Benin, Benin

bear now their name. Then, the socio-cultural groups Holli, Sahoue and Fulani are respectively the undisputed holders of Holli, Sahouè and Fulani chickens. The local population of poultry of the species *Gallus gallus* of Benin is then composed of various ecotypes among which are North, South, Holli, Fulani and Sahoue ecotypes (Bonou, 2006).

Several studies were carried out on the zootechnical and phenotypic characterization of local chickens in Benin in general (Tougan, 2008; Youssao *et al*., 2009; Ayissiwede, 2011). Most of these works on carcass traits were done on North and South ecotypes (Youssao *et al*., 2009, 2010, 2012). Little knowledge exists on the carcasses characteristics of Holli, Fulani and Sahoue ecotypes while farmers and consumers have a preference for these breeds because of their heavy format (Bonou, 2006) and the organoleptic characteristics of their meat. Furthermore, the meat quality of those 5 ecotypes of chicken is not known by the population. As the Label Rouge used by Youssao *et al.* (2009) for the improvement of local chickens of South ecotype (known for their small size), Holli, Fulani and Sahoue ecotypes may also be used for improving carcass characteristics and meat quality of South and North ecotype chicken.

To achieve this, it is necessary to evaluate the factors that influence the carcass composition of these five genetic types of local chickens in order to characterize them and establish a genetic improvement program by selecting or crossing.

The present study aims to characterize the local chicken population in order to improve their body composition for food security of Benin population and to promote the local chicken breeding. Specifically, it is to assess carcass composition of local chickens of North, South, Holli, Fulani and Sahoue ecotypes of Benin in relation with their breeding system and their slaughter age.

## MATERIALS AND METHODS

**Area of study:** The study was conducted conjointly at the experimental farm of “Ecole Polytechnique d’Abomey-Calavi (EPAC)” and at the traditional poultry breeders located in Abomey-Calavi in Atlantic Department. Situated at a latitude of 6 °27 'north and at a longitude of 2 °21' east, the Commune of Abomey-Calavi covers an area of 650 km$^2$ with a population of 307,745 inhabitants (INSAE, 2011). This area exhibits climatic conditions of sub-equatorial type, characterized by two rainy seasons with an uneven spatial and temporal distribution of rainfall: major (from April to July) and minor (from September to November). These two seasons are separated by a dry season. Average rainfall is close to 1200 mm per year. The monthly average temperatures vary between 27 and 31°C and the relative air humidity fluctuates between 65%, from January to March and 97%, from June to July. The study on the carcass composition was carried out in Laboratory of Animal Biotechnology and Meat Technology of the Department of Animal Production and Health of EPAC in Benin.

**Birds sampling:** The chickens used in this trial were produced from breeding nuclei of 10 hens and 3 cocks of each genetic type (North, South, Holli, Fulani and Sahoue), reared in confinement at the experimental farm of EPAC. The eggs of each genetic type collected from the breeding nuclei were incubated and the chicks were weighed after hatching and identified by genetic type. These chicks were reared in confinement according to the improved breeding system until the age of 12 weeks and then divided into two lots. Only the males were used in this study. Lot 1 composed of 26 cockerels of each genetic type was reared under improved breeding system and the Lot 2 also made of 26 cockerels of each genetic type was bred in free range according to the traditional breeding system at local chicken breeders targeted in each agro-ecological area. Each bird was identified by a sterile numbered ring fastened to the wing.

**Characteristics of traditional breeding system:** The scavenging of birds was the rule in this breeding system. The birds were in free range on during the day but housed at night in rudimentary shelters (traditional henhouse made of mud, straw or wicker), or kept outside on any support that could serve as a perch. There are nor quantitative nor qualitative standards in their feeding. The birds fed themselves around concessions, by gleaning here and there and receiving occasionally from the traditional breeder some grain supplement. Their diet was composed of energetic elements (kitchen waste, bran ...), vitamins (green fodder, sprouted grains ...), minerals (salt, pounded shells) and protein (termites, legumes) (Tougan, 2008; Youssao *et al*., 2013). Drinkable water was distributed in rudimentary watering tank. Various discarded containers were often used for drinking. In this type of farming, no health follow-up and no prophylactic standard were observed.

**Characteristics of improved breeding system:** In the improved breeding system used in this study, the birds were bred on a fresh wood shavings litter in buildings of California type. The livestock equipment used were composed of brooders, feeders, drinkers. The number of these devices depended on the number of birds in the henhouse. All the animals were fed with the same diet. Three diets were used: starting (2880 EM Kcal/kg and 18% of crude protein), growing (2969 EM Kcal/kg and 18% crude protein) and laying (2800 EM Kcal/kg of feed and 20% of crude protein). The starter feed was used from the hatching to the age of 2 months and the growth feed from 2 month old to the point of laying (22 weeks).

From the point of laying to the end of the experimentation, the laying feed was used. The animals were fed *ad-libitum* throughout the study. The composition of the three diets used in these experiments is given by Youssao *et al*. (2009). Feed transitions were done during three days between the different growth periods by gradual incorporation to the previous diet with the respective proportions of 25, 50 and 75% of the new diet.

Habitat used at the Experimental Farm of EPAC to house chickens during this experiment was composed of six buildings of 15 m² each divided into compartments of 5 m² with screens in which the animals divided into groups were reared. The floor was cemented and the wall height was of 90 cm and topped with wire-netting. The compartments were heated by using incandescent lamps of 100 watt and brooders consist of jars filled with charcoal lit each night until the chicks were three weeks old.

Health and medical prophylaxis consisted of the real respect of breeding hygiene rules, deworming and prevention against certain diseases such as avian chronic respiratory disease, coccidiosis, Newcastle disease, Gumboro, fowl pox, Marek's disease, avian infectious bronchitis, bursal infectious disease, small pox and avitaminosis (Youssao *et al*., 2009). Monthly, a sample of feces were analyzed in order to follow the deworming efficiency and to make sure that the coccidium and gastro-intestinal parasites didn't affect the growth performances of the birds. The prophylaxis schedule used had been described by Youssao *et al*. (2009). Between two bands, the henhouses were disinfected and left unoccupied for one to two weeks (health void). At the entrance of each building, a footbath solution based on cresol was installed to disinfect feet to each entry.

**Slaughtering process:** The choice of birds was based on body weight. The first 5 birds whose live weight was heavier than the mean and the first 5 birds whose live weight was weaker than the mean were selected. Then, a total of 26 cocks of each breeding mode were selected per genetic type for slaughtering. The animals selected were weighed and bled after 16 h of water and feed withdrawal. The chickens were bled by section of the jugular vein and then scalded in hot water (70-80°C) and plucked manually. Then, they were eviscerated and the heart, the kidney, the crop and the intestines were taken off.

**Carcass cutting:** The legs were sectioned at the tibiotarsus-metatarsal articulation and the head separated from the neck at the cranium-atlas junction. The abdominal and thoracic cavity organs were then removed as well. The bird carcasses obtained were refrigerated at 4°C for 24 h and weighed. A cut of each carcass was used to determine the weights of breast, thigh-drumstick, wings and the rest of the carcass.

**Data collecting:** The live weight at slaughter, hot carcass weight at 1 h *post mortem*, cold carcass weight at 24 h *post mortem*, carcass cuts weight (breast, thigh-drumstick, wings, neck, tarsi and the rest of carcass) and the weight of the abdominal viscera (gizzard, liver and heart) were recorded at 24 h *post mortem*. The abdominal fat was measured. The percentages of each carcass cut and abdominal viscera component were calculated from the carcass weight. By the same way, carcass yield at 1 and 24 h *post-mortem* were calculated.

**Statistical analysis:** The data collected on the carcass composition of the five genetic types of chicken were analyzed with the software SAS (Statistical Analysis System, 2006). For the analysis of variance, a fixed linear model was adjusted to the slaughter weight and the carcass traits data. This model includes the fixed effects of genetic type, breeding system and age. The interaction between genetic type and slaughter age and between breeding system and slaughter age were significant and take into account in the model of variance analysis. The mathematical expression of this model is as follows:

$$Y_{ijkl}= \mu+E_i+ME_j+Age_k+E*Age_{ik}+ME*Age_{jk}+e_{ijkl}$$

With:

- $Y_{ijkl}$: The live weight or the carcass or the visceral trait of the animal l, of the ecotype i and of the breeding system j and slaughter age k;
- $\mu$: Overall mean;
- $E_i$: Fixed effect of ecotype i (Holli, Fulani, Sahoue, North et South);
- $Me_j$: Fixed effect of breeding mode j (traditional and improved);
- $Age_k$: Fixed effect of age at slaughter k (20, 24 and 28 weeks);
- $E*Age_{ik}$: Interaction between ecotype I and slaughter age k;
- $ME*Age_{jk}$: Interaction between breeding mode j and slaughter age k;
- $e_{ijkl}$: Effect of random residual average performance of the individual l, of ecotype i, of the breeding mode j and slaughter age k.

The F test was used to determine the significance of each effect in the model. Means were compared two by two by the Student's t test.

## RESULTS

**Effect of the ecotype on the carcass traits:** The live weight, the hot carcass weight, the cold carcass weight and the weight of the different pieces of the carcass cuts varied significantly according to the on the genetic type (p<0.001; Table 1). The live weight, the hot carcass weight and the cold carcass weight of the Holli chickens were significantly higher (p<0.001) than those recorded in Fulani, Sahoue, North and South ecotypes chickens. The lowest live weight, hot carcass weight and cold carcass weight were noted in South ecotype chickens (p<0.001; Table 1). However, no difference was observed between live weight, hot carcass weight and cold carcass weight of North and Sahoue chickens (p>0.05). Similarly, hot carcass yield of five genetic types of chicken were similar (p>0.05) and varied between 78.29 and 78.84%. Moreover, cold carcass yields of the five ecotypes were similar (p>0.05) and were between 76.35 and 77.36%.

As for cutting pieces, the breast weight of chickens of Holli (198.98 g) and Fulani(185.64 g) ecotypes were similar (p>0.05) and heavier (p<0.001) than the one recorded in Sahoue (164.42 g), North (165.98 g) and South (154.27 g) ecotypes. However, no significant difference was found between the breast weight of Sahoue, North and South chicken ecotypes (p>0.05; Table 1).

The thigh-drumsticks and wings of Holli chickens (respectively 276.49 g and 116.31 g) were heavier (p<0.001) than the other four genetic types, followed by Fulani ecotype chicken (247.77 and 105.15 g, respectively). The lowest weight of thigh-drumsticks and wings, were recorded in South chickens (206.74 g and 85.02 g, respectively). However, no significant difference (p>0.05) was observed between thigh-drumsticks and wings weight of North chicken (respectively 223.81 g and 89.01 g) and Sahoue (respectively 224.44 g and 89.85 g). The percentage of the breast and thigh-drumstick in relation to the carcass did not differ significantly according to the genetic type (p>0.05; Table 1). Furthermore, the proportion of wings was affected by the genetic type with the highest proportions of cuts recorded in Holli and Fulani chickens (p<0.05). Similarly, the head of Holli genetic type was highly heavier (50.68 g; p<0.001) than the other four ecotypes of chickens whose head weight was similar (41.33 g *vs* 43.89 g; p>0.05). By the same way, the neck weight of Holli and Fulani chickens were similar (respectively 70.35 g and 63.93 g; p<0.05) but highly more important (p<0.001) than that recorded in birds of Sahoue, North and South ecotypes who had similar neck weight (p>0.05) ranging from 55.49 g to 57.31 g. The weight of the rest of carcass was 168.91 g in Holli chickens to 146.41, 147.95, 139.58 and 131.57 g, respectively in birds of North, Fulani, South and Sahouè ecotypes (p<0.001). Moreover, the tarsi weight of Holli and Fulani chickens were similar (p<0.05) but higher (p<0.001) than that recorded in birds of Sahoue, North and South ecotypes which had a similar tarsi weight (p>0.05; Table 1).

For the offal, the weight of the liver and gizzard of Holli, Fulani, North and Sahoue ecotypes were identical (p<0.05) but highly above those obtained in chickens of

Table 1: Variation of carcass traits by ecotype

| Variables | Holli | North | Fulani | Sahoue | South | RSD | Ecotype effect |
|---|---|---|---|---|---|---|---|
| Live weight (g) | $1274^{a}$ | $1065^{b}$ | $1163^{c}$ | $1060^{b}$ | 980d | 91.39 | *** |
| Hot carcass weight (g) | $1007^{a}$ | $835^{b}$ | $917^{c}$ | $830^{b}$ | 770d | 80.84 | *** |
| Cold carcass weight (g) | $988^{a}$ | $814^{b}$ | $899.1^{c}$ | $812^{b}$ | 754d | 80.44 | *** |
| Carcass yield 1 (%) | $78.8^{a}$ | $78.5^{a}$ | $78.8^{a}$ | $78.3^{a}$ | $78.65^{a}$ | 1.56 | NS |
| Carcass yield 24 (%) | $77.4^{a}$ | 76.4 | $77.2^{a}$ | $76.6^{a}$ | $76.8^{a}$ | 1.69 | NS |
| Breast (g) | 199 | $166^{b}$ | $185.6^{a}$ | $164.4^{b}$ | $154.3^{b}$ | 25.5 | *** |
| Thigh-drumstick (g) | $276.5^{a}$ | $223.8^{c}$ | $247.8^{b}$ | $224.4^{c}$ | 207d | 28.55 | *** |
| wings (g) | 116.3 | $89^{c}$ | $105.5^{b}$ | $89.9^{c}$ | $85.02^{c}$ | 12.26 | *** |
| Breast (%) | 20 | $20.3^{a}$ | 20.5 | $20^{a}$ | $20.4^{a}$ | 2.04 | NS |
| Thigh-drumstick (%) | $27.8^{a}$ | 27.5 | $27.7^{a}$ | $27.5^{a}$ | $27.3^{a}$ | 1.6 | NS |
| wings (%) | 12.1 | $11^{b}$ | $11.7^{b}$ | $11.2^{b}$ | $11.48^{b}$ | 1.37 | * |
| Head (g) | 50.7 | $42.4^{b}$ | $43.7^{b}$ | $43.9^{b}$ | $41.3^{b}$ | 6.8 | *** |
| Neck (g) | 70.4 | $55.5^{c}$ | $63.9^{b}$ | $56.3^{c}$ | $57.3^{c}$ | 9.57 | *** |
| Tarsi (g) | 51.6 | $39.1^{b}$ | $50.7^{a}$ | $40^{b}$ | $39.3^{b}$ | 10.07 | *** |
| Rest of carcass (g) | $168.9^{a}$ | $146.4^{b}$ | $147.9^{b}$ | $140^{bc}$ | $131.6^{c}$ | 20.67 | *** |
| Head (%) | $5.1^{b}$ | $5.2^{ab}$ | $4.9^{b}$ | $5.5^{a}$ | $5.5^{a}$ | 0.69 | * |
| Neck (%) | $7.1^{b}$ | $6.8^{b}$ | $7.1^{b}$ | $7^{b}$ | $7.6^{a}$ | 1.06 | NS |
| Tarsi (%) | 5.2 | $4.8^{b}$ | $5.6^{a}$ | $5^{ab}$ | $4.4^{b}$ | 1.02 | ** |
| Reste of carcass (%) | $17.1^{ab}$ | $18^{a}$ | $16.6^{b}$ | $17.2^{ab}$ | $17.4^{a}$ | 1.9 | NS |
| Heart (g) | 7.7 | $7.3^{a}$ | $7.7^{a}$ | $7^{ab}$ | $6.3^{b}$ | 1.99 | NS |
| liver (g) | 20.2 | $18.7^{a}$ | $19.1^{a}$ | $20^{a}$ | $15.6^{b}$ | 3.92 | *** |
| Gizzard (g) | 27 | $25.8^{a}$ | $27.5^{a}$ | $26.7^{a}$ | $22.1^{b}$ | 4.42 | *** |
| Heart (%) | 0.8 | $0.9^{a}$ | $0.9^{a}$ | $0.86^{a}$ | $0.84^{a}$ | 0.26 | NS |
| Liver (%) | $2.1^{b}$ | $2.3^{ab}$ | $2.2^{b}$ | $2.5^{a}$ | $2.1^{b}$ | 0.46 | ** |
| Gizzard (%) | $2.8^{b}$ | $3.2^{a}$ | $3.1^{a}$ | $3.3^{a}$ | $3.3^{b}$ | 0.52 | ** |
| Drip loss (%) | $1.9^{b}$ | $2.6^{a}$ | $2.01^{b}$ | $2.2^{ab}$ | $2.2^{a}$ | 0.75 | * |

Carcass yield 1: Hot Carcass weight at 1 h post mortem/Live weight at slaughter; Carcass yield 24: Cold carcass weight at 24h post mortem/Live weight at slaughter; RSD: Residual Standard Deviation. The means between the classes of the same line followed by different letters differ significantly with the threshold of 5%

South ecotype (p<0.001). In contrast, the heart weight did not vary significantly according to the genetic type (p>0.05). Based on the cold carcass weight, the percentage of the heart was similar for the five genetic types (p<0.05), while the respective proportions of the liver and gizzard of Sahoue chickens were higher than those recorded in chickens of Holli, Fulani and South ecotypes (p<0.01). However, no significant difference was observed between the proportions of liver and gizzard of chickens of North and Sahoue ecotype (p<0.05). Furthermore, the carcass drip losses were lower in Holli and Fulani ecotypes (p<0.05; Table 1). Overall, no abdominal fat was observed on the carcass of the 5 genetic types of indigenous chicken of Benin used in this study.

**Effect of the breeding mode on the carcass traits:** The Table 2 shows the variation in carcass traits of chicken by breeding system. The breeding mode also had very significant influence on the live weight, the hot carcass weight, the cold carcass weight, the carcass yield at 24 h *post-mortem* and the weight of the carcass cuts, the gizzard weight and the carcass drip loss (p<0.001). Indeed, the live weight at slaughter, the hot carcass weight, the weight of the cold carcass of chickens reared under improved breeding system were higher than those of chickens of traditional breeding system (p<0.001). Similarly, the carcass cuts component of chickens reared under improved breeding system were heavier than those of chickens of traditional breeding system (p<0.001). Out of thigh-drumsticks and wings, no significant difference was observed between the respective percentages of each carcass cut pieces of the both breeding modes. The carcass yield recorded at 1 h *post-mortem* was not affected by the breeding system. Nevertheless, the carcass yield at 24 h *post-mortem* was higher in birds of improved breeding system compared to chickens of traditional breeding system (p<0.05). In return, the carcass drip losses was more important in traditional breeding chickens (p<0.001).

Contrary to the heart and gizzard that were heavier in birds reared under improved breeding system than those of traditional system (p<0.05), liver weight did not vary depending on the type of breeding. Moreover, the percentages of the heart and the gizzard of both breeding mode were similar, whereas the proportion of liver was more important in traditional breeding system than in improved breeding system (p<0.05).

The carcass drip losses were significantly higher in traditional breeding system than in improved breeding system (p<0.001).

**Effect of the slaughter age on the carcass traits:** The carcass composition was also strongly affected by the slaughter age of birds (Table 2). Except the carcass

Table 2: Variation of carcass traits by breeding mode and slaughter age

| | Breeding mode | | Slaughter age | | | | | |
|---|---|---|---|---|---|---|---|---|
| Variables | Traditional | Improved | 20 weeks | 24 weeks | 28 weeks | RSD | Breeding effect mode | Slaughter effect age |
| Live weight (g) | 1028$^{a}$ | 1189$^{a}$ | 923$^{a}$ | 1134$^{a}$ | 1268$^{c}$ | 91.39 | *** | *** |
| Hot carcass weight (g) | 806.3$^{a}$ | 937$^{a}$ | 726$^{a}$ | 895.5$^{a}$ | 993.6$^{c}$ | 80.84 | *** | *** |
| Cold carcass weight (g) | 787.6$^{a}$ | 919$^{a}$ | 707.7$^{a}$ | 877.4$^{a}$ | 975.1$^{c}$ | 80.44 | *** | *** |
| Carcass yield 1 (%) | 78.4$^{a}$ | 78.7$^{a}$ | 78.5$^{a}$ | 78.9$^{a}$ | 78.2$^{a}$ | 1.56 | NS | NS |
| Carcass Yield 24 (%) | 76.5$^{a}$ | 77.2$^{a}$ | 76.6$^{a}$ | 77.3$^{a}$ | 76.8$^{aa}$ | 1.69 | NS | NS |
| Breast (g) | 160.2$^{a}$ | 187.5$^{a}$ | 140.1$^{a}$ | 181.8$^{a}$ | 199.6$^{c}$ | 25.5 | *** | *** |
| Thigh-drumstick (g) | 214.8$^{a}$ | 256.9$^{a}$ | 193.3$^{a}$ | 237.1$^{a}$ | 277.2$^{c}$ | 28.55 | *** | *** |
| wings (g) | 91.5$^{a}$ | 102.7$^{a}$ | 86.4$^{a}$ | 99.1$^{a}$ | 105.7$^{c}$ | 12.26 | *** | *** |
| Breast (%) | 20.1$^{a}$ | 20$^{a}$ | 19.6$^{a}$ | 20.7$^{a}$ | 20.4$^{a}$ | 2.04 | NS | * |
| Thigh-drumstick (%) | 27.2$^{a}$ | 27.8$^{a}$ | 27.2$^{a}$ | 26.9$^{a}$ | 28.4$^{a}$ | 1.6 | * | *** |
| wings (%) | 11.8$^{a}$ | 11.2$^{a}$ | 12.4$^{a}$ | 11.3$^{a}$ | 10.8$^{a}$ | 1.37 | * | *** |
| Head (g) | 40.8$^{a}$ | 48$^{a}$ | 38.5$^{a}$ | 44.5$^{a}$ | 50.1$^{c}$ | 6.8 | *** | *** |
| Neck (g) | 56.5$^{a}$ | 64.8$^{a}$ | 48.2$^{a}$ | 65.4$^{a}$ | 68.4$^{a}$ | 9.57 | *** | *** |
| Tarsi (g) | 38.4$^{a}$ | 47.4$^{a}$ | 35.6$^{a}$ | 42.9$^{a}$ | 50.2$^{c}$ | 10.07 | *** | *** |
| Rest of carcass (g) | 136.2$^{a}$ | 157.5$^{a}$ | 120.2$^{a}$ | 152.3$^{a}$ | 168.15$^{c}$ | 20.67 | *** | *** |
| Head (%) | 5.3$^{a}$ | 5.2$^{a}$ | 5.5$^{a}$ | 5.1$^{ac}$ | 5.18$^{ac}$ | 0.69 | NS | * |
| Neck (%) | 7.1a | 7.1$^{a}$ | 6.83$^{a}$ | 7.5$^{a}$ | 7.01$^{aa}$ | 1.06 | NS | * |
| Tarsi (%) | 4.9$^{a}$ | 5.1$^{a}$ | 5.02$^{a}$ | 4.8$^{a}$ | 5.05$^{a}$ | 1.02 | NS | NS |
| Reste of carcass (%) | 17.4$^{a}$ | 17.2$^{a}$ | 16.96$^{a}$ | 17.4$^{a}$ | 17.37$^{a}$ | 1.9 | NS | NS |
| Heart (g) | 6.8$^{a}$ | 7.6$^{a}$ | 5.6$^{a}$ | 8$^{a}$ | 7.96$^{a}$ | 1.99 | * | *** |
| liver (g) | 18.1$^{a}$ | 19.4$^{a}$ | 16.8$^{a}$ | 18.98$^{a}$ | 20.5$^{a}$ | 3.92 | NS | *** |
| Gizzard (g) | 24.1$^{a}$ | 27.43$^{a}$ | 23.1$^{a}$ | 27.3$^{a}$ | 27$^{a}$ | 4.42 | *** | *** |
| Heart (%) | 0.9$^{a}$ | 0.83$^{a}$ | 0.8$^{a}$ | 0.93$^{aa}$ | 0.82$^{a}$ | 0.26 | NS | * |
| Liver (%) | 2.3$^{a}$ | 2.12$^{a}$ | 2.4$^{a}$ | 2.2$^{a}$ | 2.1$^{a}$ | 0.46 | * | ** |
| Gizzard (%) | 3.1$^{a}$ | 3.04$^{a}$ | 3.3$^{a}$ | 3.14$^{a}$ | 2.78$^{a}$ | 0.52 | NS | *** |
| Drip loss (%) | 2.4$^{a}$ | 1.9$^{a}$ | 2.52$^{a}$ | 2.05$^{a}$ | 1.89$^{a}$ | 0.75 | *** | *** |

Carcass yield: Hot Carcass weight at 1 h *post mortem*/Live weight at slaughter; Carcass yield 24: Cold carcass weight at 24h *post mortem* / Live weight at slaughter; RSD: Residual Standard Deviation. The means between the classes of the same line followed by different letters differ significantly with the threshold of 5%

yields, the percentage of tarsi, the proportion of the rest of carcass and the drip loss, the others characteristics of the carcass vary depending on the slaughter age ($p<0.001$). The live weight, the weight of hot and cold carcasses and the weight of the carcass cuts component had increased significantly with age. Indeed, the live weight at slaughter, the hot carcass weight and the cold carcass weight of the birds passed respectively from 923g, 725 g and 707 g at 20 weeks of age to 1134 g, 895 g and 877 g at 24 weeks and 1268 g, 993 g and 975 g at the age of 28 weeks ($p<0.001$). The same trend was recorded for the weight of the cuts of breast, thigh-drumstick, wings, neck, head, rest of carcass and tarsi. The carcass yield at 1 h *post-mortem* was not affected by the slaughter age of chickens, while the highest carcass yield at 24 h *post-mortem* was recorded at the age of 24 weeks ($p<0.05$).

Furthermore, the weight and the respective proportions of offal (heart, liver and gizzard) were significantly influenced by slaughter age. The lowest weights of heart, liver and gizzard were recorded at 20 weeks, while the highest were obtained between 24 and 28 weeks of age ($p<0.001$). On the other hand, the proportions of offal percentage decreased significantly with age of birds with the exception of the heart proportion that increased with age. The carcass drip losses decreased significantly with slaughter age ($p<0.001$).

**Interaction between ecotype and the slaughter age on carcass traits:** The interaction between ecotype and slaughter age was significant on the live weight, the hot carcass weight, the cold carcass weight and the weight of the various pieces of carcass cuts ($p<0.001$; Table 3). Indeed, the live weight, the hot carcass weight and the cold carcass weight and the carcass cuts traits of the five genetic types of chickens increased significantly with age. The lowest live weight at slaughter, the hot carcass weight and the cold carcass weight of Holli, North, Fulani South and Sahoue chickens were obtained at 20 weeks of age ($p<0.001$). The same trend was recorded for the weight of breast, thigh-drumstick, wings, neck, head, rest of carcass and tarsi. However, no significant difference was noted between the hot carcass weight, the cold carcass weight, the weight of cuts of breast, thigh-drumstick, the rest of carcass and the gizzard recorded in chicken of North and South ecotypes at the 20 and 24th week ($p<0.05$). The carcass yield at 1 *post-mortem* of Holli, North South and Fulani chickens was not affected by the age; only those of Sahoue chicken varied slightly with slaughter age with the lowest carcass yield observed at 24 weeks ($p<0.001$). Moreover, apart from the variation in carcass yield at 24 h *post-mortem,* observed in Sahoue chickens, no significant difference was observed between the yields of the cold carcass at 20, 24 and 28 weeks of age in the four other genetic types ($p<0.05$).

Moreover, unlike Holli, Fulani and South chickens, the respective proportions of offal of chickens North and Sahoue (heart, liver and gizzard) were significantly influenced by slaughter age. Carcass drip losses of Holli, South and Sahoue ecotypes did not differ significantly ($p<0.05$) with the age of the birds and ranging from 1.75 to 2.64%; whereas in chickens of Fulani and North ecotypes, the drip losses decreased significantly according to the slaughter age ($p<0.001$).

**Interaction between the breeding system and the slaughter age on carcass traits:** The interaction between breeding mode and slaughter age was only observed on the live weight, the hot carcass weight, the cold carcass weight, the carcass yields, the breast weight, the thigh-drumstick, the tarsi and the rest of carcass, the percentages of the wings and the liver and the drip losses ($p<0.05$; Table 4). In improved breeding system, the live weight of the bird, the hot carcass weight, the cold carcass weight and the carcass cuts weight increased significantly with age. Indeed, the live weight at slaughter, the hot carcass weight and the cold carcass weight of chickens increased respectively from 1013, 799 and 783 g at 20 weeks of age to 1178, 926 and 909 g at 24 weeks and then 1375, 1084 and 1064 g at 28 weeks of age ($p<0.001$). The same trend was recorded for the weight of cuts of breast, thigh-drumstick, wings, neck and tarsi. The percentages of breast, rest of carcass, head, neck, tarsi and liver remained constant with the age of chickens ($p<0.05$). Nevertheless, the most important proportion of thigh-drumsticks ($p<0.05$) was recorded at 28 weeks of age while the proportions of wings and gizzard decreased with age of the birds. The offal became heavier with age of chickens ($p<0.05$); the lowest weight were recorded at 20 weeks of age. Carcass yields at 1 h and 24 h *post-mortem* and carcass drip loss did not differ significantly ($p<0.05$) with the age of the birds.

In traditional breeding, the live weight of the bird, the hot carcass weight and the cold carcass weight and its various pieces also increased significantly with age. The lowest live weight at slaughter, the hot carcass weight and the cold carcass weight of chickens were recorded at 20 weeks of age and the most important at the age of 28 weeks ($p<0.001$). The same trend was recorded for the weight of cuts of breast, thigh-drumstick, wings, neck and tarsi. However, no significant difference was noted between the hot carcass weight, the cold carcass weight, the weight of cuts of breast wings, rest of carcass, head, neck and tarsi and the percentages in relative to the carcass weight of breast, wings, head, liver and gizzard recorded at the 20th and the 24th week of age. Carcass yields at 20 and 24 h *post-mortem* didn't varied significantly ($p<0.05$) with age of the birds. However, heart and gizzard weight increased significantly with age of chickens ($p<0.05$); the lowest

Table 3: Interaction between ecotype and the slaughter age on carcass traits

| | Holli | | | Nord | | | Fulani | | | Sahoue | | | Sud | | | | Interaction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables | 20 wk | 24 wk | 28 wk | 20 wk | 24 wk | 28 wk | 20 wk | 24 wk | 28 wk | 20 wk | 24 wk | 28 wk | 20 wk | 24 wk | 28 wk | RSD | ecotype× age |
| Live weight (g) | 956.6$^{a}$ | 1305.5$^{b}$ | 1560$^{c}$ | 920$^{a}$ | 1142$^{b}$ | 1131.67$^{b}$ | 1000$^{a}$ | 1133.5$^{b}$ | 1356.7$^{c}$ | 863$^{a}$ | 1058.5$^{b}$ | 1259.2$^{c}$ | 876$^{a}$ | 1031.5$^{b}$ | 1032.5$^{b}$ | 91.39 | *** |
| Hot Carcass weight (g) | 752$^{a}$ | 1034.7$^{b}$ | 1233.1$^{c}$ | 720$^{a}$ | 904.4$^{b}$ | 878.67$^{b}$ | 788.4$^{a}$ | 897.9$^{b}$ | 1064.17$^{c}$ | 681$^{a}$ | 821.4$^{b}$ | 987$^{c}$ | 686.2$^{a}$ | 819.3$^{b}$ | 804.8$^{b}$ | 80.84 | *** |
| Cold carcass weight (g) | 736.6$^{a}$ | 1016.8$^{b}$ | 1211.3$^{c}$ | 696.8$^{a}$ | 885.2$^{b}$ | 849.7$^{b}$ | 769.6$^{a}$ | 880.4$^{b}$ | 1047.2$^{c}$ | 666.89$^{a}$ | 802.3$^{b}$ | 967.5$^{c}$ | 668.8$^{a}$ | 802.2$^{b}$ | 789.7$^{c}$ | 80.44 | *** |
| Carcass yield 1 (%) | 78.55$^{a}$ | 79.1$^{a}$ | 78.86$^{a}$ | 78.21$^{a}$ | 79.19$^{a}$ | 77.60$^{a}$ | 78.65$^{a}$ | 79.23$^{a}$ | 78.45$^{a}$ | 78.96$^{a}$ | 77.60$^{b}$ | 78.32$^{a}$ | 78.31$^{a}$ | 79.41$^{a}$ | 77.92$^{a}$ | 1.56 | NS |
| Carcass yield 24 (%) | 76.9$^{a}$ | 77.7$^{a}$ | 77.46$^{a}$ | 75.68$^{a}$ | 75.68$^{a}$ | 75.87$^{a}$ | 76.74$^{a}$ | 77.65$^{a}$ | 77.20$^{a}$ | 77.27$^{a}$ | 75.79$^{a}$ | 76.77$^{a}$ | 76.25$^{a}$c | 77.77$^{b}$ | 76.46$^{c}$ | 1.69 | NS |
| Breast (g) | 140.2$^{a}$ | 210$^{b}$ | 246.75$^{c}$ | 139.8$^{a}$ | 186.8$^{b}$ | 171.33$^{b}$ | 153.5$^{a}$ | 185.5$^{b}$ | 217.92$^{c}$ | 126.96$^{a}$ | 162.8$^{b}$ | 203.5$^{c}$ | 140.15$^{ac}$ | 164$^{bc}$ | 158.67$^{c}$ | 25.5 | *** |
| Thigh-drumstick (g) | 202.8$^{a}$ | 283.3$^{b}$ | 343.38$^{c}$ | 187.9$^{a}$ | 242.2$^{b}$ | 241.33$^{b}$ | 214$^{a}$ | 229$^{a}$ | 300.3$^{b}$ | 181.55$^{a}$ | 212.95$^{b}$ | 278.8$^{c}$ | 180$^{a}$ | 217.9$^{b}$ | 222.33$^{b}$ | 28.55 | *** |
| Wings (g) | 100.5$^{a}$ | 115.8$^{b}$ | 132.6$^{c}$ | 81.9$^{a}$ | 99.65$^{b}$ | 85.5$^{a}$ | 89.6$^{a}$ | 100.2$^{a}$ | 125.67$^{b}$ | 81.91$^{a}$ | 88.75$^{b}$ | 98.88$^{b}$ | 78.1$^{a}$ | 90.95$^{b}$ | 86$^{b}$ | 12.26 | *** |
| $^{b}$reast (%) | 18.95$^{a}$ | 20.67$^{a}$ | 20.38$^{a}$ | 19.99$^{a}$ | 21.06$^{a}$ | 19.95$^{a}$ | 19.74$^{a}$ | 21.09$^{a}$ | 20.8$^{a}$ | 18.79$^{a}$ | 20.22$^{ab}$ | 21.01$^{b}$ | 20.66$^{a}$ | 20.45$^{a}$ | 20.09$^{a}$ | 2.04 | NS |
| Thigh-drumstick (%) | 27.45$^{a}$ | 27.65$^{a}$ | 28.3$^{a}$ | 26.99$^{a}$ | 27.31$^{a}$ | 28.0$^{a}$ | 27.72$^{a}$ | 26.03$^{bc}$ | 28.6$^{c}$ | 27.17$^{a}$ | 26.49$^{b}$ | 28.8$^{a}$ | 26.89$^{a}$ | 27.15$^{a}$ | 28.0$^{a}$ | 1.6 | NS |
| Wings (%) | 13.86$^{a}$ | 11.43$^{b}$ | 11.02$^{b}$ | 11.76$^{a}$ | 11.3$^{a}$ | 9.95$^{b}$ | 11.86$^{a}$ | 11.34$^{a}$ | 12$^{a}$ | 12.44$^{a}$ | 11.11$^{b}$ | 10.12$^{b}$ | 11.85$^{a}$ | 11.32$^{a}$ | 10.99$^{a}$ | 1.37 | NS |
| Head (g) | 38.51$^{a}$ | 50.9$^{b}$ | 62.6$^{c}$ | 38.8$^{a}$ | 42.95$^{a}$ | 45.33$^{a}$ | 39.1$^{a}$ | 44.6$^{ab}$ | 47.31$^{b}$ | 39.1$^{a}$ | 41.6$^{b}$ | 50.97$^{a}$ | 36.9$^{a}$ | 42.6$^{ab}$ | 44.5$^{b}$ | 6.8 | * |
| Neck (g) | 46.32$^{a}$ | 76$^{b}$ | 88.75$^{c}$ | 46.8$^{a}$ | 63.6$^{bc}$ | 56.08$^{ac}$ | 51.08$^{a}$ | 68$^{b}$ | 72.7$^{b}$ | 47.26$^{a}$ | 54.95$^{a}$ | 66.7$^{b}$ | 49.71$^{a}$ | 64.3$^{bc}$ | 57.92$^{ac}$ | 9.57 | *** |
| Tarsi (g) | 35.34$^{a}$ | 53.8$^{b}$ | 65.63$^{c}$ | 32.53$^{a}$ | 41.2$^{ab}$ | 43.42$^{b}$ | 45$^{a}$ | 39.45$^{a}$ | 67.54$^{b}$ | 34.2$^{a}$ | 43.7$^{b}$ | 42.08$^{ab}$ | 30.8$^{a}$ | 36.4$^{a}$ | 32.5$^{a}$ | 10.07 | *** |
| Rest of carcass (g) | 130.65$^{a}$ | 167.7$^{b}$ | 208.38$^{c}$ | 120.66$^{a}$ | 154.7$^{b}$ | 163.83$^{b}$ | 127.41$^{a}$ | 159.9$^{b}$ | 156.55$^{b}$ | 110.06$^{a}$ | 142.1$^{b}$ | 166.58$^{c}$ | 112.1$^{a}$ | 137.2$^{b}$ | 166.58$^{b}$ | 20.67 | * |
| Head (%) | 5.22$^{a}$ | 5$^{a}$ | 5.14$^{a}$ | 5.58$^{a}$ | 4.87$^{b}$ | 5.27$^{ab}$ | 5.12$^{a}$ | 5.09$^{a}$ | 4.52$^{a}$ | 5.84$^{a}$ | 5.2$^{b}$ | 5.32$^{ab}$ | 5.6$^{a}$ | 5.3$^{a}$ | 5.65$^{a}$ | 0.69 | NS |
| Neck (%) | 6.29$^{a}$ | 7.58$^{b}$ | 7.36$^{b}$ | 6.76$^{a}$ | 7.18$^{a}$ | 6.58$^{a}$ | 6.65$^{a}$ | 7.7$^{b}$ | 6.94$^{ab}$ | 7.12$^{a}$ | 6.87$^{a}$ | 6.86$^{a}$ | 7.35$^{a}$ | 8$^{a}$ | 7.34$^{a}$ | 1.06 | NS |
| Tarsi (%) | 4.84$^{a}$ | 5.24$^{a}$ | 5.37$^{a}$ | 4.66$^{a}$ | 4.66$^{a}$ | 4.98$^{a}$ | 5.75$^{a}$ | 4.47$^{b}$ | 6.46$^{a}$ | 5.18$^{ab}$ | 5.46$^{a}$ | 4.35$^{b}$ | 4.69$^{a}$ | 4.53$^{a}$ | 4.11$^{a}$ | 1.02 | ** |
| Reste of carcass (%) | 17.66$^{a}$ | 16.5$^{a}$ | 17.15$^{a}$ | 17.28$^{a}$ | 17.5$^{a}$ | 19.07$^{a}$ | 16.65$^{ab}$ | 18.18$^{a}$ | 14.95$^{b}$ | 16.5$^{a}$ | 17.73$^{a}$ | 17.4$^{ab}$ | 16.74$^{a}$ | 17.14$^{a}$ | 18.37$^{a}$ | 1.9 | * |
| Heart (g) | 4.99$^{a}$ | 8.82$^{b}$ | 9.25$^{b}$ | 6.52$^{a}$ | 7.8$^{a}$ | 7.67$^{a}$ | 6.43$^{a}$ | 7.8$^{ab}$ | 8.87$^{b}$ | 4.7$^{a}$ | 8.7$^{b}$ | 7.62$^{b}$ | 5.1$^{a}$ | 7.3$^{bc}$ | 6.42$^{ac}$ | 1.99 | NS |
| liver (g) | 15.31$^{a}$ | 22.05$^{b}$ | 23.25$^{b}$ | 18.29$^{a}$ | 18.13$^{a}$ | 19.58$^{a}$ | 17.88$^{a}$ | 18.65$^{a}$ | 20.78$^{a}$ | 17.43$^{a}$ | 19$^{a}$ | 23.75$^{b}$ | 14.98$^{a}$ | 16.6$^{a}$ | 15.17$^{a}$ | 3.92 | * |
| Gizzard (g) | 21.95$^{a}$ | 28.4$^{b}$ | 30.63$^{b}$ | 23.6$^{ac}$ | 28.13$^{b}$ | 25.6$^{c}$ | 25.6$^{a}$ | 27.25$^{a}$ | 29.52$^{a}$ | 23.72$^{a}$ | 27.75$^{b}$ | 26.56$^{b}$ | 20.44$^{ac}$ | 24.95$^{b}$ | 20.75$^{bc}$ | 4.42 | NS |
| Heart (%) | 0.67$^{a}$ | 0.88$^{a}$ | 0.78$^{a}$ | 0.94$^{a}$ | 0.88$^{a}$ | 0.92$^{a}$ | 0.82$^{a}$ | 0.89$^{a}$ | 0.85$^{a}$ | 0.71$^{a}$ | 1.08$^{b}$ | 0.78$^{a}$ | 0.79$^{a}$ | 0.92$^{a}$ | 0.81$^{a}$ | 0.26 | NS |
| Liver (%) | 2.09$^{a}$ | 2.19$^{a}$ | 1.92$^{a}$ | 2.63$^{ac}$ | 2.05$^{b}$ | 2.25$^{bc}$ | 2.37$^{a}$ | 2.12$^{a}$ | 1.99$^{a}$ | 2.66$^{a}$ | 2.38$^{a}$ | 2.43$^{a}$ | 2.29$^{a}$ | 2.08$^{a}$ | 1.92$^{a}$ | 0.46 | NS |
| Gizzard (%) | 2.98$^{a}$ | 2.87$^{a}$ | 2.57$^{a}$ | 3.4$^{a}$ | 3.17$^{a}$ | 2.96$^{a}$ | 3.34$^{a}$ | 3.1$^{a}$ | 2.82$^{a}$ | 3.6$^{a}$ | 3.45$^{ab}$ | 2.92$^{b}$ | 3.1$^{a}$ | 3.11$^{a}$ | 2.64$^{a}$ | 0.52 | NS |
| Driploss (%) | 2.1$^{a}$ | 1.75$^{a}$ | 1.78$^{a}$ | 3.31$^{a}$ | 2.14$^{b}$ | 2.22$^{b}$ | 2.45$^{a}$ | 2$^{ab}$ | 1.6$^{b}$ | 2.14$^{a}$ | 2.33$^{a}$ | 1.98$^{a}$ | 2.64$^{a}$ | 2.07$^{a}$ | 1.88$^{a}$ | 0.75 | NS |

carcass yield 1: Hot Carcass weight at 1 h *post mortem*/Live weight at slaughte; Carcass yield 24: Cold carcass weight at 24 h *post mortem* / Live weight at slaughter; RSD: Residual Standard Deviation. The means between the classes of the same line followed by different letters differ significantly with the threshold of 5%. wk: week

Table 4: Interaction between the breeding system and the slaughter age on carcass traits

| Variables | Improved breeding system 20 week | Improved breeding system 24 week | Improved breeding system 28 week | Traditional breeding system 20 week | Traditional breeding system 24 week | Traditional breeding system 20 week | RSD | Interaction breeding system×age |
|---|---|---|---|---|---|---|---|---|
| Live weight (g) | 1013.04$^{a}$ | 1178$^{b}$ | 1375.81$^{c}$ | 833.2$^{a}$ | 1090.4$^{b}$ | 1160.19$^{c}$ | 91.39 | ** |
| Hot carcass weight (g) | 799.3$^{a}$ | 926.7$^{b}$ | 1084.3$^{c}$ | 652$^{a}$ | 864.7$^{b}$ | 902.8$^{b}$ | 80.84 | ** |
| Cold carcass weight (g) | 783.4$^{a}$ | 909.2$^{b}$ | 1064.8$^{c}$ | 632$^{a}$ | 845.5$^{b}$ | 885.2$^{b}$ | 80.44 | ** |
| Carcass yield 1 (%) | 78.9$^{a}$ | 78.6$^{a}$ | 78.6$^{a}$ | 78.21$^{a}$ | 79.3$^{b}$ | 77.8$^{a}$ | 1.56 | * |
| Carcass yield 24 (%) | 77.3$^{a}$ | 77.1$^{a}$ | 77.2$^{a}$ | 75.83$^{a}$ | 77.5$^{b}$ | 76.3$^{a}$ | 1.69 | * |
| Breast (g) | 163.3$^{a}$ | 184.2$^{b}$ | 215$^{c}$ | 116.9$^{a}$ | 179.5$^{b}$ | 184.3$^{b}$ | 25.5 | *** |
| Thigh-drumstick (g) | 215.7$^{a}$ | 248.1$^{b}$ | 306.8$^{c}$ | 170.8$^{a}$ | 226$^{b}$ | 247.7$^{c}$ | 28.55 | * |
| Wings (g) | 89.6$^{a}$ | 105. 6$^{b}$ | 112.8$^{b}$ | 83.24$^{a}$ | 92.6$^{b}$ | 98.6$^{b}$ | 12.26 | NS |
| Breast (%) | 20.8$^{a}$ | 20.2$^{a}$ | 20.2$^{a}$ | 18.43$^{a}$ | 21.2$^{b}$ | 20.7$^{b}$ | 2.04 | *** |
| Thigh-drumstick (%) | 27.5$^{a}$ | 27.2$^{a}$ | 28.3$^{b}$ | 27$^{ab}$ | 26.7$^{a}$ | 27.9$^{b}$ | 1.6 | NS |
| Wings (%) | 11.5$^{a}$ | 11.7$^{a}$ | 10.5$^{b}$ | 13.24$^{a}$ | 10.9$^{b}$ | 11.1$^{b}$ | 1.37 | *** |
| Head (g) | 41.4$^{a}$ | 47$^{b}$ | 55.6$^{c}$ | 35.6$^{a}$ | 42.02$^{b}$ | 44.7$^{b}$ | 6.8 | NS |
| Neck (g) | 53.4$^{a}$ | 67$^{b}$ | 74.01$^{c}$ | 43.09$^{a}$ | 63.7$^{b}$ | 62.9$^{b}$ | 9.57 | NS |
| Tarsi (g) | 38.8$^{a}$ | 45.1$^{b}$ | 58.18$^{c}$ | 32.28$^{a}$ | 40.7$^{b}$ | 42.3$^{b}$ | 10.07 | * |
| Rest of carcass (g) | 133.8$^{a}$ | 155.6$^{b}$ | 183.3$^{c}$ | 106.6$^{a}$ | 149.1$^{b}$ | 153.1$^{b}$ | 20.67 | * |
| Head (%) | 5.3a | 5.2$^{a}$ | 5.22$^{a}$ | 5.64$^{a}$ | 4.9$^{b}$ | 5.2$^{b}$ | 0.69 | NS |
| Neck (%) | 6.8$^{a}$ | 7.4$^{a}$ | 6.96$^{a}$ | 6.8$^{a}$ | 7.5$^{b}$ | 7.1$^{ab}$ | 1.06 | NS |
| Tarsi (%) | 4.9$^{a}$ | 4.9$^{a}$ | 5.38$^{a}$ | 5.13$^{a}$ | 4.8$^{a}$ | 4.73$^{a}$ | 1.02 | NS |
| Reste of carcass (%) | 17.1$^{a}$ | 17.1$^{a}$ | 16.87$^{a}$ | 16.9$^{a}$ | 17.7$^{a}$ | 17.5$^{a}$ | 1.9 | NS |
| Heart (g) | 66$^{a}$ | 8.4$^{b}$ | 8.31$^{b}$ | 5.09$^{a}$ | 7.8$^{b}$ | 7.6$^{b}$ | 1.99 | NS |
| Liver (g) | 16.6$^{a}$ | 19.5$^{b}$ | 22.1$^{c}$ | 17$^{a}$ | 18.3$^{a}$ | 18.91$^{a}$ | 3.92 | NS |
| Gizzard (g) | 24.7$^{a}$ | 28.8$^{b}$ | 28.8$^{b}$ | 21.4$^{a}$ | 25.8$^{b}$ | 25.21$^{b}$ | 4.42 | NS |
| Heart (%) | 0.8$^{a}$ | 0.9$^{b}$ | 0.8$^{ab}$ | 0.8$^{a}$ | 0.9$^{a}$ | 0.86$^{a}$ | 0.26 | NS |
| Liver (%) | 2.1$^{a}$ | 2.2$^{a}$ | 2.08$^{a}$ | 2.69$^{a}$ | 2.2$^{b}$ | 2.12$^{b}$ | 0.46 | ** |
| Gizzard (%) | 3.2$^{a}$ | 3$^{a}$ | 2.73$^{b}$ | 3.4$^{a}$ | 3.05$^{b}$ | 2.83$^{b}$ | 0.52 | NS |
| Drip loss (%) | 2$^{a}$ | 1.9$^{a}$ | 1.8$^{a}$ | 3.06$^{a}$ | 2.2$^{b}$ | 1.98$^{b}$ | 0.75 | ** |

Carcass yield: Hot Carcass weight at 1 h *post mortem* / Live weight at slaughte; Carcass yield 24: Cold carcass weight at 24h *post mortem*/Live weight at slaughter; RSD: Residual Standard Deviation. The means between the classes of the same line followed by different letters differ significantly with the threshold of 5%

weight were recorded at 20 weeks of age. The carcass drip losses decreased significantly with age of birds by passing from 3.06% at 20 weeks to 1.98% at 28 weeks of age ($p<0.001$).

## DISCUSSION

**Effect of the ecotype of the carcass traits:** The live weight, the hot carcass weight and the cold carcass weight of Holli chickens were significantly higher than those recorded in Fulani, Sahoue, North and South chickens. Lowest live weight, hot carcass weight and cold carcass weight were noted in South ecotype chickens. Birds of this study was reared under the same environmental conditions, these differences may be related to the variability of the additive genetic ecotypes of chickens used in the present study (Youssao *et al*., 2012). The results of live weight at slaughter recorded in this study at 28 weeks old are better than those reported by Youssao *et al*. (2009) on North (1068.9 g) and South (832.9 g) local chicken ecotypes of Benin at 28 weeks of age, but these live weights are below those reported by Miguel et *al*. (2008) in Castellana Negra native chickens in Spain, Yapi-Gnaore *et al*. (2010) in Forest (1612 g) and Savanna (1633.2 g) local chicken breeds of the Ivory Coast killed at 22 weeks old. Brunel *et al*. (2006) reported a weight of 2714 g and 1756 g at 27 weeks respectively for males and females local chickens of Zimbabwe. The significant effect of the genetic type on body weight of local chickens was also reported by Oluwatosin *et al*. (2007) on local chickens in Nigeria, Jaturasitha *et al*. (2008) on local chickens of Thailand, Youssao *et al*. (2009) on the local chickens of North and South ecotypes of Benin, Yapi-Gnaore *et al*. (2010) on the local chickens of North and South ecotype of two agro ecological zones of Ivory Coast and Osei-Amponsah *et al*. (2012) on local chickens in Ghana.

The hot and cold carcass yields of the five genetic types of chicken used in this study were similar ($p>0.05$) and vary respectively between 78.29 and 78.84% and between 76.35 and 77.36%. Those carcass yields are higher than those reported by Youssao *et al.* (2009) on North (75.2%) and South (75.21%) local chicken ecotypes of Benin, Label Rouge chicken strain (71.93%) and their cross (71.78 to 72, 36%) at 28 weeks of age, but lower than those obtained by Franco *et al*. (2012) in chickens of Mos strains (82.47%) and Sasso T-44 (83.31%) processed in the same condition.

The carcasses of five ecotypes of local chicken are devoid of abdominal fat. So these are lean carcasses. These results confirm the observations of Youssao *et al*. (2009) on carcass traits of local chicken of North and South ecotypes of Benin and those of Fotsa *et al*. (2008) on local chickens in Cameroon. This lack of abdominal fat observed in this study may be related to the slow growth rate of these birds. On the other hand, Ndri *et al*. (2007) reported an abdominal fat rate of 2-3% in the carcass of Label rouge chickens at 12 weeks of age. The speed of growth can influence the body composition of the animals, abdominal fat being deposited later during the growth period, after the in flexion point. According to Sandercock *et al.* (2009), genetic variation for relative weight of abdominal fat, spleen and heart was moderately high and greater at 10 than at 6 weeks of age. Broiler carcasses had a relatively high proportion of abdominal fat and smaller spleen and heart weights than traditional lines (Sandercock *et al*., 2009). For the carcass cuts traits, the breast weight of Holli and Fulani chickens are similar but heavier than Sahoue, North and South ecotypes chicken. Thigh-drumsticks and wings of Holli chickens were heavier than those of the other four genetic types, followed by the Fulani chickens. The lowest weight of drumstick-thighs and wings were recorded in South ecotype chickens. These various pieces of carcass cuts are less heavy than those recorded by Tor *et al*. (2002) on the cocks and capons raised in improved breeding system and Matarneh Abdullah (2010) in broilers reared under improved breeding system in Franco *et al*. (2012) in chicken of Mos and Sasso T-44 strains bred in improved breeding system in Spain. However, the results for the weight of the carcass cuts at 28 weeks old in this study are above those recorded in local chickens of North and South ecotypes of Benin slaughtered at the same age (Youssao *et al*. 2009). Indeed, according to the results of Youssao *et al*. (2009), the breast of North and South ecotype chicken weigh respectively 184 and 150.67 g and the thigh-drumsticks weight respectively 295.17 and 249 g with wings of 118 and 88.87 g, respectively.

The differences between the weights of the different organs (liver, heart and gizzard) of Holli, Fulani and North Sahouè chicken ecotypes are not significant. Similar results were obtained by Fotsa *et al*. (2007) on Cameroon local chickens.

**Effect of breeding mode and slaughter age on carcass characteristics:** The live weight at slaughter, the hot carcass weight, the cold carcass weight and the weight of carcass cut pieces of chickens reared under improved breeding system were higher than those of chickens of traditional breeding system. The significant effect of breeding modes (traditional *vs* improved system) on the carcass characteristics of local chickens was also reported by Oluwatosin *et al*. (2007) on local chickens in Nigeria, Jaturasitha *et al*. (2008) on local chickens of Thailand and Bogosavljevic-Boskovic *et al*. (2010) on broilers bred with or without outdoor access. The difference observed in this study is related to the feeding mode, housing and health follow-up of animals. According to Youssao *et al*. (2013), three types of indigenous chicken breeding system were identified in Benin: traditional breeding system corresponding to the type 1 and 2 and the improved breeding for type 3. The Type 1 includes livestock farmers, artisans and housewives. These breeders are distributed almost in all departments of Benin and constitute 77.78% of the total population of breeders. The herd is of an average size. Veterinary treatments are not performed. The birds produced are consumed or sold. In Type 2, breeders are more concentrated in Alibori, Atacora and Donga departments. Herds are of small size and the birds are not usually treated; no medicate exists. The sale of animals is rare. Farmers in this group represent 16.68% of the population of breeders sampled. The characteristics of these types of breeding justify the poor performance of the animals in this study. Finally, in the Type 3, breeders are met in the North in general and in Alibori department in particular. Herds are of large scale and birds undergo a satisfactory prophylaxis and medical treatment characterized by the administration of vitamin complexes, antibiotics, vaccines, deworming and anti-parasite based on veterinary requirements. This type of breeding approaches the improved breeding conditions of this study and explains the better performance of animals in this study. Generally, in terms of feeding, chicken breeders groups categorized by Youssao *et al*. (2013) in Benin provide the most grain to animals and this goes in the same direction as the work of Tougan (2008). The three types of breeding system distribute crop and kitchen residues to animal (Tougan, 2008; Youssao *et al*., 2013). However, Mikulski *et al*. (2011) reported that breeding conditions with or without outdoor access does not affect growth performance and carcass characteristics of slow or fast growing chickens.

The carcass drip losses were more abundant in chickens reared under traditional breeding system ($p<0.001$) than in improved system. This result confirms the one of Fanatico *et al*. (2005) who reported that loss of juice increased significantly when slow-growing chickens have access to the outdoors.

Moreover, carcass drip losses recorded in this study in traditional breeding system (2.4%) and improved breeding system (1.9%) are much higher than that obtained by Guerder *et al*. (2009) in laying hens which were 0.88% and that measured on the standard chicken (0.89%) by Berri *et al*. (2001b). This difference could be due to the mode of plucking used during the slaughtering process. In our study, the plucking was done manually in heated water whereas Guerder *et al*. (2009) had slaughtered the chicken at the experimental slaughterhouse according to the modern slaughtering process and the carcasses were air chilled before storing at 2°C until used.

The study of Fanatico *et al*. (2005) on the assessment of the meat quality of broiler and slow growth genotypes of chicken reared with or without outdoor access indicates significant differences between the qualities of the meat according to the production system.

The carcass composition was also affected by the age of the birds at slaughter. The live weight of the bird, the hot and the cold carcass weights as well as its various cuts increased significantly with age. These results confirm the observations of Fletcher (2002) on poultry meat quality, Fiardo (2003) on chicken meat quality and Gigaud *et al*. (2008) on chickens in France who reported such an effect of age on the carcass composition and meat quality of the chickens. The results of this study are consistent with the evolution of the growth curve of local chickens. Beyond 24 weeks of age, local chickens reach their maturity and body weight increases very slightly over a long period (Youssao *et al*., 2009, 2012).

**Conclusion:** The comparison of carcass traits of local chicken of Holli, Fulani, Sahoue, North and South ecotypes shows that carcass characteristics were affected by the genetic type, breeding mode, slaughter age and their interactions. Local chickens of Holli and Fulani ecotypes have a slaughter live weight, carcass weight (hot or cold) more important with cutting pieces heavier than the others ecotypes of local chicken studied. Improved breeding system led to an increase of the slaughter weight, the weight of hot carcass, the weight of the cold carcass and the weight of carcass cut pieces of chicken of the five local ecotypes compared to traditional breeding system. However, contrary to the free range system, the production cost of the local chicken in confinement is very expansive. The live weight of birds slaughtered at 20 weeks of age is lower than those of animals slaughtered at 24 or 28 weeks. The hot and the cold carcass weights as well as its various cuts increased significantly with age. The best yields of the carcass were recorded at 24 weeks of age. The ideal slaughtering age for the local chickens of Holli, Fulani, Sahouè, North and South ecotypes of Benin is 24 weeks or 6 months.

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