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Influence of Feed Withdrawal Length on Carcass Traits and Technological Quality of Indigenous Chicken Meat Reared Under Traditional System in Benin

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ABSTRACT

The aim of the current study was to evaluate the effects of different feed withdrawal durations (0, 12 and 24 hours) on carcass traits and meat technological quality in local chicken of Benin. 30 South ecotype chickens of Benin were divided into 3 groups and slaughtered for the study after 12 hours of feed withdrawal. These chickens were all reared in free range according to the same traditional breeding system. The pH, weight of each carcass and the color of meat (breast and thigh) were determined. It appears that longer feed withdrawal periods significantly increased weight loss in chicken. The highest carcass weight, breast weight and carcass yields were recorded after 12 hours of feed withdrawal ($P < 0.05$). Technologically, the lowest pH values in the breast muscle at 1 hour, 8 hours, 16 hours and 20 hours post mortem were found in chickens slaughtered without any feed withdrawal ($P < 0.05$). At 12 and 24 hours post mortem, the highest pH values were noted in chickens slaughtered after 12 hours of feed withdrawal ($P < 0.01$). The live weight of control chickens and those slaughtered after 12 hours of feed withdrawal was highly and positively correlated with carcass weights ($P < 0.001$) but weakly and positively associated to breast weight and thigh-drumstick weight ($P < 0.05$); while after 24 hours of feed withdrawal, the live weight was moderately and positively correlated with the thigh-drumstick weight ($P < 0.01$, $r = 0.9$) but weakly associated to hot carcass weight and cold carcass weight ($P < 0.05$). After 24 hours of feed withdrawal, carcass yield was negatively correlated to breast drip loss ($P < 0.05$). Overall, longer feed withdrawal increased weight loss, pH, luminance and yellowness of meat but reduced its redness, water holding capacity and shear force.

Keywords: Indigenous chicken, Feed withdrawal, Carcass traits, Meat quality, Benin.

INTRODUCTION

Chickens in developing countries have more diverse use and benefits to household (Padhi, 2016). In countries of sub-Saharan Africa where food products are relatively in deficit, traditional chicken represents approximately 80% of the total poultry population and contributes to a significant proportion of meat production (25-70%) and eggs (12 to 36%). In Benin, the poultry provides a part of the nutritional needs of the family and more than 50% of farmers produce for subsistence and sometimes generation of some cash income by the commercialization of livestock products in the local market (Youssao et al., 2013). The indigenous chickens represent 81.3% of the national poultry flock (CountryStat, 2013) and are an important source of animal protein supply for the population and an income for producers and poultry sellers. Most of the national poultry production comes from the family poultry breeding which is composed mainly of local population of the species *Gallus gallus* (Tougan et al., 2013b). This population is composed of a variety of ecotypes: North, South, Sahoue, Fulani and Holli ecotypes (Tougan et al., 2013b). Among these ecotypes, the North ecotype in the north region of Benin and South ecotype in the South of Benin are the predominant breeds. These indigenous chicken populations have a remarkable heterogeneity in phenotypical and polymorphism traits. Several works were done on these local genetic types (Youssao et al., 2010 and Tougan et al., 2013b). Recent works carried out on carcass composition (Tougan et al., 2013a) and technological meat quality of these five ecotypes according to the breeding mode and slaughter age

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(Tougan et al., 2013c) showed that important differences exist in meat quality. Moreover, the chemical composition of these local chicken meats was also affected by these factors (Tougan et al., 2013d). However, no data is available on the impact of pre-slaughter feed withdrawal periods on the carcass traits and technological quality of the local chicken populations of Benin. This work assesses the carcass traits and meat technological quality attributes of local chicken meat of South ecotype of Benin according to the pre-slaughter feed withdrawal periods and establishes the relationships between carcass traits and technological meat quality.

MATERIALS AND METHODS

Area of study

The study was conducted in Laboratory of Animal Biotechnology and Meat Technology of the Department of Animal Production and Health of of “Ecole Polytechnique d’Abomey-Calavi (EPAC)” in Benin. Chickens used in the current study were reared under traditional breeding system in the Commune of Abomey-Calavi (Figure 1) 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, 2010). 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.

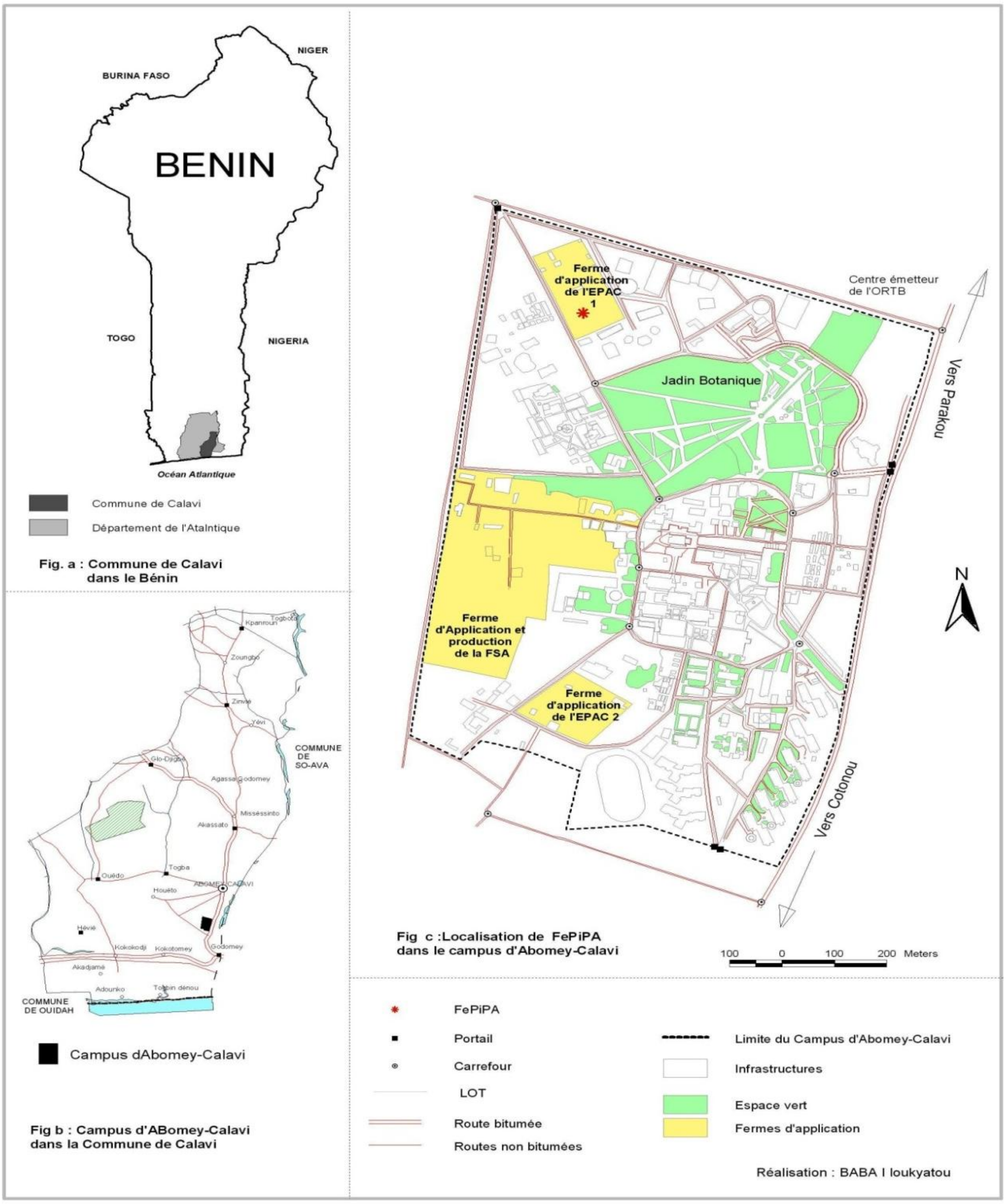

Figure 1. Area of study (Abomey-Calavi, Benin)

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Birds rearing and sampling

Birds slaughtered in the current study are local chickens of South ecotypes of Benin. A total of 30 cockerels of 6 months old and 845 grams as live weight were divided into 3 groups of 10 chickens. These chickens were all reared in free range according to the same traditional breeding system. The scavenging of birds was the rule in this breeding system. The birds were in free range 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 neither quantitative nor qualitative standards in their feeding. The birds fed themselves around concessions, by gleaning here and there, and occasionally receiving some grain supplement from the traditional breeder. Their diet was composed of energetic elements (kitchen waste, bran and etc), vitamins (green fodder, sprouted grains), minerals (salt, pounded shells) and protein (termites, legumes) (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 (Tougan et al., 2013b).

Feed withdrawal, slaughtering process and carcass cutting

The effect of feed withdrawal duration was evaluated from 3 different lots of 10 South ecotype chicken of Benin. Birds of lot 1 had undergone no feed withdrawal; and then slaughtered after being fed. In contrast, birds of lot 2 had undergone 12 hours of feed withdrawal; while birds of Lot 3 had undergone 24 hours of 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. 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 were refrigerated at 4°C for 24 hours and weighed. A cut of each carcass was used to determine the weights of breast, thigh-drumstick, wings and the rest of the carcass (Tougan et al., 2013b and Pripwai et al., 2014).

Data collecting

The live weight at slaughter, hot carcass weight at 1 hour post mortem, cold carcass weight at 24 hour 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 hours post mortem. The abdominal fat was measured. The percentages of each carcass cut and abdominal offal component were calculated from the carcass weight. By the same way, carcass yield at 1 hour and 24 hours post-mortem were calculated.

The pH was measured in the breast muscle (Pectoralis major) and the thigh muscle (Ilio tibialis) at 2 cm depth. The pH was measured using a pH-meter (Hanna Instruments Inc., model HI99161) provided with a specialized probe and temperature control system. This apparatus was calibrated with two buffers pH-meter: pH = 4.0 and pH = 7.0 following a procedure provided by manufacturer. Between the measurements the muscle was stored at 4°C in an individual plastic container.

The colour of skin and meat (breast and thigh) were determined at 24 h post mortem using a Minolta chromameter CR-400 (Japan) in the trichromatic system (CIE L * a * b*). The surface was exposed to air for 20 min at room temperature before determining the color of the muscle. The readings were taken on equivalent positions. The tip of the chromameter measuring head was placed flat against the surface of the skin or of the meat for breast and thigh. For each reading, 6 measurements were performed and the average of these readings was considered as the final value. Meat color were expressed in the CIE L*a*b* dimensions of lightness (L*), redness (a*) and yellowness (b*). The colorimeter was calibrated using the specific white board (Minolta CR 400), before measurement began.

Drip loss was measured on intact fillets of the right side of the pectoralis major and thigh muscle (5 cm×3 cm×2 cm) and packaged in plastic bags, and then hung on wooden supports at 4 °C for 24 h, and calculations were made as a percentage of weight loss during storage.

The Water Holding Capacity was calculated by the sum of drip loss and cooking loss. Then, the breast and thigh-drumstick cuts used for drip loss were separately weighed and wrapped by placing inside vacuum bags (COPVAC 17025, Vigoclima S.L., Vigo, Spain), sealed without vacuum, and cooked placing vacuum-package bags in bain-marie (Memmert GmbH + Co, GK, Germany) until the core temperature reached 70°C (Franco et al., 2012). The core temperature was controlled by inserting the electrode of a digital thermometer (TestoAG, Lenzkirch, Germany) into the center of the meat sample for the duration of the boiling process. After boiling the samples were removed, cooled to room temperature, and reweighed. The cooking loss was calculated as the loss of weight during the boiling process and was expressed as a percentage as follows:

$$\text{Cooking loss (\%)} = \frac{\text{Weight loss}}{\text{Initial fresh meat weight}} \times 100$$

The samples prepared for the determination of the cooking loss were subsequently used for the Warner-Bratzler shear force analysis according to Bratcher et al. (2005). Cores with a diameter of 1.27cm were removed from the sample at different positions parallel to fiber orientation (longitudinal axis of the myofibres) and sheared as described by Honikel (1998). Shear force determinations were conducted on a texture analyzer LF plus (LLOYD Instruments) equipped with a Warner-Bratzler shear force head vertical to the fiber direction. The Warner-Bratzler single blade was used. The shear velocity was 200 mm/min. Each value was an average of at least 5 measurements.

Statistical analysis

The data collected on the carcass traits and meat technological quality were analyzed using the software SAS (Statistical Analysis System, 2006). The general linear model procedure of SAS was used for the analysis of variance. Means were compared pairwise by the Student t test. Comparisons between the parameters of the technological meat quality were also made between the 3 lots by type of muscle (thigh and breast). The threshold of significance used herein is 5%. The F test was used to determine the significance of effect of feed withdrawal duration on the carcass traits and meat technological quality.

RESULTS

Variation of carcass traits according to the feed withdrawal periods

The carcass traits of chicken of South ecotype of Benin are given by feed withdrawal periods in table 1. With the exception of breast weight, heart weight, spleen weight and the carcass yields measured at 1 hour and 24 hours post mortem, the other carcass traits did not vary significantly according to the length of the feed withdrawal (P > 0.05). Indeed, the breast weight, the heart weight, the spleen weight, the breast percentage and the carcass yields at 1 and 24 hours post-mortem was the highest (P <0.05) in chickens that had undergone 12 hours of feed withdrawal.

Table 1. Variation of carcass traits according to the feed withdrawal periods

Variables	Feed withdrawal periods (hours)			ANOVA
	0	12	24	
	Mean ±S E	Mean ± SE	Mean ± SE	
Live weight (g)	870±33.26^{a}	846.87±33.26^{a}	816.5±33.26^{a}	NS
Hot carcass weight (g)	624.82±22.78^{a}	661.02±22.78^{a}	625.99±22.78^{a}	NS
Cold carcass weight (g)	614.44±21.59^{a}	648.68±21.59^{a}	618.56±21.59^{a}	NS
Breast weight (g)	116.12±4.77^{ac}	126.93±4.77^{c}	109.25±4.77b^{c}	*
Thigh-drumstick weight (g)	171.25±7.09^{a}	177.42±7.09^{a}	171.62±7.09^{a}	NS
Neck weight (g)	38.12±1.62^{a}	39.75±1.62^{a}	40.25±1.62a	NS
Head weight (g)	30.75±1.23^{a}	32±1.23^{a}	31.75±1.23^{a}	NS
Wing weight (g)	84.75±3.02^{a}	90.62±3.02^{a}	90.87±3.02^{a}	NS
Tarsi weight (g)	29.87±1.9^{a}	25.25±1.9^{a}	27.5±1.9^{a}	NS
Back weight (g)	96.75±4.86^{a}	105.32±4.86^{a}	105.25±4.86^{a}	NS
Gizzard weight (g)	24.12±2.29^{a}	24.87±2.29^{a}	23.62±2.29^{a}	NS
Liver weight (g)	17.5±1.06^{a}	18.05±1.06^{a}	14.62±1.06^{a}	NS
Heart weight (g)	3.5±0.37^{ac}	5.39±0.37^{b}	2.75±0.37^{c}	***
Spleen weight (g)	1.69±0.37^{ac}	3.06±0.37^{b}	1.21±0.4^{c}	**
Carcass yield at 1 hour PM (%)	71.96±1.25^{a}	78.11±1.25^{b}	76.91±1.25^{b}	**
Carcass yield at 24 hours PM (%)	70.79±1.1^{a}	76.67±1.1^{b}	75.97±1.1^{b}	**
Breast percentage (%)	18.86±0.49^{ab}	19.610.49±^{a}	17.67±0.49^{b}	*
Thigh-drumstick percentage (%)	27.89±0.48^{a}	27.32±0.48^{a}	27.71±0.48^{a}	NS
Neck percentage (%)	6.21±0.2^{a}	6.12±0.2^{a}	6.51±0.2^{a}	NS
Head percentage (%)	5.02±0.19^{a}	4.95±0.19^{a}	5.15±0.19^{a}	NS
Wing percentage (%)	13.84±0.32^{a}	13.99±0.32^{a}	14.7±0.32^{a}	NS
Tarsi percentage (%)	4.87±0.29^{a}	3.9±0.29^{a}	4.5±0.29^{a}	NS
Back percentage (%)	15.7±0.37^{a}	16.2±0.37^{a}	16.97±0.37^{a}	NS
Gizzard percentage (%)	3.89±0.28^{a}	3.82±0.28^{a}	3.81±0.28^{a}	NS

*: p<0.05 ; **: p<0.01 ; ***: p<0.001; NS: Non Significant; ANOVA: Analysis of Variance; SE: Standard Error; The means between the classes of the same line followed by different letters differ significantly at the threshold of 5%.

Variation of technological quality

The technological meat quality properties varied depending on the length of feed withdrawal (Tables 2, and 3). In breast muscle, the pH recorded at 1 hour (pH1), 8 hours (pH 8), 16 hours (pH16) and 20 hours post-mortem (pH20) in chickens that hadn't undergone any feed withdrawal were higher than those measured in chickens submitted to 12 hours and 24 hours of feed withdrawal (P <0.05). In thigh muscle, only the pH recorded at 24 hours post-mortem (PH24) varied significantly according to the time of feed withdrawal with the lowest value recorded in chickens that had not undergone any feed withdrawal while the highest value was recorded for feed withdrawal of 24 hours (P <0.05). Similarly, the drip losses, the cooking losses and the water holding capacity did not vary according to the length of the feed withdrawal (P >0.05).

In the breast meat, the different values of the luminance (L*) and redness (a*) measured at 1 hour, 8 hours, and 24 hours post mortem did not vary significantly according to the length of the feed withdrawal (P >0.05). Nevertheless, the luminance of the breast meat recorded at 16 hours post mortem increased with the duration of FW (P <0.05) while the redness (a*) decreased significantly with the length of feed withdrawal (P <0.05). Furthermore, the yellowness (b*) recorded at 1 hour, and 8 hours post mortem decreased with the duration of FW with the highest value recorded in chickens that had not undergone any feed withdrawal (P <0.05).

In thigh meat, the different values of the luminance measured at 1 hour, 8 hours, 16 hours and 24 hours post mortem were not affected by the feed withdrawal (P > 0.05). Similarly, except for the redness (a*) measured at 16 hours post mortem which decreased significantly with the duration of the feed withdrawal, the different a* values measured 1 hour, 8 hours, and 24 hours post mortem didn't vary according to the length of feed withdrawal (P > 0.05). Moreover, the yellowness values found at 8 hours, 16 hours and 24 hours post mortem remained constant regardless of the length of the FW (P>0.05).

Correlations between carcass traits and offal components

The relationships between carcass traits and offal components of south chicken are given by feed withdrawal length in tables 4 and 5. Table 4 presents the correlations between carcass traits and offal components of south chicken that hadn't undergone any feed withdrawal. Table 5 presents under diagonal the correlations between carcass traits and offal components of south chicken that had undergone 12 hours of feed withdrawal and on top of the diagonal those of south chicken that had undergone 24 hours of feed withdrawal.

The live weight of chickens slaughtered without any feed withdrawal was highly and positively correlated with the hot carcass weight and the cold carcass weight (0.91 ≤ r ≤ 0.93; P <0.001) but weakly and positively associated to the breast weight and thigh-drumstick weight (0.75 ≤ r ≤ 0.76; P <0.05). No significant correlations were found between the carcass yields and the carcass traits and technological quality parameters (pH, L*, a*, b*, drip loss, cooking loss and water holding capacity. However, the wing weight of chickens slaughtered without any feed withdrawal was negatively and moderately correlated with pH 24 (P < 0.01, r = -0.91). Moreover, cooking loss of thigh were strongly and positively correlated (P < 0.001, r = 0.98) with the water holding capacity (WHC) of the thigh. Similarly, cooking loss in the breast was moderately and positively correlated (P < 0.01, r = 0.92) with the WHC of the breast.

In broilers slaughtered after 12 hours of feed withdrawal, the analysis of the correlation matrix also shows associations between different parameters of the carcass composition and technological meat quality. The live weight of chickens that had undergone 12 hours of feed withdrawal was strongly and positively correlated with the hot carcass weight, the cold carcass weight and thigh-drumstick weight (P <0.001, r ≤ 0.94 ≤ 0.96) but moderately and positively associated with the breast weight, wing weight and thigh-drumstick weight. As found for broiler slaughtered without any feed withdrawal, no significant correlations were found between the carcass traits and technological quality parameters (pH, L*, a*, b*, drip loss, cooking loss and water holding capacity) except the positive correlation between the carcass yield recorded at 24 hours post-mortem and the pH 24 (P < 0.05, r = 0.78). However, cooking loss of thigh were strongly and positively correlated (P < 0.001, r = 0.99) with the water holding capacity of the thigh. Similarly, cooking loss in the breast was highly and positively correlated (P < 0.001, r = 0.99) with the water holding capacity of the breast.

In broilers slaughtered after 24 hours of feed withdrawal, the degree of linkage between the carcass traits and technological quality parameters (pH, L*, a*, b*, drip loss, cooking loss and water holding capacity) decreased compared to the chickens slaughtered without feed withdrawal and those slaughtered after 12 hours of FW. Indeed, the live weight of broilers that had undergone 24 hours of feed withdrawal was moderately and positively correlated with the thigh-drumstick weight (P <0.01, r = 0.9) but weakly associated to the hot carcass weight and the cold carcass weight (P <0.05, 0.82≤ r ≤ 0.85). No significant correlations were found between the carcass traits and technological quality parameters (pH, L*, a*, b*, drip loss, cooking loss and water holding capacity) except the correlation between the wing weight and the thigh drip loss (P < 0.05, r = -0.79) and breast cooking loss (P < 0.05, r = 0.78). However, cooking loss of thigh were strongly and positively correlated (P < 0.001, r = 0.96) with the water holding capacity of the thigh. Similarly, cooking loss in the breast was highly and positively correlated (P < 0.001, r = 0.99) with the water holding capacity of the breast.

Table 2. Variation of meat pH, drip loss, cooking loss, water holding capacity and shear force according to the feed withdrawal periods

Variables	Muscle	Feed withdrawal periods 0	12	24	ANOVA
		Mean ± SE	Mean ± SE	Mean ± SE	
pH at 1 hour post mortem	Breast	5.74±0.08[a]	5.71±0.08[a]	5.43±0.08[b]	*
	Thigh	5.93±0.07[a]	5.96±0.07[a]	5.77±0.07[a]	NS
pH at 4 hours post mortem	Breast	5.35±0.05[a]	5.52±0.05[b]	5.29±0.05[c]	**
	Thigh	5.55±0.08[a]	5.76±0.08[a]	5.68±0.08[a]	NS
pH at 8 hours post mortem	Breast	5.41±0.04[a]	5.37±0.04[a]	5.25±0.04[b]	*
	Thigh	5.62±0.04[a]	5.59±0.04[a]	5.58±0.04[a]	NS
pH at 12 hours post mortem	Breast	5.33±0.03[ab]	5.37±0.03[a]	5.26±0.03[b]	*
	Thigh	5.61±0.03[a]	5.62±0.03[a]	5.64±0.03[a]	NS
pH at 16 hours post mortem	Breast	5.4±0.03[a]	5.37±0.03[ab]	5.28±0.03[b]	*
	Thigh	5.75±0.05[a]	5.63±0.05[a]	5.67±0.05[a]	NS
pH at 20 hours post mortem	Breast	5.39±0.03[a]	5.38±0.03[a]	5.3±0.03[b]	*
	Thigh	5.67±0.04[a]	5.58±0.04[a]	5.64±0.04[a]	NS
pH at 24 hours post mortem	Breast	5.42±0.03[a]	5.34±0.03[a]	5.38±0.03[a]	NS
	Thigh	5.64±0.04[a]	5.63±0.04[a]	5.81±0.04[b]	*
Drip loss (%)	Breast	3.06±0.26[a]	4.29±0.26[b]	4.84±0.26[b]	***
	Thigh	2.65±0.19[a]	2.82±0.19a	3.27±0.19[a]	NS
Cooking loss (%)	Breast	30.21±1.47[a]	31.31±1.47[a]	26.19±1.47[b]	*
	Thigh	31.7±1.13[a]	32.06±1.13[a]	30.59±1.13[a]	NS
Water Holding Capacity (%)	Breast	33.27±1.47[a]	35.6±1.47[a]	31.01±1.47[a]	NS
	Thigh	34.35±1.16[a]	34.92±1.16[a]	33.86±1.16[a]	NS
Shear Force (N)	Breast	39.35±2.21[a]	38.65±2.21[a]	38.45±2.21[a]	NS
	Thigh	50.21±1.18[a]	49.25±1.18[a]	49.48±1.18[a]	NS

*: p<0.05; **: p<0.01; ***: p<0.001; NS: Non Significant; ANOVA: Analysis of Variance; SE : Standard Error; The means between the classes of the same line followed by different letters differ significantly with the threshold of 5%.

Table 3. Variation of meat color (L*, a*, b*; CIE Lab) according to the feed withdrawal periods

Variables		Feed withdrawal periods (hours) 0	12	24	ANOVA
		Mean ±S E	Mean ± SE	Mean ± SE	
Thigh Color at 1 hour PM	L*	40.79±1.21[a]	39.31±1.21[a]	43.1±1.21[a]	NS
	a*	12.77±0.88[a]	12.86±0.88[a]	11.26±0.88[a]	NS
	b*	5.66±0.63[a]	3.04±0.63[b]	6.79±0.63[a]	**
Breast Color at 1 hour PM	L*	58.25±2.55[a]	54.87±2.55[a]	60.33±2.55[a]	NS
	a*	1.51±0.62[a]	1.68±0.62[a]	2.31±0.62[a]	NS
	b*	4±0.95[a]	3.16±0.95[c]	2.31±0.95[bc]	*
Thigh Color at 8 hours PM	L*	38.68±1.27[a]	40.75±1.27[a]	37.81±1.27[a]	NS
	a*	11.72±0.79[a]	11.51±0.79[a]	13.18±0.79[a]	NS
	b*	4.86±0.85[a]	4.45±0.85[a]	4.01±0.85[a]	NS
Breast Color at 8 hours PM	L*	54.59±2.06[a]	53.93±2.06[a]	52.28±2.06[a]	NS
	a*	3.65±0.6[a]	2.51±0.6[a]	3.06±0.6[a]	NS
	b*	8.6±0.71[a]	4.15±0.71[b]	8.23±0.71[a]	***
Thigh Color at 8 hours PM	L*	38.19±1.69[a]	40.04±1.69[a]	41.37±1.69[a]	NS
	a*	12.38±0.79[a]	10.99±0.79[a]	13.81±0.79[a]	NS
	b*	5.81±0.62[a]	4.57±0.62[a]	6.15±0.62[a]	NS
Breast Color at 8 hours PM	L*	51.22±2.77[a]	53.65±2.77[a]	53.96±2.77[a]	NS
	a*	3.06±0.64[a]	2.23±0.64[a]	3.35±0.64[a]	NS
	b*	7.36±0.81[ab]	4.98±0.81[a]	8.19±0.81[b]	*
Thigh Color at 16 hours PM	L*	38.01±1.81[a]	40.87±1.81[a]	40.59±1.81[a]	NS
	a*	12.47±0.79[ac]	9.54±0.79[b]	11.87±0.79[c]	*
	b*	6.18±0.68[a]	5.86±0.68[a]	7.65±0.68[a]	NS
Breast Color at 16 hours PM	L*	51.14±2.32[ac]	58.09±2.32[bc]	53.38±2.32[c]	*
	a*	3.8±0.64[a]	2.39±0.64[b]	3.52±0.64[a]	*
	b*	8.01±0.75[c]	6.16±0.75[a]	9.77±0.75[b]	*
Thigh Color at 24 hours PM	L*	41.42±2.16[a]	43.49±2.16[a]	41.7±2.16[a]	NS
	a*	11.86±0.99[a]	10.72±0.99[a]	10.06±0.99[a]	NS
	b*	4.54±0.79[a]	5.49±0.79[a]	7.17±0.79[a]	NS
Breast Color at 24 hours PM	L*	50.34±3.79[a]	50.29±3.79[a]	45.7±3.79[a]	NS
	a*	3.8±0.7[a]	2.8±0.7[a]	3.82±0.7[a]	NS
	b*	6.83±0.89[a]	5.4±0.89[a]	7.7±0.89[a]	NS

*: p<0.05; **: p<0.01; ***: p<0.001; NS: Non Significant; ANOVA: Analysis of Variance; SE: Standard Error; L*: Luminance, a*: red index, b*: Yellow index; CIE Lab: Laboratory of the International Centre of illumination. The means between the classes of the same line followed by different letters differ significantly with the threshold of 5%.

Table 4. Correlations between carcass traits and technological quality of meat of indigenous broilers slaughtered without feed withdrawal

Variables	LW	HCW	CCW	BW	TDW	WW	CY24	L*TD24	a*TD24	b*TD24	L*BR24	a*BR24	b*BR24	pH24BR	pH24TD	DLTD	DLBR	CLTD	CLBR	WHCTD	WHCBR
LW	1																				
HCW	0.91**	1																			
CCW	0.93***	0.99***	1																		
BW	0.76*	0.87**	0.86**	1																	
TDW	0.75*	0.82*	0.83*	0.48^{NS}	1																
WW	0.51^{NS}	0.56^{NS}	0.57^{NS}	0.3^{NS}	0.74*	1															
CY24	-0.54^{NS}	-0.15^{NS}	-0.19^{NS}	-0.55^{NS}	-0.11^{NS}	-0.04^{NS}	1														
L*TD24	0.48^{NS}	0.59^{NS}	0.59^{NS}	0.61^{NS}	0.35^{NS}	0.55^{NS}	0.09^{NS}	1													
a*TD24	-0.36^{NS}	-0.44^{NS}	-0.44^{NS}	-0.61^{NS}	-0.15^{NS}	-0.38^{NS}	-0.02^{NS}	-0.74*	1												
b*TD24	-0.43^{NS}	-0.17^{NS}	-0.19^{NS}	0.005^{NS}	-0.62^{NS}	0.04^{NS}	0.68^{NS}	0.06^{NS}	-0.15^{NS}	1											
L*BR24	-0.33^{NS}	-0.61^{NS}	-0.58^{NS}	-0.68^{NS}	-0.42^{NS}	-0.51^{NS}	-0.45^{NS}	-0.53^{NS}	0.17^{NS}	0.47^{NS}	1										
a*BR24	-0.21^{NS}	-0.17^{NS}	-0.16^{NS}	-0.32^{NS}	0.27^{NS}	0.60^{NS}	0.19^{NS}	0.001^{NS}	0.22^{NS}	0.55^{NS}	-0.13^{NS}	1									
b*BR24	-0.66^{NS}	-0.52^{NS}	-0.53^{NS}	-0.46^{NS}	-0.46^{NS}	-0.28^{NS}	0.54^{NS}	0.19^{NS}	-0.26^{NS}	0.31^{NS}	0.25^{NS}	0.06^{NS}	1								
pH24BR	-0.7^{NS}	-0.63^{NS}	-0.66^{NS}	-0.45^{NS}	-0.72*	-0.91**	0.35^{NS}	-0.51^{NS}	0.17^{NS}	0.08^{NS}	0.39^{NS}	-0.49^{NS}	0.51^{NS}	1							
pH24TD	-0.02^{NS}	-0.09^{NS}	-0.08^{NS}	-0.26^{NS}	0.005^{NS}	-0.32^{NS}	-0.14^{NS}	0.003^{NS}	-0.34^{NS}	-0.38^{NS}	0.67^{NS}	-0.32^{NS}	0.48^{NS}	0.31^{NS}	1						
DLTD	-0.46^{NS}	-0.28^{NS}	-0.31^{NS}	-0.15^{NS}	-0.39^{NS}	-0.47^{NS}	0.54^{NS}	-0.39^{NS}	0.28^{NS}	-0.05^{NS}	0.05^{NS}	-0.38^{NS}	0.20^{NS}	0.60^{NS}	0.06^{NS}	1					
DLBR	-0.004^{NS}	0.11^{NS}	0.09^{NS}	0.43^{NS}	-0.21^{NS}	-0.49^{NS}	0.18^{NS}	0.13^{NS}	-0.55^{NS}	0.47^{NS}	-0.25^{NS}	-0.37^{NS}	-0.55^{NS}	0.17^{NS}	0.37^{NS}	-0.07^{NS}	1				
CLTD	-0.14^{NS}	-0.19^{NS}	-0.17^{NS}	-0.19^{NS}	-0.05^{NS}	0.25^{NS}	-0.01^{NS}	0.17^{NS}	-0.23^{NS}	-0.01^{NS}	0.32^{NS}	0.40^{NS}	0.31^{NS}	-0.30^{NS}	0.27^{NS}	0.07^{NS}	-0.05^{NS}	1			
CLBR	-0.13^{NS}	-0.32^{NS}	-0.28^{NS}	-0.50^{NS}	0.11^{NS}	-0.14^{NS}	-0.34^{NS}	-0.50^{NS}	0.12^{NS}	0.04^{NS}	0.68^{NS}	0.37^{NS}	0.01^{NS}	0.02^{NS}	0.46^{NS}	-0.32^{NS}	-0.11^{NS}	0.24^{NS}	1		
WHCTD	-0.24^{NS}	-0.24^{NS}	-0.23^{NS}	-0.21^{NS}	-0.14^{NS}	0.14^{NS}	0.13^{NS}	0.09^{NS}	-0.18^{NS}	-0.02^{NS}	0.32^{NS}	0.30^{NS}	0.34^{NS}	-0.16^{NS}	0.27^{NS}	0.27^{NS}	-0.45^{NS}	0.98***	0.15^{NS}	1	
WHCBR	-0.13^{NS}	-0.27^{NS}	-0.24^{NS}	-0.31^{NS}	0.01^{NS}	-0.34^{NS}	-0.25^{NS}	-0.45^{NS}	-0.08^{NS}	0.23^{NS}	0.55^{NS}	0.21^{NS}	0.03^{NS}	0.17^{NS}	0.41^{NS}	-0.33^{NS}	0.29^{NS}	0.02^{NS}	0.92**	-0.05^{NS}	1

***** : p<0.05; **** :** p<0.01; ***** :** p<0.001; NS: Non Significant ; LW: Live Weight; HCW: Hot Carcass Weight; CCW: Cold Carcass Weight; BW: Breast Weight; TDW: Thigh-drumstick Weight; WW: Wing Weight; CY24: Carcass Yield at 24 hours PM; L*TD24: Luminance of Thigh-drumstick at 24 hours PM; a*TD24: Redness of Thigh-drumstick at 24 hours PM; b*TD24: Yellowness of Thigh-drumstick at 24 hours PM; L*BR24: Luminance of breast at 24 hours PM; a*BR24: Redness of breast at 24 hours PM; b*BR24: Yellowness of breast at 24 hours PM; pH24BR: pH of breast at 24 hours PM; pH24TD: pH of Thigh-drumstick at 24 hours PM; DLTD: Drip loss of Thigh-drumstick; DLBR: Drip loss of breast; CLTD: Cooking loss of Thigh-drumstick; CLBR: Cooking loss of Breast; WHCTD: Water Holding Capacity of Thigh-drumstick; WHCBR: Water Holding Capacity of Breast.

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Table 5. Correlations between carcass traits and technological quality of meat of indigenous broilers slaughtered after 12 hours (below diagonal) and 24 hours (above diagonal) of feed withdrawal

Variables	LW	HCW	CCW	BW	TDW	WW	CY24	L*TD24	a*TD24	b*TD24	L*BR24	a*BR24	b*BR24	pH24BR	pH24TD	DLTD	DLBR	CLTD	CLBR	WHCTD	WHCBR
LW	1	0.82*	0.85*	0.7^{NS}	0.9**	0.47^{NS}	-0.33^{NS}	0.67^{NS}	0.42^{NS}	0.50^{NS}	-0.06^{NS}	0.15^{NS}	-0.66^{NS}	-0.61^{NS}	-0.11^{NS}	-0.53^{NS}	0.51^{NS}	0.51^{NS}	0.52^{NS}	0.33^{NS}	0.57^{NS}
HCW	0.94***	1	0.99***	0.4^{NS}	0.98***	0.8*	0.26^{NS}	0.69^{NS}	0.33^{NS}	0.53^{NS}	-0.42^{NS}	0.41^{NS}	-0.47^{NS}	-0.61^{NS}	-0.22^{NS}	-0.60^{NS}	-0.00003^{NS}	0.43^{NS}	0.56^{NS}	0.24^{NS}	0.56^{NS}
CCW	0.96***	0.99***	1	0.44^{NS}	0.99***	0.8*	0.21^{NS}	0.72^{NS}	0.29^{NS}	0.50^{NS}	-0.37^{NS}	0.43^{NS}	-0.53^{NS}	-0.62^{NS}	-0.20^{NS}	-0.64^{NS}	0.04^{NS}	0.44^{NS}	0.62^{NS}	0.25^{NS}	0.62^{NS}
BW	0.85**	0.78*	0.81*	1	0.45^{NS}	0.11^{NS}	-0.49^{NS}	0.77*	0.03^{NS}	0.06^{NS}	0.01^{NS}	-0.18^{NS}	-0.91^{NS}	0.07^{NS}	0.55^{NS}	-0.51^{NS}	0.62^{NS}	-0.09^{NS}	0.40^{NS}	-0.24^{NS}	0.46^{NS}
TDW	0.85**	0.94***	0.93***	0.61^{NS}	1	0.76*	0.11^{NS}	0.69^{NS}	0.34^{NS}	0.53^{NS}	-0.28^{NS}	0.42^{NS}	-0.53^{NS}	-0.67^{NS}	-0.24^{NS}	-0.61^{NS}	0.14^{NS}	0.51^{NS}	0.61^{NS}	0.31^{NS}	0.62^{NS}
WW	0.92**	0.91**	0.93***	0.93***	0.79*	1	0.59^{NS}	0.55^{NS}	-0.03^{NS}	0.01^{NS}	-0.35^{NS}	0.72^{NS}	-0.37^{NS}	-0.49^{NS}	-0.02^{NS}	-0.79*	-0.36^{NS}	0.12^{NS}	0.78*	-0.09^{NS}	0.74^{NS}
CY24	-0.31^{NS}	0.02^{NS}	-0.04^{NS}	-0.28^{NS}	0.13^{NS}	-0.15^{NS}	1	0.07^{NS}	-0.30^{NS}	-0.06^{NS}	-0.53^{NS}	0.49^{NS}	0.24^{NS}	0.06^{NS}	-0.10^{NS}	-0.18^{NS}	-0.87*	-0.20^{NS}	0.16^{NS}	-0.22^{NS}	0.07^{NS}
L*TD24	0.55^{NS}	0.67^{NS}	0.66^{NS}	0.24^{NS}	0.75*	0.49^{NS}	0.22^{NS}	1	-0.23^{NS}	0.13^{NS}	-0.33^{NS}	0.15^{NS}	-0.87**	-0.02^{NS}	0.33^{NS}	-0.75^{NS}	0.11^{NS}	0.06^{NS}	0.67^{NS}	-0.14^{NS}	0.67^{NS}
a*TD24	-0.39^{NS}	-0.22^{NS}	-0.25^{NS}	-0.22^{NS}	-0.35^{NS}	-0.29^{NS}	0.50^{NS}	0.01^{NS}	1	0.57^{NS}	-0.22^{NS}	-0.28^{NS}	0.27^{NS}	-0.67^{NS}	-0.46^{NS}	0.21^{NS}	0.24^{NS}	0.43^{NS}	-0.36^{NS}	0.45^{NS}	-0.33^{NS}
b*TD24	0.29^{NS}	0.24^{NS}	0.24^{NS}	0.18^{NS}	0.39^{NS}	0.16^{NS}	-0.16^{NS}	0.06^{NS}	-0.70^{NS}	1	-0.22^{NS}	-0.08^{NS}	0.07^{NS}	-0.43^{NS}	-0.67^{NS}	0.32^{NS}	0.22^{NS}	0.65^{NS}	-0.26^{NS}	0.70^{NS}	-0.24^{NS}
L*BR24	-0.22^{NS}	-0.30^{NS}	-0.30^{NS}	-0.43^{NS}	-0.21^{NS}	-0.29^{NS}	-0.20^{NS}	-0.33^{NS}	-0.42^{NS}	-0.14^{NS}	1	0.28^{NS}	-0.09^{NS}	0.03^{NS}	0.12^{NS}	0.25^{NS}	0.65^{NS}	-0.07^{NS}	0.09^{NS}	-0.01^{NS}	0.16^{NS}
a*BR24	-0.26^{NS}	-0.11^{NS}	-0.12^{NS}	-0.07^{NS}	-0.001^{NS}	-0.14^{NS}	0.51^{NS}	0.08^{NS}	0.16^{NS}	0.45^{NS}	-0.67^{NS}	1	-0.18^{NS}	-0.36^{NS}	-0.07^{NS}	-0.40^{NS}	-0.14^{NS}	0.01^{NS}	0.68^{NS}	-0.09^{NS}	0.66^{NS}
b*BR24	0.22^{NS}	0.28^{NS}	0.27^{NS}	0.36^{NS}	0.28^{NS}	0.34^{NS}	0.16^{NS}	-0.26^{NS}	-0.41^{NS}	0.6^{NS}	-0.04^{NS}	0.35^{NS}	1	-0.09^{NS}	-0.58^{NS}	0.70^{NS}	-0.47^{NS}	0.13^{NS}	-0.69^{NS}	0.33^{NS}	-0.73^{NS}
pH24BR	-0.37^{NS}	-0.11^{NS}	-0.15^{NS}	-0.40^{NS}	0.03^{NS}	-0.35^{NS}	0.78*	0.35^{NS}	0.58^{NS}	-0.03^{NS}	-0.51^{NS}	0.67^{NS}	-0.21^{NS}	1	0.63^{NS}	0.24^{NS}	-0.11^{NS}	-0.72^{NS}	-0.30^{NS}	-0.61^{NS}	-0.31^{NS}
pH24TD	0.11^{NS}	-0.04^{NS}	-0.01^{NS}	0.18^{NS}	-0.11^{NS}	-0.06^{NS}	-0.40^{NS}	-0.44^{NS}	-0.06^{NS}	0.002^{NS}	0.11^{NS}	-0.38^{NS}	-0.13^{NS}	-0.26^{NS}	1	-0.37^{NS}	0.17^{NS}	-0.85^{NS}	0.24^{NS}	-0.92**	0.26^{NS}
DLTD	-0.25^{NS}	-0.02^{NS}	-0.06^{NS}	-0.42^{NS}	0.13^{NS}	-0.29^{NS}	0.62^{NS}	0.59^{NS}	0.44^{NS}	0.02^{NS}	-0.45^{NS}	0.58^{NS}	-0.32^{NS}	0.91**	-0.48^{NS}	1	0.11^{NS}	0.02^{NS}	-0.90**	0.28^{NS}	-0.88**
DLBR	-0.05^{NS}	-0.14^{NS}	-0.11^{NS}	0.04^{NS}	-0.23^{NS}	-0.08^{NS}	-0.27^{NS}	0.27^{NS}	0.40^{NS}	-0.19^{NS}	-0.64^{NS}	0.24^{NS}	-0.60^{NS}	0.25^{NS}	-0.12^{NS}	0.38^{NS}	1	0.12^{NS}	0.03^{NS}	0.12^{NS}	0.13^{NS}
CLTD	-0.42^{NS}	-0.55^{NS}	-0.54^{NS}	-0.55^{NS}	-0.54^{NS}	-0.64^{NS}	-0.35^{NS}	-0.20^{NS}	0.24^{NS}	-0.39^{NS}	0.29^{NS}	-0.43^{NS}	-0.82*	0.03^{NS}	0.47^{NS}	0.06^{NS}	0.35^{NS}	1	0.08^{NS}	0.96***	0.09^{NS}
CLBR	0.31^{NS}	0.33^{NS}	0.34^{NS}	0.13^{NS}	0.53^{NS}	0.27^{NS}	0.04^{NS}	0.35^{NS}	-0.52^{NS}	0.26^{NS}	0.25^{NS}	-0.11^{NS}	-0.06^{NS}	0.01^{NS}	0.23^{NS}	-0.001^{NS}	-0.34^{NS}	-0.02^{NS}	1	-0.16^{NS}	0.99***
WHCTD	-0.45^{NS}	-0.55^{NS}	-0.54^{NS}	-0.60^{NS}	-0.52^{NS}	-0.66^{NS}	-0.27^{NS}	-0.14^{NS}	0.28^{NS}	-0.38^{NS}	0.24^{NS}	-0.36^{NS}	-0.84**	0.13^{NS}	0.41^{NS}	0.17^{NS}	0.38^{NS}	0.99***	-0.02^{NS}	1	-0.15^{NS}
WHCBR	0.32^{NS}	0.32^{NS}	0.33^{NS}	0.14^{NS}	0.22^{NS}	0.27^{NS}	0.01^{NS}	0.40^{NS}	-0.49^{NS}	0.25^{NS}	0.18^{NS}	-0.08^{NS}	-0.14^{NS}	0.05^{NS}	0.22^{NS}	0.05^{NS}	-0.22^{NS}	0.02^{NS}	0.99***	0.02^{NS}	1

***** : p<0.05; ****:** p<0.01 ; *****:** p<0.001; NS: Non Significant; LW: Live Weight; HCW: Hot Carcass Weight; CCW : Cold Carcass Weight; BW: Breast Weight; TDW : Thigh-drumstick Weight; WW: Wing Weight; CY24: Carcass Yield at 24 hours PM; L*TD24: Luminance of Thigh-drumstick at 24 hours PM; a*TD24: Redness of Thigh-drumstick at 24 hours PM ; b*TD24: Yellowness of Thigh-drumstick at 24 hours PM; L*BR24: Luminance of breast at 24 hours PM; a*BR24: Redness of breast at 24 hours PM; b*BR24: Yellowness of breast at 24 hours PM; pH24BR: pH of breast at 24 hours PM; pH24TD: pH of Thigh-drumstick at 24 hours PM; DLTD: Drip loss of Thigh-drumstick; DLBR: Drip loss of breast; CLTD: Cooking loss of Thigh-drumstick; CLBR: Cooking loss of Breast; WHCTD: Water Holding Capacity of Thigh-drumstick; WHCBR: Water Holding Capacity of Breast.

DISCUSSION

Variability of the carcass traits according to the feed withdrawal periods

The weight of the different carcass cuts did not vary significantly according to the length of feed withdrawal. These observations are comparable to the findings of Contreras-Castillo et al. (2007). The similarity observed between the pre-slaughter live weights of the birds at the beginning of the experiment shows that the three experimental groups are statistically homogeneous. The average slaughter live weight of the south local chicken recorded herein at 6 months old (845 ± 26.8 grams) is consistent with the values reported by Tougan et al. (2013a) for the same ecotype of chicken.

In the current study, as carcass yields, the breast weight, the breast percentage, the heart weight, the spleen weight were affected by the duration of the water diet. These results are consistent with those reported by Contreras-Castillo et al. (2007) and Eman (2014). According Rosenvold et al. (2001), carcasses yields in chicken increased with the extension of the feed withdrawal duration. This important change in carcass yield of broilers depending on the feed withdrawal length could be due to the fact that the changes in digestive tract content is most important in birds that had undergone a short feed withdrawal time (Lyon et al.,2004). As found by Petracci et al. (2010), length of fasting is important because it affects carcass yield (live weight losses), carcass contamination and product safety (pathogenic and spoilage bacteria) and quality (ultimate muscle pH). The recommended length of time without feed for birds before slaughtering is between 8 and 12 hours, as this allows the majority of the flock to evacuate remaining fecal matter, and minimizes any negative effects on body weight and carcass (Bilgili, 2002 and Northcutt et al., 2003). Weight loss of the birds during the period between FW and processing is called as live shrink or shrinkage (Bilgili, 2002). After broilers have been without feed for more than 6 hours, they begin to draw moisture and nutrients from their own body tissues and this weight loss may then affect edible yield (Northcutt, 2010). Birds lose 0.18% of body weight per hour during the withdrawal period, to a maximum of 0.42% (Northcutt, 2001; Nijdam et al., 2005 and Petracci et al., 2010). In the first 4-6 hours, weight loss in birds is mainly due to gastric emptying, so carcass yield is not negatively influenced (Petracci et al.,2010). After 6 hours, there are losses in moisture and nutrients from body tissues, which can affect carcass yield (Petracci et al., 2010). Pripwai et al. (2014) had recorded a carcass yield of 70% in Thai indigenous chickens at 14 weeks of age, after fasting for 12 hours before slaughter.

Overall, the results of carcass traits parameters found in this study at 28 weeks old are below those reported by Choo et al. (2014), Cassandro et al. (2015), Liu et al. (2015), Raphulu et al. (2015) and Padhi et al. (2016).

This variability among results can be due to several factors such as genotype, age, sex, production system, feeding, feed and water withdrawal, transport, slaughter process, post mortem aging time (Tougan et al., 2013a). These factors can promote a significant difference in carcass traits and parameters of technological quality in chicken meat (Thobela et al., 2015 and Padhi et al., 2016).

Variation of technological quality of meat according to the feed withdrawal periods

The variation observed between pH values according to the feed withdrawal period herein confirms the findings of Contreras-Castillo et al. (2007) and Eman (2014). The different pH values recorded herein varying between 5 and 6 are comparable to those reported in the literature (Hasan, 2012; Tougan et al., 2013b and 2013c). The highest pH values found in meat after 24 hours of feed withdrawal may be due to the starvation and dehydration that can lead to depletion of muscle glycogen and reduction in weight (Adzitey, 2011).

The thigh and breast meat color (CIELAB; L * a * b *) were also affected by the length of the liquid diet. This variation of the color parameters of the meat according to the feed withdrawal periods is in agreement with the results reported by Rosenvold et al. (2001) and Eman (2014). Lyon et al. (2002) have also shown that feed withdrawal increased the luminance of meat in chicken (from 46.1 to 48.9) and the yellowness (from 2.8 to 3.7) but reduced the redness (from 4.1 to 3.1).

Correlations between carcass traits and technological quality of meat

Overall, the live weight of chickens slaughtered without any feed withdrawal was highly and positively correlated with the hot carcass weight and the cold carcass weight but weakly and positively associated to the breast weight and thigh-drumstick weight, while in broilers slaughtered after 24 hours of feed withdrawal, the live weight was moderately and positively correlated with the thigh-drumstick weight but weakly associated to the hot carcass weight and the cold carcass weight. This difference in the relationships between the carcass traits and quality according to the feed withdrawal period could be due to the variation of digestive tract contents at slaughtering time. According to Tougan et al. (2013a) and Tougan et al. (2013b), the slaughter live weight in South chicken slaughtered after

12 hours of feed withdrawal is highly and positively correlated with the hot carcass weight, breast weight, thigh-drumstick weight, rest of carcass weight, tarsi weight, neck weight and head weight ($P<0.001$; $0.62 \leq r \leq 0.99$), moderately associated to the cold carcass yield and wing weight, weakly and positively associated to the gizzard weight ($P < 0.05$; $r = 0.44$), but negatively correlated with the carcass drip loss ($P<0.01$, $r= -0.51$). Moreover, according to these authors, the dry matter content of the meat is positively correlated with the index of redness (a *), the chromaticity (C *), the protein content and fat content but negatively associated the luminance among five types studied genetic. Furthermore, similar relationships to the current findings between carcass traits and meat technological quality properties are reported by Musa et al. (2006b) in chickens Anka and Rugao strains and Olawumi (2013) in chickens and Arbor Acre in Nigeria. Moreover, Ojedapo et al. (2008) showed strong phenotypic positive correlations between live weight and carcass weight (0.95), thigh weight (0.93) and breast weight (0.97) in broilers. Similar correlations were also obtained by Musa et al. (2006) and Chabault et al. (2012).

CONCLUSION

The present study carried out on the variability of carcass characteristics and technological meat quality of broilers of South ecotype of Benin according to the pre-slaughter feed withdrawal periods reveals that the weight loss decreases when feed withdrawal period increases confirming that increasing feed withdrawal times will result in higher carcass yield. The highest carcass yields can be obtained with a feed withdrawal of 12 hours. Technologically, luminance and the yellow index of the meat increases with longer feed withdrawal period while the index of red decreases. Furthermore, it is important to note that the breast was most affected by the variation of feed withdrawal periods compared to the thigh meat.

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Competing interests

The authors have no competing interests to declare.

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