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RESEARCH ARTICLE

INFLUENCE OF PRE-SLAUGHTER CAPTURE CHASE DURATION STRESS ON CARCASS AND MEAT QUALITY OF INDIGENOUS CHICKEN REARED UNDER TRADITIONAL SYSTEM IN BENIN.

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Abstract

The current study aims to evaluate the influence of the pre-slaughter capture chase duration stress on carcass and meat quality in local chicken of Benin. Sixty-four chickens of 6 to 7 months old divided into 4 flocks of 8 males and 8 females each reared under traditional system were used. Chickens of first group were not chased before slaughter. Whereas, chickens of the second, the third and the fourth groups were slaughtered respectively after 5 minutes, 10 minutes and 15 minutes of chase by 3 persons. Carcass and meat quality was evaluated. Carcass quality traits didn't vary according to the pre-slaughter capture chase stress. The two longer capture chase duration chickens had the lower breast pH at the first measure time. But it was higher in those chased during 15 minutes at 48 hours after slaughter. Control birds showed lower pH than the 5 minutes stressed one at 1 and at 12 hours. The thigh pH values were higher with the most chased chickens. However, drip loss at 24 hours after slaughter didn't vary. The breast lightness was higher in the most chased on the slaughter day. Meanwhile, the breast yellow index was higher with chickens of 15 minutes of chase. But no difference was found for the meat red index values of the four flocks. The meat flavor, juiciness, tenderness and global acceptance didn't vary according to the pre-slaughter capture chase stress. In sum, the sensory and technological meat qualities of local chickens decrease more with the capture chase duration stress.

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Introduction:-

Stress can be considered as the reaction of the organism or the biological response to stimuli that disturb its normal physiological equilibrium or homeostasis (Lara *et al*., 2013). This response results in the increasing of poultry plasma corticosterone concentration. According to Selye (1976), stress is a nonspecific response of the body to any demand whereas the stressor is an agent that produces stress at any time.

For animals destined to slaughter, the environmental conditions, the capture, the manipulations, the transportation, the feed withdrawal are some stress factors that can have consequences on the production (Lara *et al*., 2013), animal welfare (Voslarova *et al*., 2007) and on carcass and meat quality (Radu *et al*., 2012). But genetics and biotope can affect the extent of these consequences. Genetics can explain 40% to 50% of the variability of breast ultimate pH observed within a population (Le Bihan-Duval *et al*., 2001 and 2008; Chabault *et al*., 2012).

Researchers are already working on how to control carcass and meat quality changings due to pre-slaughter stress factors across America, Europe, Asia and North Africa (González *et al*., 2007; Zhang *et al*., 2014; Perai *et al*., 2014) where, the consequences of these factors on their genetic resources are already known. Meanwhile, the influence of local pre-slaughter stress conditions on indigenous chicken carcass and meat quality isn't fully investigated in West Africa in general and in Benin in particular. These chickens are often slaughtered after a capture chase of which stress has detrimental effects on the meat quality due to the divagation and the almost non-existence of habitat that characterize the traditional breeding system (Bonou, 2014). Ten minutes of pre-slaughter capture chase stress had negatively affected meat pH, lightness and its red index mostly those of the thigh. Meat was darker, redder with a lower acidity degree and then, could be favorable to microorganism proliferation (Bonou *et al.*, 2017). Or, a prior survey revealed that in the Atlantic region of Benin, local chickens are chased to be capture during 8 to 19 minutes in an open area, in a fence, or in a building or henhouse (Bonou, 2014). But the reaction of the meat quality of this animal resource to stress factors duration is less investigated. Thus, from which minor capture chase duration, meat and carcass quality attributes of these chickens are affected and what are the consequences when the duration flows? This work is to answer these questions by the assessment of the influence of pre-slaughter capture chase duration stress on carcass and meat quality of indigenous chicken reared under traditional system in Benin.

Materiels and Methods:-

Area of study:-

The study was carried out in the Laboratory of Animal Biotechnology and Meat Technology of the Department of Animal Production and Health of the Polytechnic School of Abomey-Calavi. The chickens used were produced under traditional breeding system in Abomey-Calavi. This area benefits from climatic conditions of subequatorial type characterized by two rainy seasons with an uneven spatial and temporal repartition of rainfall (the major, from April to July and the minor, from September to November). These seasons are separated by two dry seasons. Average rainfall is close to 1200 mm per year. The monthly average temperatures vary between 27°C and 31°C. The relative air humidity fluctuates between 65% from January to March and 97% from June to July.

Birds rearing and Sampling:-

Sixty-four (64) local chickens of six to seven months old produced from two (2) roosters and ten (10) hens all of South ecotype of Benin were used. These birds were reared under traditional breeding system where, they have a habitat for night housing or protection against bad weather and a course of 400 m^2. They fed themselves around and also received grains, agricultural by-products and kitchen rests. Birds were vaccinated against fowl pox and Newcastle disease. On the eve of the slaughter day, chickens were divided into four homogeneous flocks of 8 males and 8 females each. They were registered and kept where they will be chased the following day.

Pre-slaughter conditions, slaughter process and carcass cutting:-

Birds of the flock 1 were the control chickens and didn't undergo any stress before slaughter. Chickens of the flock 2 were chased during 5 minutes in a henhouse of 32 m^2, those of the flock 3 during 10 minutes in a yard of 212 m^2 and the one of the flock 4 during 15 minutes in a closed area of 400 m^2. Three persons were involved. After capture, birds were weighted and immediately slaughtered by section of the jugular vein. Then, chickens were scalded in a hot water (75°C) and plucked manually. Legs have been sectioned at the tibio-tarsusmetastasal joint level. The head were separated from the neck at the skull-atlas junction. The abdominal and thoracic cavities organs were taken off. Hot carcasses have been weighted and immediately cut.

Data Collecting:-
Live weight before slaughter, hot carcass weight and carcass cuts weight (breast, wings and thigh-drumstick) were registered. Carcass yield was determined from the live weight and the percentage of each carcass cut from the hot carcass weight.

The pH was measured in the right slice of the breast muscle (*Pectoralis major*) and in the right thigh muscle (*Iliotibialis superficialis*) at 2 cm depth with a portable pH-meter (HANNA Instrument R, Italy) provided with a specialized probe and a temperature control system. Measures were taken at 1h, 12h, 24h and 48h after slaughter. For every measure, 5 repetitions were performed. On each measure day, the pH-meter has been calibrated previously with two buffers pH-meter: pH 4 and pH 7 following a procedure described by the manufacturer.

The drip loss was determined with the left slice of the breast muscle according to the procedure described by Honikel (1987). Each sample was suspended to a hook, put into a refrigeration bag without touching its bottom. After 24 hours at 4°C in hung position, the samples were taken out of the bag without touching the bottom that contains the draining juice. They were mopped, weighted and drip loss was calculated as the percentage of weight loss during the storage.

The meat color was determined using a Minolta Chromameter CR-400 (Japan) in the trichromatic system (CIE L*a*b *) after storage of the samples at 4°C during 1 h 30 min. This is based on three dimensional space with one dimension for luminance (L* is the lightness) and two for color a* (redness) and b * (yellowness) (Zhang and Barbut, 2005). The chroma (C) and the hue angle (h) were determined as followed: $C= (a^{*2}+ b^{*2})^{1/2}$ and $h = \tan^{-1} b^*/a^*$. For each measure, 5 repetitions were performed. The measures were taken on the ventral face, at the third superior on the thickest part of the breast muscle left slice and on the middle of the ventral face of the left thigh muscle. The Minolta was calibrated using standard color tiles. The color was measured on the slaughter day and at 24 hours *post mortem*.

The right slice of the *Pectoralis major* of each chicken was used for the sensory analysis. The samples were put in cooking bags separately without seasoning and boiled in a bain-marie until the meat core temperature reached 75°C. A trained jury of 10 members was used for the test. After cooling to room temperature, each sample of meat cooked was cut into ten identical pieces at least. Every judge received in a plate divided by the manufacturer in four parts of different colors a piece of each category and each flock of chicken and filled in a recapitulative results form. In total, eight samples of which two by flock (one from a male and one from a female) were put by turn in the plate under numbers 1 to 8. The judges have appreciated the tenderness, the juiciness, the flavor and the global acceptance of the meat under marks going from 1 to 5.

Statistical Analysis:-
The data collected on carcass and meat quality were analyzed using the software SAS (Statistical Analysis System, 2006). The General Linear Model procedure was used for the variance analysis. The Fisher test was used to test the significance of the capture chase duration stress and the sex effects on carcass and meat quality traits. Means were compared pairwise by the Student test.

Results:-

Carcass traits of indigenous chicken according to the pre-slaughter capture chase duration stress:-
Carcass traits are given by pre-slaughter capture chase duration stress in table 1. The live weight, the hot carcass weight, the breast weight, the thigh-drumstick weight and the wings weight were similar for the control and the different chased birds. The hot carcass yield didn't even statistically vary according to the pre-slaughter capture chase duration stress. The yields of the breast, of the thigh-drumstick and of the wings were also the same.

The carcass traits of males and of those of females by flock are presented in the table 2. The wings weights of males were higher with 5 and 10 minutes chased birds than those of their counterpart females. The tendency was the same with the thigh-drumstick yield of 5 and 15 minutes chased chickens and with the wings yield of the last one.

Variation of pH and of drip loss of indigenous Chicken:-
The variation of the pH is given in the table 3. The pH of the breast muscle at 12, 24 and 48 hours *post mortem* was higher in the most chased chickens. Meanwhile, the other flocks showed similar breast pH except at 12 hours after slaughter where, it was lower with control birds. However, at one hour, birds of 10 and 15 minutes had lower breast

pH than the one of 5 minutes chase of which pH was higher than the one of the control ($p<0.001$). In the thigh, the pH values were higher with stressed chickens. Those of 10 and 15 minutes had the higher pH. Besides, for the different flocks of chickens, the most important pH fall was observed in the two muscles during the first twelve hours *post mortem* (figure 1 and figure 2).

The variation of the pH of males and females of the four flocks is presented in the table 4. The breast meat pH of males was higher than the one of females at one hour in the stressed birds and at the other measures times in chickens chased during 5 and 15 minutes. The tendency was not statistically significant in the control. In the thigh, apart from 1 and 12 hours in the control, pH values of males were also higher than those of females of all the flocks.

The drip loss was statistically similar between flocks (Table 1) and sexes (Table 2). However, females and the less chased chickens tend to show the important proportions.

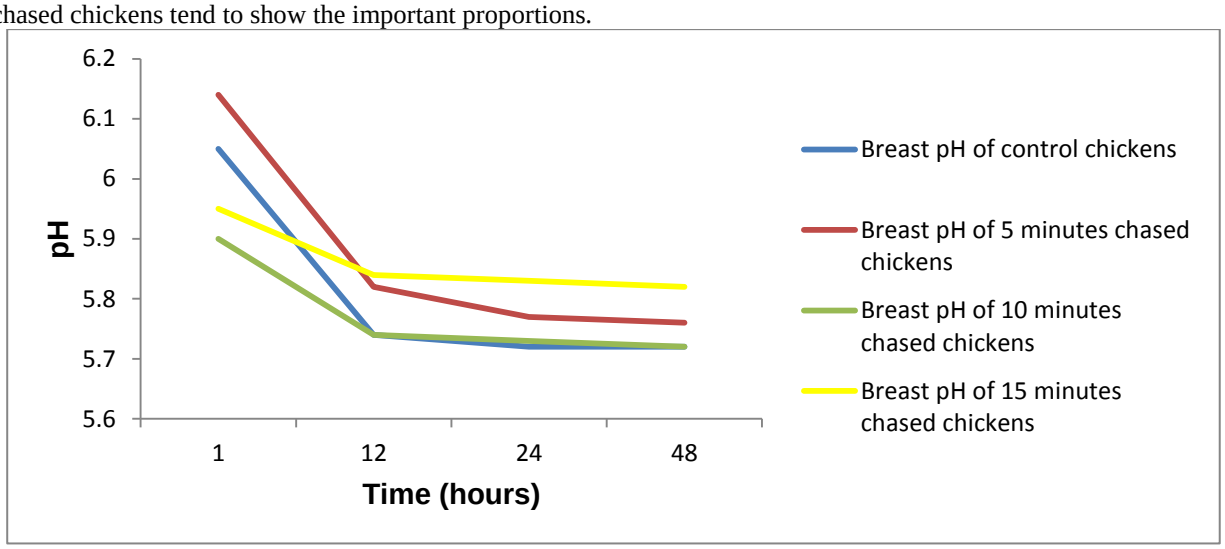

Figure 1:- Breast meat pH fall according to the capture chase duration stress during the 48 hours *post-mortem*

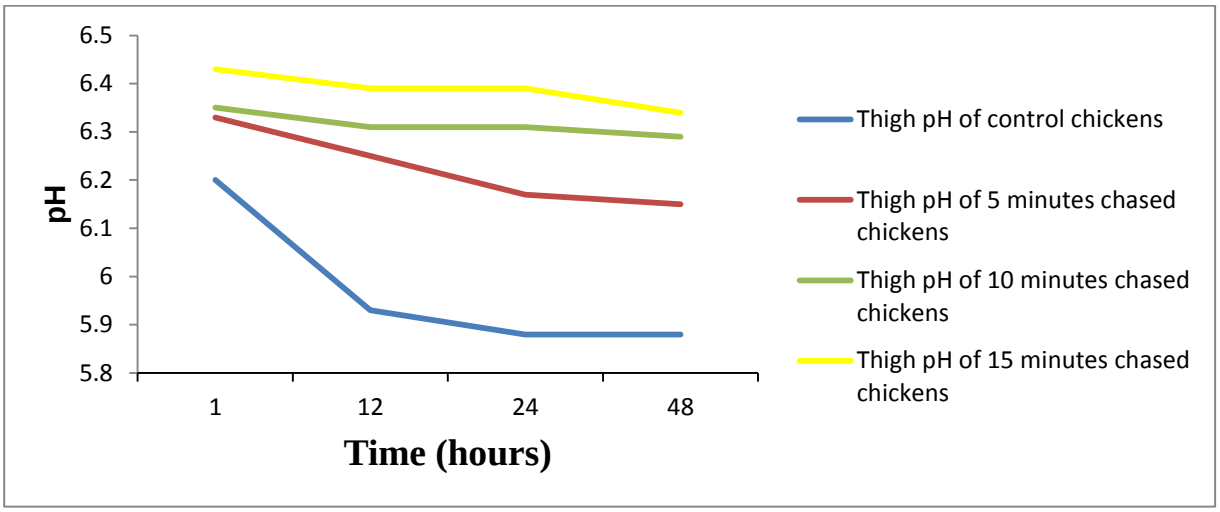

Figure 2:- Thigh meat pH fall according to the capture chase duration stress during the 48 hours *post-mortem*

Table 1:- Carcass traits, drip loss and sensory quality of the *Pectoralis major* of indigenous chicken

Variable	Chicken NC	Chicken CA	Chicken CB	Chicken CC	Standard Error	ANOVA
Live weight (g)	728.56a	742.50a	739.37a	705.62a	37.00	NS
Hot carcass weight (g)	473.02a	470.00a	476.25a	471.87a	27.96	NS
Breast weight (g)	106.24a	107.90a	107.54a	103.69a	6.45	NS
Thigh-drumustick weight (g)	140.40a	142.30a	145.59a	136.83a	9.37	NS
Wings weight (g)	58.98a	61.81a	60.88a	56.53a	3.49	NS
Hot carcass yield (%)	64.20a	63.55a	64.19a	67.59a	2.71	NS
Breast yield (%)	22.68a	22.94a	22.70a	22.36a	0.82	NS
Thigh-drumustick yield (%)	30.04a	30.18a	30.57a	29.62a	1.16	NS
Wings yield (%)	12.60a	13.19a	12.86a	12.46a	0.55	NS
Drip loss (%)	1.28a	1.24a	0.94a	1.11a	0.23	NS
Flavor	2.70a	2.67a	2.63a	2.61a	0.07	NS
Juiciness	2.86a	2.83a	2.83a	2.75a	0.07	NS
Tenderness	3.32a	3.48a	3.38a	3.36a	0.07	NS
Global Acceptance	3.16a	3.11a	3.06a	3.01a	0.06	NS

NS : P > 0.05 ; Means of the same line followed by different letters differ significantly at the threshold of 5%; NC : Non-chased ; CA : Chased for 5 minutes; CB : Chased for 10 minutes ; CC : Chased for 15 minutes ; ANOVA : Variance Analysis

Table 2:- Carcass traits, drip loss and sensory quality of the *Pectoralis major* of males and females of the indigenous chicken according to the pre-slaughter capture chase duration stress.

Variable	Chicken NC		Chicken CA		Chicken CB		Chicken CC		Standard Error	ANOVA
	Female	Male	Female	Male	Female	Male	Female	Male		
Live weight (g)	725.10a	732.02a	695.00a	790.00a	710.00a	768.75a	686.25a	725.00a	52.60	NS
Hot carcass weight (g)	470.04a	476.00a	448.75a	491.25a	437.50a	515.00a	493.75a	450.00a	39.50	NS
Breast weight (g)	104.38a	108.10a	106.57a	109.22a	102.45a	112.63a	105.47a	101.91a	9.37	NS
Thigh-drumustick weight (g)	130.30a	150.50a	125.37a	159.22a	129.56a	161.62a	127.65a	146.01a	12.59	NS
Wings weight (g)	54.98 a	62.98 a	54.68 a	68.93 b	52.02 a	69.75 b	52.05 a	61.02 a	4.35	*
Hot carcass yield (%)	65.30 a	63.10 a	65.06 a	62.03 a	61.42 a	66.95 a	72.80 a	62.38 a	3.74	NS
Breast yield (%)	21.68 a	23.68 a	23.77 a	22.11 a	23.46 a	21.94 a	22.02 a	22.70 a	1.17	NS
Thigh-drumustick yield (%)	29.06 a	31.02 a	27.98 a	32.39 b	29.73 a	31.41 a	26.42 a	32.81 b	1.46	*
Wings yield (%)	11.80 a	13.40 a	12.27 a	14.11 a	12.09 a	13.64 a	10.86 a	14.05 b	0.67	*
Drip loss (%)	1.36a	1.20a	1.63a	0.85a	0.98a	0.90a	1.23a	0.98a	0.32	NS
Flavor	2.74a	2.66a	2.71a	2.63a	2.68a	2.57a	2.73a	2.50a	0.10	NS
Juiciness	2.84a	2.88a	2.85a	2.81a	2.72a	2.93a	2.82a	2.68a	0.10	NS
Tenderness	3.28a	3.36a	3.41a	3.56a	3.32a	3.45a	3.31a	3.41a	0.10	NS
Global Acceptance	3.19a	3.13a	3.15a	3.07a	3.01a	3.12a	3.07a	2.94a	0.09	NS

NS : P > 0.05 ; * : P < 0.05 ; Means between the classes of the same line followed by different letters differ significantly at the threshold of 5%; NC : Non-chased ; CA : Chased for 5 minutes; CB : Chased for 10 minutes ; CC : Chased for 15 minutes ; ANOVA : Variance Analysis

Table 3:- Breast and thigh muscles pH of indigenous chicken according to the pre-slaughter capture chase duration stress

Moment (hour)	Variable	Chicken NC	Chicken CA	Chicken CB	Chicken CC	Standard Error	ANOVA
1	Breast pH	6.05c	6.14b	5.90a	5.95a	0.04	***
	Thigh pH	6.20a	6.33b	6.35bc	6.43c	0.03	*
12	Breast pH	5.74a	5.82b	5.74a	5.84b	0.02	*
	Thigh pH	5.93a	6.25b	6.31bc	6.39c	0.03	***
24	Breast pH	5.72a	5.77ab	5.73a	5.83b	0.03	*
	Thigh pH	5.88a	6.17b	6.31c	6.39c	0.04	***
48	Breast pH	5.72a	5.76a	5.72a	5.82b	0.03	*
	Thigh pH	5.88a	6.15b	6.29c	6.34c	0.03	***

* : P < 0.05 ; *** : P < 0.001 ; Means of the same line followed by different letters differ significantly at the threshold of 5%; NC : Non-chased ; CA : Chased for 5 minutes; CB : Chased for 10 minutes ; CC : Chased for 15 minutes ; ANOVA : Variance Analysis.

Table 4:- Breast and thigh muscles pH of males and females of the indigenous chicken according to the pre-slaughter capture chase duration stress

Moment (hour)	Variable	Chicken NC		Chicken CA		Chicken CB		Chicken CC		Standard Error	ANOVA
		Female	Male	Female	Male	Female	Male	Female	Male		
1	Breast pH	6.00a	6.10a	5.93a	6.36b	5.82a	5.98b	5.73a	6.16b	0.05	*
	Thigh pH	6.15a	6.25a	6.20a	6.46b	6.20a	6.50b	6.21a	6.65b	0.04	*
12	Breast pH	5.75a	5.72a	5.72a	5.92b	5.73a	5.75a	5.66a	6.01b	0.03	***
	Thigh pH	5.93a	5.93a	6.14a	6.36b	6.15a	6.47b	6.17a	6.62b	0.04	***
24	Breast pH	5.70a	5.73a	5.63a	5.91b	5.72a	5.75a	5.66a	6.00b	0.03	***
	Thigh pH	5.83b	5.94a	6.07a	6.28b	6.15a	6.47b	6.17a	6.62b	0.05	*
48	Breast pH	5.70a	5.73a	5.62a	5.89b	5.71a	5.74a	5.65a	5.99b	0.04	**
	Thigh pH	5.83b	5.94a	6.06a	6.24b	6.15a	6.43b	6.16a	6.51b	0.04	*

NS : P > 0.05 ; * : P < 0.05 ; ** : P < 0.01 ; *** : P < 0.001; Means between the classes of the same line followed by different letters differ significantly at the threshold of 5%; NC : Non-chased ; CA : Chased for 5 minutes; CB : Chased for 10 minutes ; CC : Chased for 15 minutes ; ANOVA : Variance Analysis

Color of the *Pectoralis major* and of the *Iliotibialis superficalis* muscles

Color traits on the slaughter day and at 24 hours *post mortem* are presented in table 5. In the thigh, the yellow index b * was higher in the 10 and 15 minutes chased chickens than in the others on the slaughter days but similar at 24 hours after. No difference was found in the other color traits with this muscle at the two times. For the breast meat, the first days, the lightness was lower with the control and the 5 minutes stressed animals ($p<0.05$). The yellow index b * and the chroma were higher in the 15 minutes stressed chickens ($p<0.05$). The following day, the yellow index b * was higher in the 5 and 15 minutes chickens. The others parameters were the same.

The variation of color by sex for the four groups is presented in table 6. In the thigh muscle, on the slaughter day, the yellow index and the chroma in females chased for 10 and 15 minutes were higher than the one of their correspondent males ($P <0.05$). The hue angle showed the inverse. At 24 hours *post mortem*, the yellow index in females chased for 10 and 15 minutes was also higher. Meanwhile the red index a^* and the hue were more important in males than in females chased during 5 and 15 minutes.

In the breast meat, on the first day, the lightness was higher in females of 5 and 10 minutes of chase than in their counterpart males. The tendency was the same for yellow index of these two groups and for the chroma of the last one. The red index and the hue were similar. At 24 hours, the red index was more important in the males with control and 10 minutes chased chickens. The hue of these birds and of the 15 minutes one presented the same tendency. On the contrary, the yellow index was lower in males of the different groups.

Sensory analysis of the *Pectoralis major* of indigenous chicken

The flavor, the juiciness, the tenderness and the global acceptance of the breast meat didn't vary between the four groups of chickens (Table 1). From one sex to the other, they didn't even vary (Table 2).

Table 5:- Color of the *Pectoralis major* and of the *Iliotibialis superficalis* muscles of indigenous chicken according to the pre-slaughter capture chase duration stress

Moment	Muscle	Variable	Chicken NC	Chicken CA	Chicken CB	Chicken CC	Standard Error	ANOVA
Slaughter day	Thigh	L*	45.76a	45.88a	46.98a	47.61a	0.73	NS
		a*	17.46a	17.44a	17.40a	16.57a	0.54	NS
		b*	8.16a	8.16a	9.69b	9.25ab	0.53	*
		Hue angle	2.04a	2.02a	2.20a	2.18a	0.17	NS
		Chroma	20.10a	19.57a	20.43a	19.61a	0.58	NS
	Breast	L*	57.80a	57.88a	59.50ab	60.32b	0.62	*
		a*	5.30a	5.28a	5.16a	5.61a	0.36	NS
		b*	9.50a	9.55a	8.65a	10.97b	0.47	**
		Hue angle	0.08a	0.08a	-0.06a	0.23a	0.19	NS
		Chroma	11.20a	11.29a	10.42a	12.64b	0.50	**
24 hours after slaughter	Thigh	L*	47.10a	47.17a	47.11a	48.69a	0.60	NS
		a*	17.78a	17.54a	17.74a	16.57a	0.49	NS
		b*	9.37a	9.39a	9.55a	10.08a	0.49	NS
		Hue angle	2.06a	2.08a	1.95a	1.87a	0.17	NS
		Chroma	20.26a	20.24a	20.61a	19.87a	0.52	NS
	Breast	L*	57.94a	57.96a	58.04a	59.08a	0.60	NS
		a*	5.20a	4.35a	5.29a	4.90a	0.39	NS
		b*	9.14a	10.37ab	9.15a	10.99b	0.46	**
		Hue angle	0.30a	0.02a	0.33a	-0.15a	0.23	NS
		Chroma	11.22a	11.56a	11.20a	12.40a	0.50	NS

NS : P > 0.05 ; * : P < 0.05 ; ** : P < 0.01 ; L* : lightness ; a* : red index ; b* : yellow index ; Means of the same line followed by different letters differ significantly at the threshold of 5% ; NC : Non-chased ; CA : Chased for 5 minutes; CB : Chased for 10 minutes ; CC : Chased for 15 minutes ; ANOVA : Variance Analysis

Table 6:- Color of the *Pectoralis major* and of the *Iliotibialis superficalis* muscles of males and females of indigenous chicken according to the pre-slaughter capture chase duration stress.

Moment	Muscle	Variable	Chicken NC		Chicken CA		Chicken CB		Chicken CC		Standard Error	ANOVA
			Female	Male	Female	Male	Female	Male	Female	Male		
Slaughter day	Thigh	L*	45.75a	45.77a	44.76a	47.01a	46.88a	47.08a	47.45a	47.77a	1.04	NS
		a*	17.48a	17.44a	17.82a	17.06a	18.36a	16.44a	16.65a	16.49a	0.76	NS
		b*	8.90a	7.42a	8.95a	7.37a	11.89b	7.49a	11.46b	7.05a	0.69	*
		Hue	1.98a	2.10	1.92a	2.11	1.58a	2.81	1.47a	2.90	0.23	*

		angle		a		a		b		b		
		Chroma	20.68a	19.52a	20.08a	19.06a	22.36b	18.50a	20.94b	18.27a	0.79	*
	Breast	L*	58.78a	56.82a	59.59b	56.17a	60.98b	58.01a	60.40a	60.24a	0.86	*
		a*	5.15a	5.45a	4.96a	5.61a	5.30a	5.03a	5.99a	5.23a	0.51	NS
		b*	10.10a	8.90a	10.81b	8.28a	10.31b	6.99a	11.21a	10.73a	0.64	*
		Hue angle	-0.30a	0.47a	-0.28a	0.45a	-0.21a	0.09a	0.44a	0.03a	0.26	NS
		Chroma	11.70a	10.70a	12.14a	10.44a	11.94b	8.90a	13.03a	12.25a	0.70	*
24 hours after slaughter	Thigh	L*	48.00a	46.20a	48.10a	46.24a	47.48a	46.73a	49.62a	47.77a	0.85	NS
		a*	16.98a	18.58a	16.22a	18.86b	17.23a	18.25a	16.13a	17.02a	0.69	*
		b*	9.94a	8.80a	9.97a	8.82a	11.42b	7.68a	11.35b	8.82a	0.66	*
		Hue angle	1.87a	2.26a	1.88a	2.29a	1.70a	2.20a	1.34a	2.40b	0.24	*
		Chroma	20.76a	19.76a	19.45a	21.02a	21.26a	19.96a	20.24a	19.54a	0.73	NS
	Breast	L*	59.40a	56.49a	59.44a	56.49a	58.39a	57.70a	59.92a	58.24a	0.85	NS
		a*	4.12a	6.28b	3.72a	4.97a	4.23a	6.34b	4.55a	5.24a	0.55	*
		b*	10.40b	7.88a	11.82b	8.91a	10.39b	7.90a	12.37b	9.62a	0.62	*
		Hue angle	-0.29a	0.89b	0.10a	-0.06a	-0.27a	0.95b	-0.61a	0.30b	0.32	*
		Chroma	11.41a	11.03a	12.59b	10.53a	11.37a	11.03a	13.42b	11.37a	0.69	NS

NS : P > 0.05 ; * : P < 0.05 ; L* : lightness ; a* : red index ; b* : yellow index ; Means between the classes of the same line followed by different letters differ significantly at the threshold of 5% ; NC : Non-chased ; CA : Chased for 5 minutes; CB : Chased for 10 minutes ; CC : Chased for 15 minutes ; ANOVA : Variance Analysis

Discussion:-

Carcass traits of indigenous chicken according to the pre-slaughter capture chase duration stress:-

The live weight, the hot carcass weight, the breast weight, the thigh-drumstick weight and the wings weight as well as the yields of the hot carcass, of the breast, of the thigh-drumstick and of the wings were similar for the control and the different stressed birds. Apart from the wings weight and the yields of the thigh-drumstick and of the wings, the parameters were also the same between sexes. The similarity observed between the carcass traits shows that the experimental flocks are homogenous. The weight and the yield results of the current study are close to those recorded by Youssao *et al.*, (2009), Tougan (2010) and Bonou *et al.*, (2017). The non-existence of significant difference between weight and yield parameters according to the stress in the present study was also reported by Bonou *et al*., (2017) with stress of one hour of transportation and of 10 minutes of capture chase. This situation could be explained by the short stress durations and the immediate slaughter of birds after the process. Otherwise, the immune reaction could result in reduction of feed intake, growth disturbance and weight loss. As example, Sohail *et al*., (2012) recorded in broiler exposed to chronic heat stress a reduction of 16.4% of feed intake, of 32.6% of body weight and an increasing of feed conversion ratio of 25.6%.

The yields of the thigh-drumstick results of the current study according to the sex are opposite to those of Chabault *et al*., (2012). They reported in commercial lines that for a given age, the breast and the thigh yields are often higher with females due to their most precocity muscle development in comparison to males. This precocity observed in females is not true in the local chickens.

Variation of pH and of drip loss of indigenous chicken:-

The pH of the breast muscle at 12, 24 and 48 hours *post mortem* was higher in the most chased chickens. Meanwhile, the other flocks showed similar breast pH except at 12 hours after slaughter where, it was lower with control birds. The muscle acidification was then least with chickens of 15 minutes of chase. Their glycogen stock level could be lower. They could have certainly use part of their reserve to produce energy during the physical activities they endured in the stress process. According to Berri (2015), the ultimate pH depends on the glycogen concentration of the muscles at the slaughter time. Transportation for 3 hours decreases the plasma glycogen concentration in broilers (Zhang *et al*., 2014). Animal's disturbance lead to the depletion of muscle glycogen content and then to a higher meat pH (Cartier and Moëvi, 2007). The wings flapping duration on the slaughter line is negatively correlated to the muscle glycogen potential (Berri *et al*., 2005).

At one hour, birds chased for 10 and 15 minutes had lower breast pH than those of 5 minutes of which, pH was higher than the one of the control. Acidification was then abnormally higher in the two most chased chickens at that time. These birds had certainly produced more lactic acid not yet resorbed. Besides, the lower pH of the control chickens at 1 and 12 hours *post-mortem* compare to those of 5 minutes chase one, indicates that this short time of capture chase already affects meat quality. This observation is most obvious in the thigh for, control thigh pH values were lower all the times.

The results of the current study are similar to those of other authors with comparable stress factors. Gigaud *et al*., (2007) observed with the free-range chicken that as for the transportation duration, a long waiting time (superior to 4 hours) result in higher pHu. Longer is the transportation duration, higher is the pHu. Berri *et al*., (2005) studying the effect of the activity on the slaughter line recorded that the increasing of the wings flapping duration provokes a higher pHu in broilers. Debut *et al*., (2003) noticed that the thigh pHu is one of the main parameters influenced by pre-slaughter stress conditions. They observed that a two hours of transportation leads to a higher ultimate pH (6.21). But, they remarked no difference in the breast meat pH of transported and control chickens. Besides, Barbut *et al*., (2005), Oba *et al.,* (2009), Langer *et al.*, (2010) and Xing *et al.,* (2015) have recorded Pale Soft and Exudative (PSE) chicken meat with short lengths of transportation at high temperature.

The pHu usually observed in chicken meat is around 5.8 (Gigaud *et al*., 2007). The pH48 of the breast meat was respectively 5.72, 5.76, 5.72 and 5.82 with control, 5, 10 et 15 minutes chased chickens. These values seem acceptable for, close to those reported in the literature (Berri and Jehl, 2001; Quentin *et al*., 2003; Debut *et al*., 2003: Fanatico *et al*., 2005; Tougan (2010); Bonou *et al*., 2017). On the contrary, the thigh muscle pH was higher in the chased birds and was respectively 6.15, 6.29 and 6.34 from the less to the most chased one. Bonou *et al*., (2017) also registered similar result with local chickens chassed during 10 minutes. So, the thigh meat of these chased birds could be favorable to microbial proliferation and then, presents important sanitary risks for the consumers.

In the two muscles, and for the different flocks, the most important pH fall occurred in the first twelve hours *post mortem*. Bonou *et al*., (2017) found a similar result. During this period, the muscle glycogen was more available for anaerobic glycolysis reactions that take place in meat maturation process.

Besides, from one sex to the other, males showed higher pH values than their homologues females at several measures times. Bonou *et al.,* (2017) also recorded similar situation. The glycogen potential was therefore least in males. They seem more sensitive to the stress than females. Schneider *et al*., (2012) reported an ultimate breast pH in the males higher than the one in the females (5.96 *vs* 5.87).

The drip loss was statistically similar for the different groups. The closeness of breast meat pH48 in the current study with the normal ultimate pH value could justify this. Bonou *et al*., (2017) also reported the same thing in such situation. Debut *et al*., (2003) didn't found difference in the drip loss when pH values were normal. On the other hand, Berri *et al*., (2005), studying the effect of the stress of the activity on the slaughter line preceded or not by heat exposure, found that drip loss was more important in the stressed chickens of which pHu was relatively lower. Schneider *et al*., (2012) and Zhang *et al*., (2014) also reported lower drip loss when the pH was higher.

Drip loss didn't statistically vary by sex but females showed the important arithmetic proportions. This tends to confirm the negative correlation that exists between meat pH and meat drip loss. In the study of Schneider *et al*., (2012), the difference was clear. The drip loss of females (2.34) was significantly higher than the one of the males (1.99%).

Color of the *Pectoralis major* and of the *Iliotibialis superficalis* muscles:-

In the breast meat, the lightness was higher in the 10 and 15 minutes chased chickens on the slaughter day but the same the day after. It was similar in the thigh at the two moments. The higher values in the most chased birds could be a color defect. High lightness was also reported with other close pre-slaughter stress factors. As example, the activity on the slaughter line was associated with higher meat lightness (Berri *et al*., 2005). On the contrary, lower meat lightness was found in certain studies. Gigaud *et al*., (2007) observed that as for the chase duration, a long waiting time, (superior to 4 hours) result in a lower lightness. Debut *et al*., (2003) observed a similar effect also after two hours of transportation but only in the thigh meat. Bonou *et al*., (2017) registered lower lightness with local chickens stressed by the transportation or by the capture chase.

The yellow index b * registered in the breast was higher in the chickens chased for 15 minutes at the two times and in the one of 5 minutes of chase only the second day. In the thigh, it was higher with 10 and 15 minutes chased birds only the first day. As the breast lightness, the yellow index was influenced by the long durations chase notably on the slaughter day. It was more abundant in those with higher lightness. Bonou *et al.,* (2017) obtained similar results with non-stressed chickens and with females in most of the cases. .

In both breast and thigh, the red index a* was the same at the two times for all the flocks. The capture chase duration didn't affect the red index in the current study. On the contrary, Bonou *et al*., (2017) got redder breast meat in local chickens stressed by 10 minutes capture chase.

The local chicken meat pH and color of the current study results analysis reveals that breast meat of the most chased birds have lower pH at one hour *post mortem* associated to higher lightness and yellow index on the slaughter day. A similar relation was described in several studies. Thus, Berri *et al*., (2005), Gigaud *et al*., (2006), Gigaud and Berri (2007), Gigaud *et al*., (2007 and 2008), Sheard *et al*., (2012), Harford *et al*., (2014) and Xing *et al*., (2015) reported that the color of meat in poultry especially the lightness and the ultimate pH are in significant negative correlation. In addition, this study showed that the higher lightness tend to be associated with higher yellow index. Bonou *et al*., (2017) also remarked such relation with non-stressed chickens and with females in most of the cases. Harford *et al*., (2014) wrote a similar report. Indeed, the selection for the increasing of the lightness resulted in an increasing of the yellow index. However, the negative relationship reported between the red index and the yellow index is not observed while comparing the flocks in this study.

In general, the higher lightness and yellow indexes were found in females whereas the higher red indexes were observed in males. These reports are the consequence of pH that tends to be higher in males. The results correspond to the relationships described above between these parameters of color and the pH (Sheard *et al*., 2012 ; Harford *et al*., 2014 ; Bonou *et al*., 2017 ; Xing *et al*., 2015). The negative correlation between the yellow index and the red index that was not observed above is nevertheless remarked in the breast meat of 10 minutes chased chickens at 24 hours *post-mortem*. Besides, El Rammouz (2005) indicated that in poultry, the concentration of the myoglobin, pigment responsible for the red color, is more abundant in the breast and thigh muscles of the males than in those of the females.

Sensory analysis of the *Pectoralis major* of indigenous chicken:-

The flavor, the juiciness, the tenderness and the global acceptance of the breast meat didn't vary between the groups and sexes of local chickens. Bonou *et al*., (2017) also recorded similar result with control, 10 minutes chased and one hour of transportation chickens. These quality traits depend on muscle composition and structural property especially on its major components such as muscular fiber, connective tissue and intramuscular lipids (Lefèvre and Bugeon., 2008, Listrat *et al*., 2015). Meat sensory quality determinatives pointed out by these authors didn't therefore vary in chickens in this study. Besides, the non-existence of difference between sensory quality attributes according to the stress could be explained by the non-conservation of the meat used for the test during a long time. The analysis was done at 48 hours after slaughter. Otherwise, the difference could affect meat juiciness and tenderness which are directly in relationship with meat pH (Hocquette *et al*., 2000; Geay *et al*., 2002).

The marks given by the jury to the sensory meat attributes are around 3/5. Similar results were gotten by Youssao *et al*., (2009), Tougan (2010) and Bonou *et al.,* (2017).

Conclusion:-

The study of the influence of the pre-slaughter capture chase duration stress on carcass and meat quality of indigenous chicken reared under traditional system in Benin reveal that these stress conditions doesn't influence the carcass quality but, from 5 minutes of chase, the meat quality is negatively affected. The two longer chase durations acidify precociously the breast meat that is less dark and more yellow. However, the acidification doesn't reach the one of PSE or acid meat. But two days after, the acidity level is lower with the most chased chickens. The longer chase durations reduce more seriously the acidification of local chicken thigh meat that is in such conditions favorable to microbial proliferation.

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