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Response of Local Chicken and Commercial Broiler Breeds to Chronic Heat Stress under Tropical Environment: 1 Effect on Growth Performance

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ABSTRACT

This study was carried out to determine the effect of hyperthermia on growth parameters of the local chicken and exotic broiler breed in tropical environment at 25 and 35°C. The chickens were raised at 25°C consumed more food than those raised under hyperthermia. The consumption reduction in local chickens under thermal stress varies from -2.39 to -7.90%. In hyperthermia, water consumption increased in exotic chicken (4.99 to 7.04%) but, decreased (7.50%) in local chicken. The weight loss at 8th weeks in exotic chickens varies from -24 to -29%, while the local chicken under the same challenging stress increased live weight by 10 to 34%. Hyperthermia resulted in a reduction of the weight gain of -3.09% in local chicken and -14.56% in exotic chicken. The consumption index increased by 57.72% and 60.67% respectively in local chicken and exotic strain respectively. The carcass yield decreased by 25.79 and 15.01% respectively in exotic and local birds respectively. In the two genetic types, the induction of heat stress caused a decline in the proportion of the pancreas by 37.83% in the local chicken and by 25% in the exotic strain. The proportions of other organs declined in local chicken (-22.34% to -36.36%) and increased in exotic chickens (10.33 to 24.59%). These results showed that local chicken have better adaptability to heat stress than exotic chicken.

Key words: Adaptability; chicken; hyperthermia; productivity

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INTRODUCTION

Local chicken is the main source of meat and eggs in more than 80% of the rural and poor households in developing countries (Tchoumboue *et al.*, 2000). The improvement of its productivity will be highly beneficial in the relief of the socio-economic and nutritional status of the farmers. Unfortunately, the global warming and climatic changes is particularly deleterious to tropical agriculture in general and to the local genetic resources, hence impairing their sustainable management initiatives. The ambient heat of the tropical zones constitutes a major constraint to the development of poultry production in these areas, because it induces considerable economic losses in their breeding by leading to fall in productivity and increase in mortality (El-Gendy, 2009). To limit the harmful effects of heat, several technical solutions including nutritional or environmentally oriented actions are possible (Yahav, 2000). To date, none of these techniques could restore the zootechnical performances close to those obtained in temperate climate, reason for which the genetic approach for solutions should be envisaged.

The local animal genetic resources are theoretically better adapted to their environment. Knowing that the response of chickens to thermal waves is based on their genetic constitution (Yalcin *et al.*, 1997), the use of the crossings between hypothetical thermo tolerant local chicken and the highly productive exotic standard breeds are sometimes recommended for the improvement of the breeds, strains or lines for better yielding poultry production in tropical environment. However, such an initiative requires a good control of preliminary parameters comprising adaptability to the thermal stress of the existing breeds and strains involved in the crossbreeding programe.

The objective of this study was to evaluate the effects of heat stress on the growth performances and carcass yield of local and exotic chickens under Cameroon condition.

MATERIALS AND METHODS

The animals

The parental chicken: The parental animals consisted of a normal feathering type of local chicken, whereas the commercial breed was a Hubbard terminal line from a neighboring hatchery operator in western Cameroon.

After 15 days of adaptation in station during which all the animals were vaccinated against current diseases and subjected to internal and external antiparasitic treatment. Birds of all pens received feed ration containing 18.5% crude protein and 2730 Kcal/kg of metabolisable energy. The crossings were done by natural mounting, and resultant eggs were collected and stored for a maximum of 7 days. These eggs were then treated in a conventional way before being artificially incubated.

Experimental chicks: Among the chicks resulting from incubations, only the viable ones presenting normal feathering were retained for the experiment. The chicks of each genetic type were separated into two batches, of which one was reared under a continuous average temperature of 35°C (32 with 37°C) and a relative humidity from 68 to 90% until the 8th week. Each of the other batches was started at 35°C, then the temperature was gradually reduced by approximately 3-4°C every week until the average ambient temperature reached 25°C at the end of the 4th week. The chicks were placed on wood chip litter, receiving the broilers' conventional prophylaxis, and having free access to fresh water and to a ration made of 22.19% CP and 3046.8 Kcal ME/Kg. From the 1st- 8th week, the animals were subjected to a continuous lighting.

Data collection: The animals were weighed individually on a weekly basis. Also, the quantity of food consumed by batch per week was evaluated by computing the difference between the total quantity distributed and the residues. These data thereafter made it possible to calculate the mean daily weight gain (DWG), the consumption index (CI) and mean daily consumption (DC) according to formulas below.

$$DWG = \frac{FW - IW}{n.7}$$

DWG= daily weight gain
FW=Total weight of the batch in weekend
IW=Total weight of the batch at the beginning of week
n= number of chicks in the lodge

$$DC = \frac{IQ - WR}{n.7}$$

DC= daily consumption
IQ= quantity of food brought to the lodge during the week
WR= weekly residues
N: number of chicks in the lodge

$$CI = \frac{DC}{DWG}$$

CI= consumption index

The breathing rate of individual animals was evaluated as the number of respiratory ventilation per minute, was recorded three times a week by palpation and observation method of breathing.

At the end of the experimentation period, the death rate, expressing the degree of rusticity of the animals in a given environment was evaluated according to the formula:

Death rate (%) = *(an Effective Number of mortalities/of the initial herd) X 100*.

Statistical Analysis: The collected data were subjected to the generalized linear model of the analysis of the variance according to the following statistical equation:

$Yijk = \mu + g_i + t_j + (gxt)_{ij} + e_{ijk}$ Where:

Y_{ijk} = measured Value of the parameter of the individual k, of genetics type i, and under treatment

μ = average general of the value of the parameter

g_i = effect fixes genetic type i(i= 1 to 2)

t_j = effect fixes temperature j (j= 1 to 2)

e_{ijk} = residual error

Data were analyzed using Excel 2003 and SPSS 12.0.

RESULTS

Effects of heat stress on the growth performances and carcass characteristics

Feed consumption: Figure 1 illustrates the effect of breeding temperature on the weekly evolution of feed consumption in local and exhotic hens.

Feed consumption raises in a linear way with the age of the animals whatever the genetic type and breeding temperature. Throughout the duration of test, the feed consumption is significantly higher (P<0.05) in exotic chicken as compared to its local counterpart. In addition, within each genetic type and whatever the age, the animals under 25°C consumed more feed than those bred fewer than 35°C.

The effect of the breeding temperature on the variation of feed consumption is illustrated by figure 2.

It can be realized that the raise of the ambient breeding temperature involves a drop in feed consumption in all the genetic types. This drop of consumption is much severe in the local chicken and varies from -2.39% (week 7) to -7.90% (week 5). On the other hand, the said variation is much more constant in exotic breed from the 5th to the 8th week and is around -5%.

Water consumption: Water consumption varies according to the genetic type and breeding temperature (figure 3).

Throughout the breeding period, the exotic chicken bred at 35°C consumed more water than at 25°C. The contrary was observed with the local chicken which, after a drastic reduction in its feed consumption, also lowered its water intake. Water consumption experienced a remarkable increase in exotic chicken from the 6th week, being significantly higher (P<0.05) as compared to that of local animal irrespective of the breeding temperature. The variation in water consumption in the local and exotic chicken exposed to an increase temperature from 25°C to 35°C is illustrated in figure 4.

It is noticed that while the exotic chickens increases their water intake by 4.99 to 7.04% in situation of heat stress, the local chicken reduces and maintain it to a constant rate of about 7.5% throughout the breeding period. This may be thanks to an early regulatory mechanism acquired at the onset of the stress.

Live weight: Table 1 presents the evolution of the live weight at local hen and the commercial stock between 4th and the 8th week according to the temperature of breeding.

The analysis of the variance revealed that the growth performances of chickens are significantly affected (P<0.01) by their genetic type, and breeding temperature (P<0.05) and their interaction.

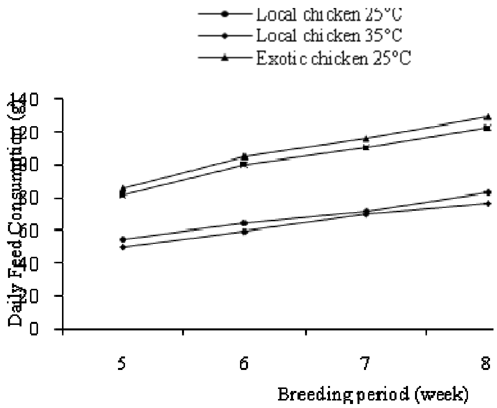

Fig. 1: Weekly daily feed consumption of local and exotic chickens at 25 and 35°C

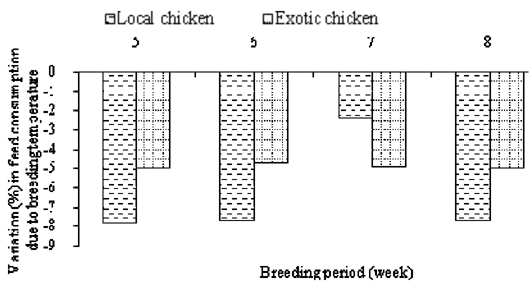

Fig. 2: Weekly variation in feed consumption in local and exotic chickens subjected to a rise in the breeding temperature from 25° to 35°C

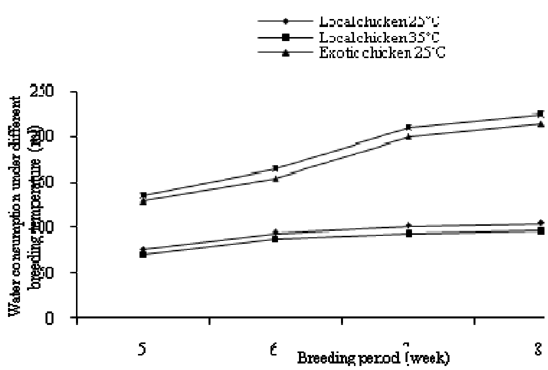

Fig. 3: Weekly evolution of water consumption in local and exotic chickens bred at 25 and 35°C

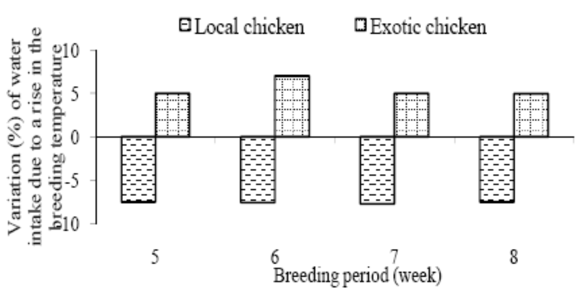

Fig. 4: Variation of water intake in local and exoticchickens exposed to a rise in breeding temperature from 25to 35°C

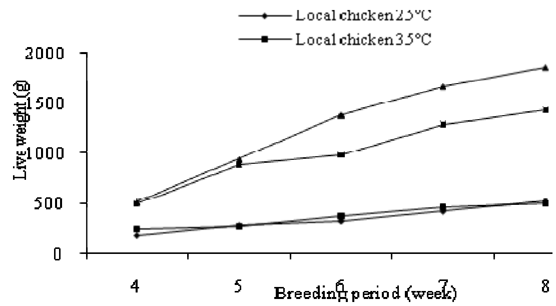

Fig. 5: Weekly live weight in local versus exotic chickens bred at 25 and 35°C

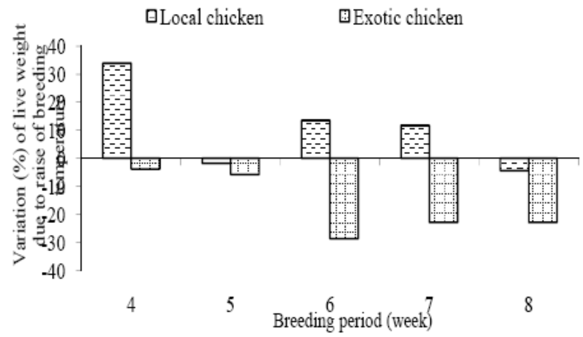

Fig. 6: Variation of the live weight of local versus exotic chickens exposed to a rise in breeding temperature from 25 to 35°C

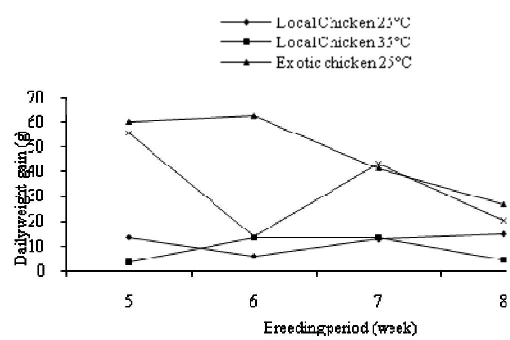

Fig. 7: Weekly daily weight gain in local versus exotic chicken bred at 25 and 35°C

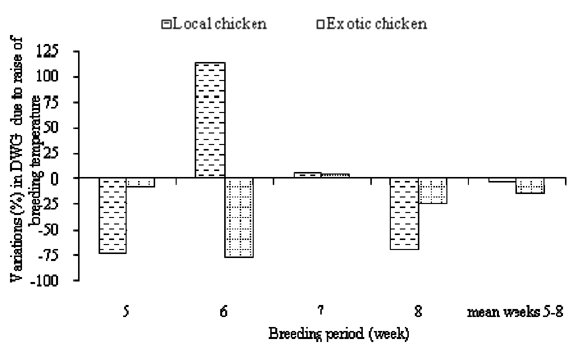

Fig. 8: Weekly variation of the mean daily weight gain in local versus exotic chickens exposed to a rise in the breeding temperature from 25 to 35°C

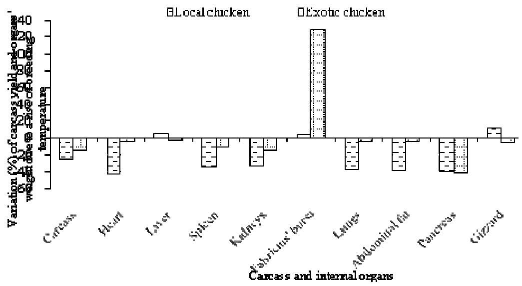

Fig. 9: Variation of the carcass yield and weight of offal in local and exotic chickens exposed to a rise in the breeding temperature from 25 to 35°C.

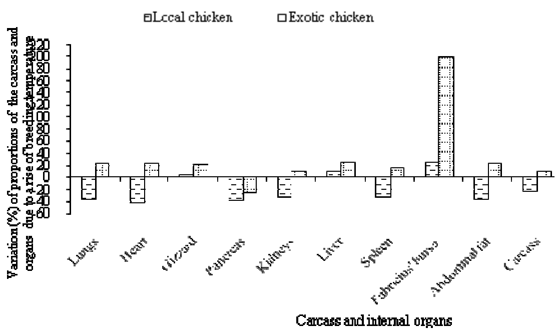

Fig. 10: Variation in the proportions of the carcass and offal of local and exotic chickens subjected to a rise of the breeding temperature from 25 to 35°C.

Apart from the first week of exposure to heat stress, the live weight of local hen was not significantly affected by a rise in the ambient temperature from 25 to 35°C during the subsequent weeks; proving that the local chickens adapted themselves earlier at the unset of the stress. The contrary was observed in the exotic breed where the increase of ambient temperature significantly ($P<0.05$) affected the growth performances, which became severely depressed from the 3rd week following exposure to heat stress. The live weight of the two genetic types of chicken according to the ambient temperature is illustrated in figure 5.

The live weight and growth rate of local chicken were significantly low ($P<0.05$) as compared to exotic counterparts. However, the later displayed a significant ($P<0.05$) depression in their growth rate one week after the induction of heat stress. This variation of weight performances due to heat stress increased as the weight of the animals and time of exposure increased.

The general feature of the variations of weight performances of chickens raised at 25°C as compared to those under hyperthermia is shown in figure 6.

The exotic chicken exposed to heat stress, as compared to its homologous under neutral thermal rearing, presents negative variations of performances as long as the stress lasts. These variations become significantly higher ($P<0.05$) from the 6th week, and are about -24 to -29%. On the other hand, the variations of performances in local chicken exposed to the same thermal stress are much more positive (+10% to +34%), except at the 5th and 8th week of age where they were slightly negative. Thus, the growth performances of local chicken could be affected by the heat stress like those of its exotic type counterpart, but with a lesser amplitude.

Body measurements: The evolution of body measurements of the local and commercial exotic chicken according to the breeding temperature is presented in table 2.

The analysis of variance revealed that body measurements of chicken were significantly affected by its genetic type ($P<0.01$), the breeding temperature ($P<0.05$), while the interaction between these two factors of variation has no significant effect ($P\geq0.05$).

Body measurements selected are those presenting strong positive correlations with the live weight. It comes from table 2 that the shank diameter in local chicken was not significantly ($P\geq0.05$) influenced by the breeding temperature whatever the age of the animals was. However, the heat stress involved nonsignificant reductions of this parameter ranging from -0.60 to -11.11%.

The variation of body measurements was reduced as the age of local chicken increases. In exotic breed on the contrary, the variations of reduction of the shank diameter was significant ($P<0.05$) as long as the stress lasts, and was between -17.71 and -25.33%. However, this reduction (-8.02%) was not significant ($P\geq0.05$) at the second week of stress.

The length of the shank, wing and chest increased with the rise in the ambient temperature. The body length was not significantly affected in the two genetic types of hens.

Weight gain: The average daily weight gains of local and exotic chickens raised at different temperatures are represented in table 3. The mean daily weight gain was very high in exotic chicken as compared to its local type counterpart. Chickens reared under hyperthermia performed poorly than those at thermal comfort. The weekly daily weight gain of the various types of chickens according to the breeding temperature is illustrated in figure 7.

The general trend in mean daily weight gain is variable depending on the genetic type of chicken and the breeding temperature. If the daily weight gain tends to increase in exotic chicken at 25°C between the 5th and 6th week before witnessing a progressive fall, the chicken of the same type raised at 35°C presents an evolution in saw teeth shape. Hyperthermia induced in four weeks of stress a drop in weight gain by -3.09% in local chicken and -14.56% in exotic chicken. The weekly variation of weight gain is illustrated in figure 8.

At same age, the response displayed by the local and exotic chickens vis-à-vis the heat stress were identical, but with different amplitudes, except at the 6th week of breeding (2nd week of heat stress) during which the local chicken presented an increasing weight gain (+113.8%), as compare to that of the exotic chicken (-77.68%) during the same period.

Consumption Index: Feed consumption according to the breeding temperature of the two types of chicken is presented in table 4.

Chickens reared at high temperature presented a higher index CI. Independently to the breeding temperature

Table 1: Evolution of the live weight in the local and a commercial breed according to the breeding temperature

Week	Live weight (g)				Signification		
	Local chicken		Exotic chicken				
	25°C	35°C	25°C	35°C	G	T	G×T
4	187.14±43.28^{a}	250.62±043.95^{b}	514.17±089.63^{c}	493.95±71.17^{c}	**	*	*
5	280.71±70.44^{a}	275.62±047.91^{a}	935.56±141.12^{b}	881.25±127.19^{b}	**	*	*
6	323.57±105.46^{a}	367.29±079.02^{a}	1373.33±142.76^{c}	978.95±140.64^{b}	**	*	*
7	411.43±107.73^{a}	459.44±158.41^{a}	1663.33±198.69^{c}	1280.50±290.61^{b}	**	*	*
8	513.67±14.10^{a}	490.83±156.34^{a}	1847.50±287.91^{c}	1423.00±322.95^{b}	**	*	*

^{a,b}values bearing the same superscript in a row are not significantly different (P≥0.01); ** = P<0.01; *= P<0.05; G= genetic type, T= temperature, GXT= genetic type × temperature interaction

Table 2: Effect of ambient temperature on body measurements of local and exotic chickens

Week	Body measurements						Signification		
	Local chicken			Exotic chicken					
	25°C	35°C	Variation (%)	25°C	35°C	Variation (%)	G	T	G×T
Shank diameter (mm)									
4	7.38±1.31^{a}	6.56±0.87^{a}	-11.11	11.50±0.60^{b}	09.02±1.88^{c}	-21.56	**	*	NS
5	7.92±0.81^{a}	7.21±0.96^{a}	-08.96	11.09±1.81^{b}	10.20±0.62^{b}	-08.02	**	*	NS
6	8.08±1.05^{a}	7.47±0.90^{a}	-07.54	14.79±0.87^{c}	11.34±0.69^{b}	-23.33	**	*	NS
7	8.50±0.99^{a}	8.37±1.45^{a}	-01.53	15.59±1.35^{c}	11.64±0.94^{b}	-25.33	**	*	NS
8	9.09±1.17^{a}	9.03±1.30^{a}	-00.60	15.64±1.17^{c}	12.87±1.20^{b}	-17.71	**	*	NS
Shank length (cm)									
4	3.01±0.38^{a}	3.62±0.31^{b}	+20.26	03.87±0.31^{b}	03.84±0.32^{b}	- 00.17	*	*	NS
5	3.45±0.41^{a}	3.99±0.36^{b}	+15.65	04.13±0.30^{b}	04.62±0.32^{c}	+11.86	*	*	NS
6	3.87±0.61^{a}	4.41±0.43^{ab}	+13.95	04.89±0.64^{bc}	05.14±0.34^{c}	+05.11	*	*	NS
7	3.97±0.59^{a}	4.89±0.53^{b}	+23.17	05.30±0.26^{bc}	05.46±0.33^{c}	+03.01	*	*	NS
8	4.96±0.56^{a}	5.42±0.55^{b}	+09.27	05.67±0.37^{bc}	6.05±0.38^{c}	+18.81	*	*	NS
Wing length (cm)									
4	09.98±0.91^{a}	11.87±0.77^{b}	+18.93	13.15±0.64^{c}	13.93±0.78^{d}	+05.93	*	*	NS
5	11.40±0.94^{a}	13.01±0.82^{b}	+14.12	13.75±1.16^{bc}	14.53±0.68^{c}	+05.67	*	*	NS
6	12.04±0.73^{a}	13.71±1.19^{b}	+13.87	15.87±1.29^{c}	16.16±0.75^{c}	+01.83	**	*	NS
7	13.33±1.39^{a}	13.76±1.21^{a}	+03.22	18.15±1.05^{c}	16.58±1.20^{b}	-08.65	**	*	NS
8	14.13±1.05^{a}	15.47±1.38^{b}	+09.48	19.13±0.89^{c}	18.44±1.35^{c}	-03.61	**	*	NS
Chest circumference (cm)									
4	13.20±1.40^{a}	15.79±1.30^{b}	+19.62	21.95±0.78^{d}	19.51±0.99^{c}	-11.12	*	*	NS
5	16.34±1.54^{a}	17.35±1.45^{a}	+06.18	22.32±2.09^{b}	22.70±1.42^{b}	+01.70	**	NS	NS
6	16.71±1.89^{a}	18.33±1.48^{a}	+09.69	27.23±1.48^{b}	25.29±1.54^{b}	-07.12	**	NS	NS
7	17.90±1.43^{a}	19.98±1.87^{b}	+11.62	30.87±1.04^{d}	28.13±2.11^{c}	-08.87	**	*	NS
8	20.47±2.29^{a}	21.72±1.79^{a}	+06.11	32.92±2.66^{b}	31.26±2.32^{b}	-05.04	**	NS	NS
Body length (cm)									
4	11.34±0.71^{a}	11.27±0.60^{a}	-00.62	13.40±0.73^{b}	13.54±0.68^{b}	+01.04	*	NS	NS
5	13.28±1.15^{a}	12.38±0.67^{ab}	-06.78	14.00±0.52^{bc}	14.91±0.90^{c}	+06.50	*	*	NS
6	13.50±0.73^{a}	13.14±1.04^{a}	-02.67	16.73±0.58^{b}	16.60±1.01^{b}	-00.77	*	NS	NS
7	13.98±1.46^{a}	13.67±1.18^{a}	-02.22	19.03±0.87^{c}	17.43±1.13^{b}	-08.41	**	*	NS
8	15.15±1.29^{a}	15.32±1.37^{a}	+01.12	20.17±0.91^{b}	19.38±1.47^{b}	-03.92	**	NS	NS

a, b on the same line, values with the same superscripts are not significantly different (P ≥ 0.01);** = P<0.01; *= P<0.05; G= genetic type, T= temperature, GXT= genetic type × temperature interaction

Table 3: Daily average weight gain in local versus exotic chicken at low and high temperature

	Daily weight gain (g)			
	Local chicken		Exotic chicken	
	25°C	35°C	25°C	35°C
Mean DWG_{5-8}	11.66±3.79	8.57±5.27	47.74±16.85	33.18±19.34

Table 4: Consumption index in local versus exotic chickens at low and high temperature

	Consumption index			
	Local chicken		Exotic chicken	
	25°C	35°C	25°C	35°C
Mean CI_{5-8}	6.48±2.78	10.22±6.26	2.67±1.53	4.29±2.71

the CI was more than twice higher in local chicken than its exotic counterpart.

A general increase in the consumption index in local (57.72%) and exotic chicken (60.67%) in case of hyperthermia was observed. However, the thermal stress did not affect this parameter in all birds in the same way, in particular at the 5th, 6th and 8th week of breeding.

Carcass yield and proportions of offal: Table 5 shows the characteristics of the carcass according to the temperature of breeding. The analysis of variance showed that the genetic type and the breeding temperature significantly affected the carcass yield and internal organ weight in chicken, whereas the interaction between these two factors was significant only in the weight of the carcass and abdominal fat. Under the same temperature, the parameters of the carcass and offal are significantly (P<0.05) higher in exotic than in local chicken. For the two genetic types, the yields of the dissected carcass and kidney (P<0.01) were significantly reduced by the increase in the breeding temperature. This reduction was also observed at the level of the weight of the heart, lungs and abdominal fat in local chicken, whereas in the exotic

Table 5: Carcass yield and weight of offal in local versus exotic chickens according to the breeding temperature

Parameters	Carcass and offal yield (g)				Signification		
	Local chicken		Exotic chicken				
	25°C	35°C	25°C	35°C	G	T	GXT
Carcass	390.00±79.07[b]	290.00±91.24[a]	1362.50±323.31[d]	1157.92±150.00[c]	**	**	*
Heart	3.00±00.55[b]	1.69±00.45[a]	6.25±00.55[c]	5.92±00.48[c]	**	*	NS
Liver	14.24±03.45[a]	14.98±03.37[a]	33.79±06.18[b]	32.50±02.87[b]	**	NS	NS
Spleen	1.24±00.12[a]	0.81±00.23[a]	2.37±00.28[b]	2.09±00.64[b]	*	NS	NS
Kidneys	5.79±01.16[b]	3.81±00.87[a]	12.25±00.34[d]	10.45±01.92[c]	*	*	NS
Bursa of fabricius	0.24±00.04[a]	0.25±00.11[a]	0.54±00.12[b]	1.23±00.37[c]	*	*	NS
Lungs	3.96±00.88[b]	2.44±00.53[a]	7.12±00.85[c]	6.76±00.54[c]	*	*	NS
Abdominal fat	4.95±01.32[b]	2.98±00.89[a]	25.09±11.71[c]	23.97±12.37[c]	**	*	*
Pancreas	1.91±00.29[a]	1.13±00.19[a]	4.40±00.32[c]	2.55±00.52[b]	*	*	NS
Gizzard	11.07±01.77[a]	12.42±02.02[a]	24.93±02.54[b]	23.46±02.69[b]	*	NS	NS

Different superscripts in a row differ significantly; ** = P<0.01; *= P<0.05; G= genetic type, T= temperature, GXT= genetic type x temperature interaction

Table 6: Carcass and offal percentages (%) in local versus exotic hens according to the temperature of breeding

carcass and offal	percentages (in % of live weight)			
	Local chicken		Exotic chicken	
	25°C	35°C	25°C	35°C
Carcass	76.08	59.08	73.75	81.37
Lungs	0.77	0.49	0.38	0.47
Heart	0.58	0.34	0.34	0.42
Gizzard	2.15	2.25	1.35	1.65
Pancreas	0.37	0.23	0.24	0.18
Kidneys	1.13	0.77	0.66	0.73
Liver	2.77	3.05	1.83	2.28
Spleen	0.24	0.16	0.13	0.15
Bursa of fabricius	0.04	0.05	0.03	0.09
Abdominal fat	0.96	0.61	1.35	1.68

type the significant reduction in weight was observed for the pancreas. In addition, a very significant increase in the weight of the bursa of Fabricius was noticed in exotic chicken reared under high temperatures.

Table 6 presents the proportions of the carcass and internal organs of local and exotic chickens according to the breeding temperature.

The increase in the breeding temperature generated a drop in the proportion of the pancreas and an increase in the proportions of the liver, bursa of Fabricius and gizzard. In addition, the heat stress caused a reduction in proportions of carcass, lungs, heart, kidneys, spleen and abdominal fat of local chicken, but their increase in exotic chicken.

The variations of the carcass yield and the organ proportions are illustrated in figures 9 and 10.

The carcass yield was reduced by 25.79 and 15.01% respectively in the local and exotic chicken under high temperature. The same was observed in offal weight which underwent a decrease from 34.20 to 43.67% in local chicken, and 4.46 to 42.04% in exotic chicken. However, the local chicken showed an increase in the liver weight (+5.20%), gizzard (+12.19%) and bursa of Fabricius (+4.16%). On the other hand, the exotic chicken displayed a significant increase (P<0.05) in the weight of bursa of Fabricius (127.78%).

The proportions of the gizzard, liver and the bursa of Fabricius in both chicken types subjected to a hyperthermia underwent an increase. The increase in the proportion of the bursa of Fabricius varied strongly (+200%) in exotic hen. In the two genetic types, the induction of the thermal stress caused a fall of the proportions of the pancreas of about 37.83% in local hen and 25.00% in the exotic stock. The proportions of the other bodies dropped in local hen (-22.34% to -36.36%) and increased in exotic hen (+10.33% to +24.59%).

DISCUSSION

The present study revealed that the growth performance is significantly affected by the genetic type and the breeding temperature. It is well known that heat stress limits the physical activities of the animals. This drop of the activities has a negative impact on the feeding behavior and consumption (Bohren *et al.*, 1982). Under these conditions, the animals are more gathered around the water points and increase their water consumption.

The reduction of feed consumption obtained in our study under heat stress is lower than reported by Waibel and MacLeod (1995), Bordas and Minvielle (1997) and Veldkamp *et al.* (2000). In the present study, the decrease of feed consumption is higher in local chicken. This could be explained by the fact that the latter being of small size and with lower growth rate has less need for feed consumption as compared to the exotic chickens. The same is true for water consumption..

As confirmed by Ozbey *et al.* (2000), the rise in the breeding temperature in general has a significant effect on the increase of water consumption in poultry. This was however not the case in local chicken. This detail could be related to an adaptation phenomenon. In natural environment, under the extensive system, the local chicken sometimes has access to drinking water only occasionally. These various feeding and drinking behaviors could also be the result of a long process of adjustment of the different genetic types to their various breeding systems.

This study revealed that the rise in the breeding temperature significantly affected the live weight, the weight gain, the consumption index, and the carcass yield as well as the body measurements having strong correlations with the live weight. These results are in conformity with those of Bohren *et al.* (1982), Donkoh (1989), Ozbey and Ekmen (2000), Ziad (2006), Ozbey *et al.* (2006). A high temperature causes physiological changes in the birds such as the drop of the metabolic rate, this in turn reduces food consumption (Ziad, 2006), digestion and the metabolism (Bonnet *et al.*, 1997; Har *et al.*, 2000). Moreover, the activities of trypsin, chymotrypsine and amylase are significantly reduced in chickens exposed to 32°C (Ziad, 2006), which would involve a reduction in the digestibility of the amino acids. The drop in digestibility of the nutrients would be responsible for the poor productivity.

The reduction of the live weight went up to 29% at the 3rd week of the stress. This result is definitely higher than mentioned by Alihussain-Gardia *et al.* (1983), Emery *et al.* (1984), Mashaly *et al.* (2004). According to Larbier *et al.* (1993), a chronic exposure to heat would involve harmful effects on the aptitude of the animal to digest the digest proteins which is affected by the increase in the temperature (N'dri, 2006). A temperature higher than 25°C involves an increase in the fattening as observed with exotic chicken. This is not the case with the local chicken which thus shows its best adaptability to the heat stress. This also reflects by its live weight which is not significantly affected by the chronic heat stress.

The constancy of local chicken in spite of the rise in the ambient temperature is noted at the level of the body length and the shank diameter which varied little. On the other hand, the significant variations in shanks length, wings length and the chest circumference resulted in an increase in body surface to alleviate body temperature by convection.

The reduction of weight gain of exotic chicken (-77.68%) approaches the margin of 60-74% reported by Hacina *et al.* (1996). Mc Dowell (1972) explained the reduction of the feed efficiency by the fact that in hot climate, the chemical costs per body manufacturing unit are higher because a proportion of chemical energy is trapped for the metabolic process necessary to dissipation of heat.

Conclusion

The study showed that the local chicken is affected by a rise in the ambient temperature compared to exotic counterpart. Heat stress reduced feed consumption in both types of chickens. This reduction in feed consumption significantly affected the live weight and the weight gain in the exotic chicken than local type.

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