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Genetic Improvement of Local Chickens by Crossing with the Label Rouge (T55*SA51): Carcass Characteristic, Organoleptic Qualities and Heterosis Effects

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Abstract: The aim of this study was to evaluate the carcass characteristic and the organoleptic qualities of Label Rouge, North and South Local Chicken and their crossbreed MnFl (females Label Rouge x males of North ecotype), MlFn (North females ecotype x males Label Rouge) and MsFl (Label Rouge females x males of the South ecotype). This study was carried out on the Experimentation Farm of the Polytechnic School of Abomey-Calavi, from August 2007 to may 2008. Ten chicken of each genotype were slaughtered at 24 weeks age. The local chickens of the North ecotype had a live weight at the slaughter significantly higher than that of the Southern ecotype and lower compared to the cross and the Label Rouge; the same tendency was observed for the noble carcass cuts. The carcass yield was similar for the six genetic types. The meats of Label Rouge chickens, the local chickens and the Cross MsFl were less tender ($p<0.05$) than those of North chickens and the Cross containing the "North blood" (MnFl and MlFn). No significant differences were observed in other hand on the juiciness and the flavor for the six genetic types. For each type of crossing, the heterosis effect of the live weight, the hot carcass weight and the wet carcass weight had a close values. In general, the different heterosis rates of the crossing male of North ecotype x female Label was superior than those of the other crossings.

Key words: Crossing, heterosis, label rouge, local chicken, carcass, meat, Benin

INTRODUCTION

Food safety is today the greatest challenge of the United State Organization for Food and Agriculture (FAO) and consists in obtaining and guaranteeing an increasing the quality and the quantity of food production for the population which increase year by year. In the field of animal production, poultry breeding represents one of the ways on which the countries of sub-Saharan Africa in general and the Benin in particular, were committed to increase their production of animal proteins. In Benin, in spite of the efforts provided by the government, the meat production in general and poultry meat in particular is under the needs expressed by the consumers and this deficit is made good by imports which increase year by year (FAOSTAT, 2008). For more durability and food safety in animal protein, the meat production must be directed towards the indigenous chicken populations which indeed account for 80% of the local production of chicken meat. In Benin, the indigenous chicken populations of the species *Gallus gallus* of the two great climatic areas (north and south) have a remarkable heterogeneity in phenotypical traits (live weight, body measurement, the feathers' colour, the feathers' structure, feather distribution, the feather drawing, the nature of feathering, the colouring of the legs and the eyes colour) (Youssao *et al*., 2007) and in polymorphism trait (Youssao *et al*., 2009a). The differences of colour come from major gene effect and cultural preferences of the breeder, but not by the climate.

A comparison for the growth performances and of the north ecotype chicken to those of the south ecotype was carried out in station in order to test if the difference of Live Weight between those two ecotypes chicken is due to the climate and/or to the breeding mode (Youssao *et al*., 2009a). In this study, the Label Rouge (T55 X SA51) were identified as control animal in the evaluation of the indigenous chicken populations of *Gallus gallus* species in the coastal countries of West Africa, in particular, in Benin, in Ivory coast and in Ghana within the frame of the Promoting Sustainable Development in Agricultural Research Systems Project (Youssao, 2006). It comes out from this study that the weight of Label Rouge (2539 g) was the double of these of indigenous chicken of north ecotype (1202 g) and 2.8 times these of indigenous chickens of south ecotype (880 g). The North local chickens have a live weight at slaughter higher

than the ones of the South local chickens and were significantly weaker ($p<0.001$) than those of the Label Rouge (Youssao *et al*., 2009b). In conclusion, the difference of weight performance comes from polygene effect, but not the climate too.

Taking into account of the differences on growth between the local chickens and the Label Rouge, the genetics improvement of local chicken have been achieved by crossing with Label Rouge in order to evaluate the growth performances of crossbreed with the one of the parental (Youssao *et al*., 2009c). It comes out from this study that the Label have a weight and an Average Daily Gain (ADG) significantly higher ($p< 0.001$) than that of local chickens (North and South) ones and the crossbreed had an intermediate average daily gain and live weight at slaughter weight (Youssao *et al*., 2009c).

The aim of this study was to evaluate the carcass characteristic and the organoleptic qualities of these crossbreed with those of parental ones and to evaluate their hetesosis effect.

MATERIALS AND METHODS

Area of study: The study of Genetic improvement of local chickens by crossing with the Label Rouge was carried out on the Experimentation Farm of the Polytechnic School of Abomey-Calavi (EPAC), from August 2007 to May 2008. This Farm is located in the Department of the Atlantic and more precisely in the District of Abomey-Calavi. This district profits from the climatic conditions of subequatorial type, characterized by two rainy seasons: the large (from April to July) and the small (from September to November). These two seasons are intercalated by a dry seasons. Average pluviometry is close to 1200 mm per annum. The monthly average temperatures vary between 27 and 31°C and the relative humidity of the air fluctuates between 65% from January to March and 97% from June to July.

Animals and management: The reproductive animals used for this study are consisted of Label rouge chickens and local chickens of the North and South ecotypes. The Label Rouge chicken is a heavy stock with slow growth resulting from the final crossing between the T55 stocks and SA51 of the group SASSO. The local chickens of the North and South ecotypes came from the cores of reproducers of the Experimental Farm of the Animal Health and Production Department from of the Polytechnic School of Abomey-Calavi (EPAC). This study was carried out on a sample of reproducers divided into 7 lots:

- lot 1 is composed of 10 females Label Rouge and 4 males of North ecotype.
- lot 2 is composed of 10 females of North ecotype and 4 Label Rouge males.
- lot 3 is composed of 10 females Label Rouge and 4 males of the South ecotype.
- lot 4 is composed of 10 females of South ecotype and 4 males Label Rouge.
- lot 5 is composed of local chickens of the North ecotype.
- lot 6 is composed of local chickens of the South ecotype.
- lot 6 is composed of the Label Rouge.

These reproducers were old on average of 240±21 days and were in their third month of laying. The eggs obtained of the various lots were collected, counted, weighed and incubated per lot. At the hatching, 6 lots of chicks were made up:

- The lot MnFl is composed of 47 chicks resulting from the crossing between females Label Rouge and males of North ecotype.
- The lot MlFn is composed of 58 chicks resulting from the crossing between North females and males Label Rouge.
- The lot MsFl is composed of 36 chicks resulting from the crossing between Label Rouge females and males of the South ecotype.
- The lot of north local chickens composed of 112 chicks.
- The lot of South local chickens composed of 128 chicks.
- The lot of Label Rouge composed of 204 chicks.

The coupling between the males Label Rouge and the females of South ecotype were stopped because the females of south ecotype are smaller in format than the males Label Rouge which regularly injury them during the coupling. Few fertile eggs were obtained, no eggs were incubated and in consequence, this lot weren't taken into account in the suite of the experiment.

All the animals were fed with the same diet. Three diets were used: starting (2880.53 EM Kcal/kg and 18.61% of crude protein), growth (2969.58 EM Kcal/kg and 17.8% crude protein) and laying (2800 EM Kcal/kg of feed and 20.14 % of crude protein). The starter feed was used from the hatching to the age of 2 months and the growth feed from 2 month old to the point of laying (22 weeks). From the point of laying to the end of the experimentation, the laying feed was used. The animals were fed *ad libitum* throughout the study. The prevention against the disease of Newcasttle, Coccidiosis, avian infectious bronchitis, Gumboro, fowl pox and the Marek's disease was made. Monthly, a sampling of feces were analyzed in order to follow the effectiveness of the antiparasitic treatments made and to make sure that the coccidium and gastro-intestinal parasites do not influence the growth performances of the animals. The animals of the three genetic cross as well as the parental were raised in the same condition (on the plans of feeding and medicare) until 24 weeks age when they

were slaughtered. Their live weights before the slaughter were 2309 g, 1215 g and 992 g, respectively for the Label Rouge, North ecotype chickens and South ecotype chicken and 2012 g, 2145.17 g and 1883 g respectively for the MnFl, MlFn and MsFl crossbreeds.

Slaughter: The criterion of selection of the animals slaughtered was the weight and it is the first 5 animals which weighted higher than the average weight and the first 5 animals which are below the average weight. Once the choice carried out, the animals was put on an empty stomach during 16 h, after, their live weights were taken. The chickens were bled by section of the jugular vein and scalded in boiled water and manually plucked. Then, they were eviscerated and the crop was taken off.

Measure pH: The pH was initially taken 15 min after and 24 h later the slaughter on the carcass breast before cutting. The pH was measured using a pH-meter of HANNA mark provided with a specialized probe. This apparatus was calibrated with two buffers pH-meter: pH = 4.1 and pH = 7.1 following a procedure provided by manufacturer (HANNA Instrument ®, Italy).

Cutting of the carcass: 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 as the abdominal fat. The carcass weight as well as the ones of the waste products and the giblets (head, legs, liver, heart, gizzard, abdominal fat and proventriculus) was determined. The various cuts taken were the following: the breast, the whole thigh-drumstick, the wings and the rest of the carcass.

Cooking: The carcass cut (drumstick, thigh, breast) of the animals of each genetic type (Label rouge, chicken of North, chicken of the South, MnFl, MlFl, MsFl) were cooked with water in a separate pot without flavoring and salt during a proportional time to their weight "right to be cooked" on the base of 1 h for 1 kg.

Jury: The jury was composed of 24 members taken randomly. It should be noted that no judge was informed on the type of meat he tasted, he has only to assess the quality on the basis of form which was given to him.

Tasting: For each mode of cooking, each judge receives in a plate, a part of each homologous cutting belonging to each genetic type (example: 5 judges receive each, one piece of drumstick of each genetic type) and fills a results recapitulation formulary resulting from tasting.
The judges evaluated the three important characteristics for the meat quality: tenderness, juiciness and the flavor intensity, noted on scales going from 1-5. Moreover, each judge gave a total note of appreciation varying from 1-10. For tenderness, the 1 corresponds to very tough, the 2 to tough, the 3 to acceptable, the 4 to tender and the 5 to very tender. As for the juiciness, the 1 corresponds to very dry, the 2 to dry, the 3 to acceptable, the 4 to marrowy and the 5 to very marrowy. At last, the intensity of the flavor is very weak (1), weak (2), acceptable (3), high (4) and very high (5). All the collected data were recorded on a card in which each animal carries a number and all information relating to it.

Statistical analysis: The live weight at slaughter, the carcass weight, the hot carcass weights, the wet carcass weight, the carcass cut weight, the internal weights organs (gizzard, liver and heart), the pH measured at 15 mn (pH15) and at 24h (pH24) after slaughter, was initially recorded. The breast proportions, thigh-drumstick and wings were calculated compared to the weight of the carcass. The variance analysis was carried out by considering the genetic type (Label, chickens of North, chickens of the South and the three cross ones) as source of variation. The means were calculated and compared by the test of t.
As for organoleptic qualities, the tenderness, the juiciness, the flavour and the acceptability were taken into account for the data analysis. Two factors were taken into account in the variance analysis: the genetic type (Label Rouge, chickens of North and chickens of the South and the 3 cross ones) and the carcass cut (thigh, drumstick and breast). The means were initially calculated and the comparisons were made between the genetic types and for each genetic type, between the various pieces of cutting, using the t test. Heterosis was estimated as:

$$\text{Heterosis} = \frac{F_1 - \frac{(\text{Parent}1 + \text{Parent}2)}{2}}{\frac{(\text{Parent}1 + \text{Parent}2)}{2}}$$

Where, F1 resulting from the crossing MnFl, MlFn or MsFl, the parents were male or female of Label Rouge and local chicken ecotype of the north or South area, according to the crossing.
The data were analyzed by SAS (Statistical Analysis System, 1989) and variance analysis was carried out by the model linear procedure (Proc GLM).

RESULTS

Characteristic of the carcass: Table 1 presents the weights of the various components of the carcass by genetic types. No abdominal fat was observed for al the chickens (North and South ecotype, cross and Label Chick). The live weight at the slaughter varied according to the genetic type ($p<0.001$). The live weight at the slaughter of the Label Rouge was significantly higher

Table 1: Comparison of the carcass characteristics of the local chickens, the Label Rouge and the crossbreeds resulting from their crossing

Variables	Label Rouge	South local chicken	North local chicken	MlFn	MnFl	MsFl	Test of sig.	RSD	R^2
Live weight (g)	2309.17^{a}	991.67^{e}	1215^{d}	2145^{b}	2012.5^{bc}	1882.5^{c}	***	195.56	0.89
Hot carcass weight (g)	1680.17^{a}	750^{d}	920.83^{d}	1595^{b}	1477.5^{c}	1387.5^{c}	***	103.67	0.93
Wetcarcass weight (g)	1646.5^{a}	743.33^{e}	913.33^{d}	1548.25^{ab}	1444.5^{b}	1352^{c}	***	117.75	0.91
Carcass yield 1h (%)	73.92^{a}	75.86^{a}	75.79^{a}	74.55^{a}	73.41^{a}	73.69^{a}	NS	5.43	0.03
Carcass yield 24h (%)	71.93^{a}	75.2^{a}	75.21^{a}	72.36^{a}	71.78^{a}	71.8^{a}	NS	4.45	0.12
Breast (g)	388.33^{a}	150.67^{e}	184d	363^{ab}	347^{bc}	319.25^{c}	***	37.79	0.88
Thigh and drumstick (g)	554.5^{a}	249^{e}	295.17^{d}	625^{a}	476.5^{c}	449.5^{c}	***	36.02	0.93
Wings (g)	194.83^{a}	88.67^{d}	118^{c}	204.25^{a}	190^{a}	174.5^{b}	***	15.12	0.91
Breast (%)	23.48^{a}	20.24^{b}	20.24^{b}	23.42^{a}	24.05^{a}	23.6^{a}	***	1.42	0.6
Thigh and drumstick (%)	33.93^{a}	33.5^{a}	32.32^{a}	33.99^{a}	32.96^{a}	33.25^{a}	NS	1.82	0.11
Wings (%)	11.89^{a}	11.93^{a}	13.36^{a}	13.18^{a}	13.15^{a}	12.92^{a}	NS	2.08	0.09
Heart (g)	8.5^{a}	5.83^{b}	6.58^{b}	8.62^{a}	7.5^{a}	8.5^{a}	***	1.14	0.5
Neck (g)	125.8^{b}	60.67^{d}	76.67^{c}	142^{a}	123^{b}	119.25^{b}	***	13.45	0.85
Liver (g)	34.67^{a}	8.67^{b}	10.75^{b}	31^{a}	24.87^{b}	26.12^{b}	***	5.25	0.81
Gizzard (g)	51^{a}	21.33^{d}	21.67^{d}	31^{c}	38.37^{b}	27.25^{c}	***	6.66	0.76
Head (g)	102^{a}	50.5^{e}	54.67^{d}	72.25^{c}	94.25^{b}	73.87^{c}	***	6	0.92
Legs (g)	104.83^{a}	37.17^{d}	44.58^{d}	80.5^{b}	83.75^{b}	77.5^{c}	***	6.75	0.94
Rest (g)	366.33^{a}	151.67^{e}	198^{d}	300.25^{b}	305.25^{b}	283.25^{c}	***	44.38	0.77
pH1	6.44^{a}	6.47^{a}	6.46^{a}	5.73^{c}	5.78^{c}	6.21^{b}	***	0.2	0.7
pH24	6.23^{a}	6.22^{a}	6.2^{a}	5.71^{d}	5.95^{c}	6.09^{bc}	***	0.2	0.44

RSD: residual standard deviation; R^2: coefficient of determination; MnFl: north male and label female; MlFn: label male and north female; MsFl: south male sud and label female; ***: p<0.001; NS: p>0.05, the means between the classes of the same column followed by different letters, differ significantly (p<0,05)

than those of cross and the local breeds. Among the cross ones, the MlFn males have a weight more significant than that of MsFl, whereas MnFl have an intermediate weight and not differ significantly from both others cross. The local chickens of the North ecotype had a live weight at the slaughter significantly higher than that of the Southern ecotype and lower compared to the cross and the Label Rouge. Proportionally to the live weight at the slaughter, the Label Rouge had a carcass (hot or wet) heavier than the cross ones and the local breeds had the least significant carcasses (p<0.001). On the other hand, all the genetic types gave similar carcass yield varying from 73.41-75.86% for the hot carcass and from 71.78-75.21% for the wet carcass.

As for the carcass cut noble, the Label Rouge have a breast, thighs and drumstick heavier than those of cross resulting from the local males parents (p<0.05) but close to cross to parents male of Label breed (p>0.05). The wings of the Label Rouge had a weight more significant than that of cross MsFl (p<0.05) and similar to those of both others cross. The local chickens of the North ecotypes of Benin had a breast, thighs, drumsticks and wings heavier than those of the South ecotype (P<0.05).

In addition, few differences were observed between the proportions of the various pieces of cutting. The proportions of breast, the thighs and drumsticks and the wings of the Label Rouge do not differ significantly from those of the three types of cross. At the local breeds, the proportions of the noble pieces were identical and the only difference compared to cross and the Label Rouge was observed on the breast proportion; the local chickens had a less significant proportion of breast (p<0.001) than the cross and the Label.

For the weight of the visceral organs, the heart, the liver and the gizzard of the local chickens have respective weights lower than those of the other genetic types (p<0.001). The weight of the heart of the Label Rouge was not different from those of the cross ones, whereas the gizzard of the Label is heavier than that of cross (p<0.01). The weight of the liver of the Label was near to that of cross of father Label and significantly more significant than those of cross resulting from indigenous cocks.

The pH1 and pH24 of the Label Rouge were identical to those of local chickens of North and the South whereas the cross ones had the lower pH (p<0.001).

Organoleptic qualities: The meat of the Label chickens, local chickens of South ecotype and cross MsFl were more tender (p<0.05) than that of chickens of North and cross containing the gene north (MlFn and MnFl). No significant difference was observed on the juiciness and the flavour for the 6 genotypes. The averages of tenderness, the juiciness and the flavour of the various genetic types are given in the Table 2.

The breast, the thigh and the drumstick have the same tenderness and the identical flavours whereas the breast is juicier than the drumstick and the thighs have an intermediate appreciation (Table 2).

The tenderness, the juiciness and the flavour of the various organs (breast, thigh, drumstick) were identical for the south and the north local chickens and the cross ones (MlFn, MnFl and MsFl). However, at the Label Rouge, the breast is juicier than the drumstick whereas the juiciness of the thigh was intermediate with that of the two other pieces of cutting. However no significant difference was observed between the tenderness and the flavour of the three pieces of meat of the Label

Table 2: Organoleptic quality of the six genetic types

Source of variation		Tenderness		Juiciness		Flavour	
		Mean	SE	Mean	SE	Mean	SE
	Label	3.95[a]	0.21	3.38[a]	0.18	2.81[a]	0.19
Origin	MlFn	3.27[b]	0.17	3.09[a]	0.15	3.06[a]	0.15
	MnFl	3.19[b]	0.16	3.14[a]	0.14	2.83[a]	0.15
	MsFl	3.5[a]	0.16	3.14[a]	0.14	2.97[a]	0.15
	North	2.95[b]	0.21	3.28[a]	0.18	2.81[a]	0.19
	South	3.52[ab]	0.21	3.33[a]	0.18	2.90[a]	0.19
Organs	Breast	3.61[a]	0.13	3.48[a]	0.11	2.90[a]	0.12
	Thigh	3.26[a]	0.13	3.21[ab]	0.11	2.94[a]	0.12
	Drumstick	3.32[a]	0.13	2.99[b]	0.11	2.85[a]	0.12

ES: standard error; the means between the classes of the same column followed by different letters, differ significantly (p<0,05)

Table 3: Organoleptic quality of the different pieces of cutting (breast, thigh, drumstick) of each genetic type

Origin	Organs	Tenderness		Juiciness		Flavour	
		Mean	SE	Mean	Mean	SE	Mean
Label rouge							
	Breast	4.43[a]	0.37	4.00[a]	0.32	3.00[a]	0.33
	Thigh	3.57[a]	0.37	3.43[ab]	0.32	3.00[a]	0.33
	Drumstick	3.86[a]	0.37	2.71[b]	0.32	2.43[a]	0.33
Male Label X Female of North ecotype							
	Breast	3.64[a]	0.29	3.27[a]	0.25	3.09[a]	0.27
	Thigh	3.09[a]	0.29	3.00[a]	0.25	3.18[a]	0.27
	Drumstick	3.09[a]	0.29	3.00[a]	0.25	2.91[a]	0.27
Male of North ecotype X Female Label							
	Breast	2.92[a]	0.28	3.08[a]	0.24	2.75[a]	0.25
	Thigh	3.67[a]	0.28	3.25[a]	0.24	3.08[a]	0.25
	Drumstick	3.00[a]	0.28	3.08[a]	0.24	2.67[a]	0.25
Male of South ecotype X Female Label							
	Breast	3.83[a]	0.28	3.42[a]	0.24	3.00[a]	0.25
	Thigh	3.5[a]	0.28	3.00[a]	0.24	2.83[a]	0.25
	Drumstick	3.17[a]	0.28	3.00[a]	0.24	3.08[a]	0.25
North ecotype							
	Breast	3.14[a]	0.37	3.57[a]	0.32	2.71[a]	0.33
	thigh	2.57[a]	0.37	3.14[a]	0.32	2.86[a]	0.33
	drumstick	3.14[a]	0.37	3.14[a]	0.32	2.86[a]	0.33
South ecotype							
	Breast	3.71[a]	0.37	3.57[a]	0.32	2.86[a]	0.33
	Thigh	3.14[a]	0.37	3.43[a]	0.32	2.71[a]	0.33
	Drumstick	3.71[a]	0.37	3.00[a]	0.32	3.14[a]	0.33

SE: standarderror; the means between the classes of the same column followed by different letters, differ significantly (p<0,05)

Rouge. The comparison of organoleptic qualities of the various pieces of cutting is given to Table 3.

Heterosis effect of the carcass performances: Table 4 presents the heterosis effect of various crossbreeds between Label Rouge an indigenous chicken. The heterosis effects were significant (p<0.001) and varying between 12,86-22.65. The higher heterosis were observed in the MlFn group. For those crossing, the carcass yield was not improved because the heter 21.73 22.65 and 20.67% respectively for the live weight, the hot carcass weight and that heterosis effect was weak and not significant in each crossbreed (p>0.05).

The weight heterosis of the breast, the thigh and the drumstick, the wings and the neck were significantly higher (p<0.001) and the highest heterosis were observed for the breast and the neck for each crossbreed. For the weight of the head and the one of the legs, some important heterosis effect (p<0.01) were obtained in the group of the cross MnFl. Apart from the tenderness of the cross MlFn meat, the heterosis effect of the three cross were negative and non significant.

DISCUSSION

Characteristics of the carcass: The live weight at slaughter and the carcasses weight (hot and wet) of the Label Rouge were significantly higher than those of cross and the local chickens. The animals being raised in the same conditions and at the same age, this difference is then from genetic origin. The Label weight being twice more significant than the weight of the local chickens, it is then logical that their cutting pieces are the double of those of local chickens. The carcass weight and the carcass cut of local chickens had been improved by crossing with the Label Rouge breed through F1 whose carcass performances are intermediate to those of the parental ones. Among the cross ones, the males MlFn had a weight more

Table 4: Heterosis effect of the various crossbreeds between Label Rouge and indigenous chicken

Variable	MlFn (%)	MnFl (%)	MsFl (%)
Live weight (g)	21.73***	14.21**	14.06**
Hot carcass weight (g)	22.65***	13.61**	14.19**
Wet carcass weight (g)	20.97***	12.86**	13.15**
Carcass yield 1 (%)	-0.41^{NS}	-1.93^{NS}	-1.60^{NS}
Carcass yield 2 (%)	-1.64^{NS}	-2.43^{NS}	-2.40^{NS}
Breast (g)	26.85***	21.26***	18.46**
Thigh and drumstick (g)	47.12***	12.16***	11.89**
Wings (g)	30.58***	21.47***	23.10***
Breast (%)	10.02**	7.13^{NS}	8.01**
Thigh and drumstick (%)	-0.48^{NS}	2.44^{NS}	-1.39^{NS}
Wings (%)	6.05^{NS}	6.29^{NS}	4.02^{NS}
Heart (g)	14.3*	-0.53^{NS}	18.63**
Neck (g)	40.27***	21.50***	27.90***
Liver (g)	36.50***	9.51^{NS}	20.54***
Gizzard (g)	-14.68*	5.60^{NS}	-24.65***
Head (g)	-7.77*	20.32***	-3.12^{NS}
Legs (g)	7.76*	12.11**	9.15*
Tenderness	-5.22^{NS}	-7.54^{NS}	-5.76^{NS}
Juiciness	-7.21^{NS}	-5.71^{NS}	-0.75^{NS}
Flavour	8.90*	5.69^{NS}	1.58^{NS}

*: p<0.05; **: p<0.001; ***: p<0.001; NS: p>0.05

significant than that of MsFl, whereas MnFl had an intermediate weight and not significantly different from both others cross.

According to Firm SASSO, labels' were selected to provide a quality of meat higher than that of standard broiler, which does not prevent the labels from having normally an abdominal fattening level of about 2-3% at 12 weeks age (N'dri *et al*., 2007). In the case of this study, no abdominal fat was observed and the results of this study confirm those of Fotsa (2008) in Cameroun at the time of the study on the body composition and organoleptic qualities of the local cocks and the Label Rouge. The explanation of this extreme low fattening level can be required in the speed of very slow growth of the animals; the adipose tissue settles tardily during the growth and a delay of growth delays in particular the fat deposit.

According to Santé *et al*. (2001), the breast weight percentage in the carcass is an important criterion in the broiler poultry production. Thus the carcass weight and the large breast proportion of the Label Rouge chicken and cross make them to be the better broiler chicken compared to the indigenous chicken. If the local chickens were slaughtered at their slaughter age, the Label Rouge and the cross on the other hand were slaughtered at an advanced age.

According to Youssao *et al*. (2009a), beyond 12 weeks, it is not economically profitable to raise the Label rouge in tropical area. The 10th week is advised because the feed conversion at the 12th week is 7.7 against 4.29 for the 10th week and for a live weight of 1691 g. In France, the slaughter age was also fixed at 81 days. It would be useful and practical to undertake a study aiming at comparing the three genetic types according to their slaughter age. A similar comparison was made in France by Quentin *et al*. (2003) with an aim of comparing the carcass composition and some meat quality parameters of the chickens at fast growth, average growth and slow growth, fed with 3 increasing proteinic and energy concentration diets. It comes out from this study that for chicken slaughtered at the commercial age, the chicken F had a higher pectoral muscles (*Pectoralis major* + *minor*) yield and a weaker abdominal fat content (17,2% and 2,64% respectively) compared to the chickens M (15.7%, 2.86% respectively) and the chickens S (14.4%, 3.44% respectively) (p<0.05). The density of the diets used doesn't have any effect on the carcass composition, the ultimate pH and the water loss of the chicken meat (Quentin *et al*., 2003).

Organoleptic qualities: Contrary to the standard chickens which are little appreciated compared to local chickens, the Label Rouge and the crossbreeds MnFl, MlFn and MsFl are accepted by the consumers of Benin as well as local chickens. Apart from the juiciness and the flavour, the meat of the Label Rouge chickens, local chickens of the South and the cross ones containing Southern blood (MsFl), were more tender (p<0.05) than that of chickens of North and cross containing Northern blood (MlFn and MnFl). The chickens of North raised in pure breed or crossing were less tender in the present study. A repeatability of the experimentation will make it possible to confirm or invalidate the results of this study. The study of tenderness by the use of the force of shearing of muscle fibres or by proportioning of collagen will bring more precise details on the results obtained. In a general way, tenderness of the poultry meat depends on the quality of connective tissue (collagen), the myofibrillar structure and the structural interactions between fibres and the extracellular matrix. The poultry meat texture problems concern as well an excessive callousness as of a lack of cohesion of meat (Santé *et al*., 2001).

The results on the tenderness, the juiciness and the flavor were not overall significant for all piece of the carcass tasted by the panelists on the cross, the North local chickens and the South local chickens. These results are in accordance with those of Fotsa (2008) on chickens of Cameroun and the Label Rouge. In a similar study carried out on selected animals at slow and fast growth and tested at equal age (16 weeks), Touraille *et al*. (1981) find few variations for the organoleptic characters as well for the thigh for the pectoral one. According to Guèye *et al*. (2000), a sensory test including local chickens of 24 weeks old and 7 weeks a commercial stock, showed differences in flavor to the advantage of local chickens but the others organoleptic characters such as tenderness, the juiciness were comparable between the two genetic types tested. A test of tasting on the broiler in semi divagation and in total confinement shows that the organoleptic quality of the meat resulting from the broiler are significantly better when they are raised in a semi divagation system compared to intensive system (Deka and Kalita, 2004). This difference is explained by the physical exercises, the food consumed at the time of the divagation and

according to Gaddis *et al.* (1950), by the presence of intramuscular grease associated to the juicier character of the meat. In the case of this study, the crossbreeds and the parentals were raised in cloistering and their sensory qualities were overall identical.

Heterosis effects: Generally, the three types of crossing profited from a double heterosis effect. Indeed, cross MnFl and MsFl are prone on the one hand to an individual heterosis owing to the fact that they are the product of a crossing of two genetically distant parents and on the other hand of a maternal heterosis related to the fact that their mother (Label Rouge) is itself product of a crossing (T55*SA51) and that it confers them an advantage in relation to the situation that it is used as pure breed (Youssao *et al.*, 2009a). As for cross MlFn, they profited from an individual heterosis on the one hand because being the products of a crossing and on the other hand, a paternal heterosis related to the fact that their father (Label Rouge) is itself product of a crossing (T55*SA51).

For the live weight, the hot carcass weights and the wet carcass weight, the heterosis rates were similar in the order of 13 and 14% respectively for cross MlFn and MsFl; these rates remained significantly lower than those obtained at cross MnFl. One could expect that the crossbreeds MsFl have heterosis effects as high as those of MnFl since they contain also the blood of the Label Rouge (known for its good carcass performances) that their various mothers would have transmitted for them, but it is not the case. This difference could be explained by the expression of the strength of the respective fathers. Indeed, in the present study, the animals of North ecotype had better carcass characteristics than those of chickens of South ecotype. By the same ways, the heterosis rates of MnFl for the other variables were better than those of the two other types of cross. All this leads us to say that the crossing male of North and female Label is most interesting in the present study.

The heterosis rates calculated on the carcass yield at 1 h and 24 h after slaughter were negative for all the three types of crossing. These results are contrary to those of Ricard (1990) which reports that the carcass yield of cross is generally better than that of the parental stocks. According to Sun *et al.* (2005), the heterosis percentage varying by hybrid type, from -32.49-18,62 for breast muscle yield traits, -20,50-22,07% for leg muscle yield trait, -15,59-8.85% for wing weight. Those results are similar to ones obtained in this study. In a total way, it was thus observed that the expression of the genotype of the individuals of the first generation (F1) was higher than the average of the values of the parental genotypes, contrary to what should occur if there were simple addition of characters (Falconer and Mackay, 1996). The crossing reduces the frequency of homozygote alleles (identical gene couples) and increases the number of heterozygote allele (Lhoste *et al.*, 1993; Bonnes *et al.*, 1991, Leroy *et al.*, 2000). So the majority of the recessive characters, unfavorable, are masked by dominant, favorable characters. This is why the crossbreeds often have genetic capacities definitely higher than the average of those their parents. The high heterosis observed in the present study is explained by the distance of these two races on the genetic level. This variability of the heterosis obtained in this experimentation comes from the fact that the relative value of a crossing depends on the genes which are put in presence and not the absolute value of each one of these genes (Ricard, 1990).

In general, experimental data presented in this paper demonstrated that there are differential gene expression between chicken hybrids and their parents. The same results were also reported in inbred birds and their hybrid offspring (Emmerson *et al.*, 1991; Ye *et al.*, 1997; Nestor and Anderson, 1998; Nestor *et al.*, 2001; Sun *et al.*, 2005). Therefore, it may be concluded that the hybrid genetic performance is not a simple additive product of genetic material fro both parent, but the result of variation in expression of the two set of the genes withing the hydrides results l the occurrence of heterosis.

Conclusion: This study related to the genetic improvement of local chickens by crossing with the Label Rouge. It enabled us to evaluate the carcass characteristics, the organoleptic and sensory qualities of the meat. With regard to the carcass characteristics, we noted that the Label Rouge chickens have a live weight at slaughter and a carcass (hot or wet) weight significantly higher than those of the crossed and locals. The local chickens have a breast proportion less significant than the cross ones which do not differ significantly from the Label Rouge. The crossing had no effect on the carcass yield at the slaughter. The meats of the Label Rouge chickens, the local chickens of the South and cross MsFl were more tender than those of chickens of North and cross containing North blood (MnFl and MlFn). The crossing does not influence the juiciness and the flavour for the six genotypes. The meat of cross MnFl, MlFn and MsFl is appreciated as well as those of the Label Rouge and local chickens. The characteristic of absence of abdominal fat is found in the groups of the local chickens, the crossbreeds and the Label Rouge. The label thus seems as an interesting genotype for a project of genetic improvement of local hen.

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