Productivity of Animals from the Cross Between N'dama And Nelore At The Kila Ranch in the Republic of Congo

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Abstract
Purpose: *The objective of this study was to improve the productivity of the N'Dama breed bred in the Congo, which shows low productivity.*
Methodology: *the crossing between Nélores gave NN, the NN females are crossed with the N'Dama ND males, which gives the N'Dalores 1 of the male and female animals of NDL blood. The NDL females are crossed with the NN male Nélores in order to obtain the expected crosses called the N'Dalores 2, having NN/NDL (NNDL) blood.*
Results: *the N'Dalores 2 resulting from the cross between the N'Dalore 1 and the Nélore, are born with a weight of 24.14 ± 1.65 kg for the males and 22.93 ± 2.15 kg for the females. N'Dalores are humpless, with varying coats of grey-white, light-grey, fawn and grey-white with dark spots. N'Dalores animals have higher production performance than N'Dama animals. At slaughter, the live weight was 388.16 ± 5.1 kg with an average yield of 60.14%.*
Conclusion: *the results obtained show that the Nélore breed was adapted to the rearing conditions of the Kila farm, and the improvement of the N'Dama breed was observed through the crossbreeds. These results are an important tool in the development of breeding programs and improvement of the zootechnical performance of N'Dama cattle.*
Keywords: *Nélore-N'Dama-N'Dalore-Crossing-Improvement-Congo*

I. Introduction

In Congo, food self-sufficiency as a vision of the government since the 1980s has generated many agricultural development projects with results below the expectations of the populations (AKOUANGO, 2018).

However, the development potential of livestock farming is enormous and only needs to be rationalized and improved to enhance animal production. The Congo, despite the efforts made, is today considered a country with a weak pastoral tradition which translates by a massive importation of foodstuffs mainly of meat origin (DIMI et al., 2021).

The majority of cattle breeding herds in the Congo are populated by N'Dama breed cattle. Despite its hardiness, its trypanotolerance, it shows slow growth, low meat yield, lengthening of the duration between two calvings, low calving weight, low fertilizing power and a small scrotal circumference (DIMI, 2021).

In order to improve the low productivity through the criteria mentioned above of N'Dama cattle, Nelore cattle were imported from Brazil in order to adapt them to the climatic conditions of Congo and then use them as an improving breed.

From 2012 to 2014, 4418 heads of Nelore cattle were imported from Brazil and transferred to the northern part of the country in the department of Cuvette where they are raised on the Kila, Mbobo and Kangala ranches.

The supply of blood to a certain degree by the Nélore in the N'Dama could improve certain production parameters in the N'Dama. Maintaining the blood level of the Nelore at a certain given percentage will improve meat production in crossbreds.

II. Material And Methods

Geographic location
The Kila ranch is located 15km from the Oyo sub-prefecture to the north on the Oyo-Obouya axis, on national road no. 2 between Bara village and Opokagnia, basin department. It is located south of the equator, between

1°11' 25.80" South latitude and 16°01' 56.11" East longitude of the Greenwich meridian at an altitude of 311m above sea level. the sea, to the south-west of the Congolese Basin. It specializes in the production and distribution of beef for the internal market of the Republic of Congo.

Climatic aspects : The area is under the influence of the Congolese equatorial climate of the "Guinean Forest" type, characterized by relatively high rainfall, i.e. 1600 -1800 mm of water per year, with an average annual temperature of 26°C and a low annual temperature difference of around 2°C. In this locality, the year is divided into four **seasons :** a long rainy season from October to December, a short dry season from January to February, a short rainy season from March to April and a long dry season from May to September.

Hydrographic aspects : The study area is watered mainly on the east side by the Alima, one of the tributaries of the Congo River, with an average flow of 537 m3/s (DIMI et al., 2020).

Aspects of the soil and vegetation : In the study area, the soil is characterized by an almost permanent hydromorphy with an accumulation of organic matter. It is 86-96% sandy, rich in fine sand (62-73%), clay (0 – 8.5%) and very permeable. The pH fluctuates between 5.2 and 5.9 (YOKA et al., 2007). Soil moisture also varies with depth.

Food: The animals graze on natural rangelands, where species such as: *Bulbostylis laniceps, Trachypogon spicatus, Ctenium newtonii, Hyparrhenia wombaliensis* (MOPOUNDZA et al, 2016) are found. The farm also has artificial grassed pastures with: *Panicum massaye, Brachiara brizenta, Brachiara omidicola, Bracharia Laneiro.* Brewery grains are distributed twice (2) a week with a mineral vitamin supplement based on cooking salt. Drinking water is served ad libitum.

Prophylaxis : Animals undergo regular deworming and treatment with trypanocides. They are vaccinated against pasteurellosis and contagious bovine pleuropneumonia and are screened for brucellosis and tuberculosis. The mounts are natural, the breeding bulls are left there permanently.Compared to their N'Dama landrace parents.

Description of crossings

The first crossing consisted in crossing Nélores animals to give the first generation of Nélores in Congo; these are NN/NN animals, male and female. Subsequently, Nélores NN females were crossed with N'Dama ND males in order to improve the productivity of the N'Dama breed. This second level of crossing will thus give the N'Dalores 1 of the male and female animals of NDL blood. This is the contribution of Nélore blood to N'Dama with different genotypes.

NDL♂ males are castrated, fattened, then taken to the slaughterhouse; while all the NDL♀ females are used in the renewal of the herd by crossing them with the male Nélores (NN♂) in order to obtain the expected crosses called the N'Dalores 2, having for blood NN♂/ NDL♀ (NNDL).
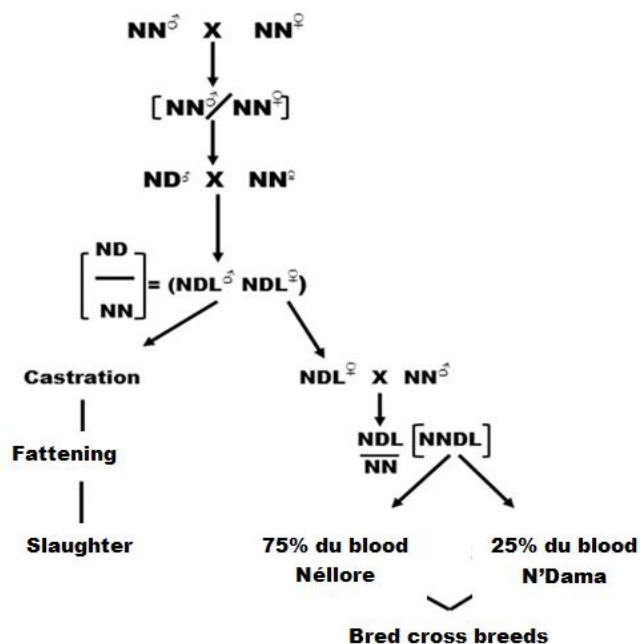
ND : N'Dama ;   NN : Nélore ;   NDL : N'Dalore 1 ;   NNDL : N'Dalores 2

Estimation of Live Weight and Weight Growth

For adult males and females, weighing took place early in the morning before watering. They were weighed using a COIMMA KM3-N brand scale, 4000 kg range and 2 kg precision.

The calves were weighed in the morning on an empty stomach once a month from birth until the age of 6 months. They were weighed using a two-hook HANGING SCALE load cell with a capacity of 200 kg $\pm$ 0.1 kg accuracy, at the end of which they were suspended via straps passed between the legs. The average daily gains (ADG) are determined by the formula proposed by LHOSTE et al., (1993).

with GMQ in grams/day

$$GMQ = \frac{Wf - Wi}{\Delta T} \times 1000$$

Where: Wf = final weight; Wi = initial weight; ΔT = duration between two weighings in days.

Determination of slaughter yields

Live animals were weighed upon arrival, fasted for 24 h, and then weighed before slaughter. Stunning is done by an electric shock using a hammer gun on the animal's head. The bleeding was done by cutting the jugular vein at the level of the neck. The quartered carcasses were weighed just after dressing using a 400 kg dynamometer-type scale with Salter dial with an accuracy of approximately 200 g.

The carcass of male cattle slaughtered at Kila is defined as follows: whole body of a slaughtered animal, cut through a sagittal slit approximately along the spine, after bleeding, skinning, evisceration and removal of head, feet , tail, hump and testicles. The head is separated from the carcass between the occipital (occipital bone) and the first cervical vertebra (atlas); the front feet are severed between the carpus and the metacarpus, and the hind feet between the tarsus and the metatarsus.

To obtain the quarters, the half-carcasses were cut, the front meat is processed to 7 ribs and the rear to 8 ribs.

The gross yield is obtained by the formula:

$$R_{moyen} = \frac{Poids\ carcasse}{Poids\ vif} \times 100 \qquad R_{net} = \frac{Poids\ carcasse}{Poids\ vif\ vide} \times 100$$

With empty liveweight = liveweight – 4% liveweight

Statistical processing

Data analysis was done with R version 2.10.1 software. They made it possible to obtain the means, standard deviations, confidence interval and the coefficient of variation.

The comparison of the modalities of the variables studied by the analysis of variance and the mean comparison test were made by Tukey's test. The probability value was considered significant for a value ≤ 0.05.

III. Results

Different coats of N'Dalores 1 and N'Dalores 2

The N'Dalores 1 (NDL) presented white gray coats for the males and fawn for the females.

Gray-white coat, with dark spots   **Rawn dress**

As for the N'Dalores 2 animals, NNDL, the coats are fawn, cream-white and gray-white.

Cream white dress   **gray-white dress**

Table 1: Average Daily Gain (ADG) of N'Dalores

	N'Dama	N'Dalore	Nélore
Weight (kg)			
Birth	$20,06^c \pm 2,15$	$23,51^b \pm 1,85$	$27,45^a \pm 0,64$
6 months	$65,41^c \pm 3,56$	$95,04^b \pm 5,76$	$116,05^a \pm 1,55$
12 months	$111,47^c \pm 1,3$	$165,88^b \pm 7,19$	$167,98^a \pm 5,01$
GMQ (g/j)			
Birth at 6 months	$251,94^c \pm 1,41$	$399,44^b \pm 3,85$	$492,22^a \pm 0,91$
6 months à 12 months	$255,89^c \pm 2,53$	$393,56^a \pm 1,43$	$288,5^b \pm 3,46$
Increase overAt the N'Dama (%)			
Birth at 6 months	-	**36,60%**	-
Birth at 12 months		**34,98%**	

The letters a, b, and c being different, the means are significant at P<0.05

Weight evolution of N'Dalores 2

Table 2: Weight evolution of N'Dalores 2 (NNDL)

Characteristics	N'Dalores	
	Males	**Females**
Birth weight (kg)	24,14 ±1,65	22,93 ±2,15

Weight at three months (kg)	57,20 ±2,83	53,86 ±3,24
Weight at six months (kg)	98,97[a] ±6,17	90,67[b] ±5,18
Weight at twelve months (kg)	168,40[a] ±8,25	163,72[b] ±6,11
Weight at twenty-four months (kg)	258,74[a] ±1,44	246,35[b] ±9,75
Weight at thirty-six months (kg)	359,74[a] ±23,2	329,49[b] ±6,69

The letters a, b being different, the means are significant at P<0.05

Comparison of the weight evolution of the three breeds

The average values obtained resulting from the weight evolution of the three breeds of the study gave rise to analyzes of variance with a view to highlighting the effectiveness of the crosses between the N'Dama and the Nélore according to the weights at the standard age.

Table 3. Analysis of variance of the race and sex effect

Age (month)	Source of variation	Degree of freedom	Sum of squares of deviations	Calculated F value	Probability (P-value)	Meaning
P₀	Race	2	6988,6	1862,84	< 2.2e - 16	***
	Sexe	1	37,4	19,9232	0,00001249	***
	Race-Sexe	2	14,3	3,8174	0,02336	*
	Résiduel	236	442,7	-	-	-
P₃	Race	2	56284	5852,44	< 2.2e - 16	***
	Sexe	1	1251	260,14	< 2.2e - 16	***
	Race-Sexe	2	350	36,42	1.628e - 14	***
	Résiduel	236	1135	-	-	-
P₆	Race	2	111945	3719,079	< 2.2e - 16	***
	Sexe	1	3020	200,668	< 2.2e - 16	***
	Race-Sexe	2	375	12,456	0,000007202	***
	Résiduel	236	3552	-	-	-
P₁₂	Race	2	176967	2591,7567	< 2e - 16	***
	Sexe	1	2737	80,1786	< 2e - 16	***
	Race-Sexe	2	184	2,6979	0,06942	.
	Résiduel	236	8057	-	-	-
P₂₄	Race	2	108431	906,25	< 2.2e - 16	***
	Sexe	1	111770	934,15	< 2.2e - 16	***
	Race-Sexe	2	62277	520,50	< 2.2e - 16	***
	Résiduel	236	18904	-	-	-
P₃₆	Race	2	21277	33,399	3.888e - 08	***
	Sexe	1	120688	189,443	< 2.2e - 16	***
	Race-Sexe	2	48933	76.810	2.795e - 15	***
	Résiduel	236	100657	-	-	

Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 4. Test for comparing the means of the race effect on weight

Age (month)	Source of variation	Average	Sd	N
P₀	**N'Dalore**	23,49000[b]	2,00654	36
	N'Dama	20,06175[c]	2,15177	36
	Nélore	27,46951[a]	0,77390	36
P₃	**N'Dalore**	55,52750[b]	3,46168	36
	N'Dama	37,64477[c]	2,40047	36
	Nélore	75,09146[a]	4,05849	36
P₆	**N'Dalore**	95,04250[b]	6,97824	36
	N'Dama	65,40525[c]	3,55476	36
	Nélore	116,12439[a]	5,00786	36
P₁₂	**N'Dalore**	165,87751[b]	7,57891	36
	N'Dama	111,46882[c]	2,80543	36
	Nélore	167,90981[a]	3,74717	36
P₂₄	**N'Dalore**	252,58384[b]	12,79593	36
	N'Dama	176,99531[c]	4,65537	36

P₃₆			
	Nélore	304,33051[a]	47,14263	36
P₃₆	**N'Dalore**	344,62044[b]	29,89110	36
	N'Dama	254,67213[c]	1,30483	36
	Nélore	376,32235[a]	29,48342	36

The letters a, b, and c being different, the means are significant at P<0.05
Slaughter yield of N'Dalores 2

Table 5: Slaughter yield of N'Dalores 2

Characteristics	N'Dalore	N'Dama
	μ ± DP	μ ± DP
Number of animals	32	18
Average slaughter age (months)	54±8,3	60,20±1,7
Live weight at slaughter (kg)	388,16±5,1	329,33±3,1
Carcass weight (kg)	231,38[a]±48	167,11[b]±6,3
Average yield (%)	60,14[a]	50,6[b]
Net yield (%)	62,10	52,9

The letters a, b being different, the means are significant at P<0.05

IV. Discussion

Crossing between an improver breed and a local breed is a method of genetic improvement that can help increase the production efficiency of beef cattle. This genetic improvement lies in the fact that it makes it possible to predict how much the selection of any characteristic influences another characteristic positively or negatively and to what intensity (PEREIRA, 2008).

The Kila farm proceeded with three crosses, namely: the Nélores among themselves, then the N'Dama males and the Nélores females from the first cross and finally the females from the second cross and the Nélores males which gave the animals which are high, in particular the N'Dalores 2.

The N'Dalores 2 animals resulting from the cross are without bumps, and have 25% N'Dama blood and 75% Nelore blood. It does not seem desirable to go beyond the F2 stage, because the purpose of this crossing at the Kila ranch is not to replace N'Dama blood with Nélore blood, rather to substitute it up to 25%. It should be remembered that the N'Dama is renowned for its adaptive capacity in the pre-forest areas of sub-Saharan Africa thanks to its trypanotolerance. This factor is decisive for the breeding of the N'Dalores with the blood of the N'Dama in the Congo.

The different coats appeared in the phenotype of N'Dalores 2, fawn, creamy white and gray-white is the genotypic expression of the parents. However, the gray-white coat with dark spots could find its origin in the N'Dama genotype. Indeed, the Nélore being of pure blood, its genealogy is mastered on the other hand, the genealogy of the N'Dama is not mastered.

The average weight of N'Dalores at birth is 24.14±1.65 kg and 22.93±2.15 kg respectively for males and females, while for N'Dama, this weight is 20 .62±1.21 kg for males and 19.49±3.09 kg for females. N'Dalores are born heavier than N'Dama. At 12 months thegap widens, weight monitoring from 12 to 36 months still shows a weight disparity in favor of the N'Dalores. The weights of the Crusaders are much higher than the weights of the N'Dama, with significant differences (P<0.05) at all ages. The superiority of the Crusaders over the local breed is well expressed. These results show that the contribution of the improver breed is important in increasing the weight of N'Dalores from birth to adulthood.

The average daily gain of the N'Dalores from birth to 6 months is 399.44 ± 3.85 g/day against 251.94 ± 1.41 g/day in the N'Dama. The notion of the milk production of the mothers would also come into play at this stage, because the Nélore is used as a dairy breed in India and originally it was imported into Brazil for its milk production before being improved for meat (GAUR et al. al., 2002). The Average Daily Gain from 6 to 12 months reached 393.56 ± 1.43 g / day in the N'Dalores while in the N'Dama it is maintained at 255.89 ± 2.53 g / day. This clearly shows the interest of crossbreeding which improved the Average Daily Gain to 36.60% and 34.98% respectively before and after weaning. This result confirms the words of TEIXEIRA & ALBUQUERQUE, (2005) who think that the indices of total production can increase by 10 to 20% in favor of the Bos taurus cross breeds, in favorable environments and, 30 to 50% in the crosses between Bos taurus and Bos indicus, in unfavorable climatic conditions.

At slaughter, in general, the conformation of the N'Dalores is good, with convex muscular profiles. The average carcass yield has a high value of 60.14% against 50.6% for N'Dama.

The N'Dalores show a better ability to fatten than the N'Dama; this ability results in the existence of a muscular fat which is always present; which proves that there has been a dose of improvement.

Meat production is highly dependent on growth, which expresses the farming conditions where the animals are exploited. According to OWENS et al., (1993), growth can be defined, generally as the production ofnew cells, including not only their multiplication defined as hyperplasia, but also the increase in volume, defined as hypertrophy, and also the differentiation of the same cells, giving rise to organs and tissues.

BARBOSA & ALENCAR, (1995), suggested that crossbreeding between taurine and zebu can be one of the strategies to improve production indices in beef cattle farms. According to MACEDO MOTA et al., (2013), new concepts of growth physiology help in the management of modern beef production systems, combining information on growth efficiency, degree of maturity and carcass quality. In recent decades, the relationship between the structural growth of the body improved, allows the selection of more efficient animals, depending on weight and age, for meat production (PATIÑO, 2010).

V. Conclusion

The results on the productivity of the animals resulting from the crossing between the N'Dama and the Nélore are high compared to those of the N'Dama. This study shows through these results that the weight of the Crusaders was much higher than that of the N'Dama. It can be said that the supply of Nélore blood to the tune of 75% to the N'Dama animals has improved the productivity of the N'Dama breed through the crossbreeds. These results are an important tool in the development of programs to improve the zootechnical performance of N'Dama cattle.

Bibliographic References

[1]. **AKOUANGO P.,** 2018. Sustainable Agricultural Policy in the Republic of Congo – Diagnosis and Perspective. Edition the Harmattan. ISBN: 978-2-14-009400-2-126p12.

[2]. **ALENCAR, M.M., BARBOSA, P.F., TULLIO, R.R.** et al. 1995. Peso à desmama de bezerros da raça Nelore e cruzados Canchim x Nelore e Marchigiana x Nelore. R. Soc. Arms. Zootec., 24(6):917-925.

[3]. **DIMI NGATSE S., OGNIKA A. J., AKOUANGO P.** Conformation of Nélore cattle (Bos indicus) at the Kila ranch in the Cuvette department in the Republic of Congo. Journal of Animal & Plant Sciences, 2020. Vol.43(1):7340-7349. ISSN 2071-7024.

[4]. **DIMI NGATSE Silvere.** "Productive and reproductive adaptation of Nélore cattle to the kila ranch in the Republic of Congo". Single doctoral thesis. Marien N'gouabi University, 2021, 151p.

[5]. **DIMI NGATSE Silvère, OGNIKA Alexis Jonas, MOPOUNDZA Paul, AKOUANGO Parisse** Productive adaptation of the Nélore breed at the Kila Republic of Congo ranch. Journal of Applied Biosciences 157: 16204 – 16212 ISSN 1997-5902.

[6]. **LHOSTE P., DOLLE V., ROUSSEAU J., SOLTNER D. 1993.** Zootechnics manual for hot regions: livestock systems, Collection Précis d'Élevage, Ministry of Cooperation, France.

[7]. **YOKA J., LOUMETO J.J., VOUIDIBIO J.**- Some ecological characteristics of the savannas of the Ollombo area (Cuvette Congolaise, Republic of Congo. A. UMNG 2007- 8 (4): 74 – 87.

[8]. **MOPOUNDZA P., DIMI NGATSE S., OGNIKA A.J., AKOUANGO P**. Characterization of semi-flooded natural pastures in the Cuvette department for productive cattle breeding in the Republic of Congo. Journal of Animal & Plant Sciences, 2016. Vol.28, Issue 2: 4398-4408. ISSN 2071-7024.

[9]. **GAUR G.K., KAUSHIK S.N. & GARG R.C**. Ongole cattle status in India 2002. Project Directorate on Cattle, PH-7, Pallavpuram Phase 2, Modipuram, Meerut- 250 110, Uttar Pradesh, India.

[10]. **MACEDO MOTA L.F., T. M. DE A. MARIZ J. DO S. RIBEIRO M. E. FERREIRA DA SILVA, ; D. M. DE LIMA JUNIOR;** Morphometric divergence in growing cattle classified for different frame classes. Revista Brasileira de Higiene e Sanidade Animal V. 11, n.2 (2013), ISSN: 1981-2965.

[11]. **PATINO DA COSTA, M.J.R.; SILVA, E. V**. da C. Aspectos básicos do behavior social de bovines. Rev. Arms. Repr. Anim., Belo Horizonte, v.31, n.2, p.172-176, abr./jun., 2010

[12]. **PEREIRA J.C.A.** Melhoramento Genetico Aplicado a Produçao Animal. 5.ed.belo Horizonte: FEPMVZ,2008. 617p.

[13]. **TEIXEIRA, R.A.; ALBUQUERQUE, L.G**. Heterose maternal e individual para ganho desmama em bovinos Nelore X Hereford e Nelore X Angus. Arquivo Brasileiro Medicina Veterinária e Zootecnia, v.57, n.4, p.518-523, 2005.