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Viability and adaptability of mestizo female cattle from artificial insemination compared with local

Kpassi SEME [1,2*], Koffi Ganyo SOMENUTSE [2], Fatoumata COULIBALY [3],
Bèdibètè BONFOH [2], Mensah Délako KOTOE [2], Léopold Komi KOUMESSI [2],
Kakom Assota KOSSOGA [2] and Wéré PITALA[1]

[1]Higher School of Agronomy, Department of Animal and Veterinary Sciences, University of Lomé ESA/UL,
01BP: 1515 Lomé, Togo.
[2]Togolese Institute of Agronomic Research; BP: 1163 Lomé, Togo.
[3]University Peleforo Gon COULIBALY, BP : 1328 Korhogo, Côte d'Ivoire.
[*] Corresponding author; E-mail: semejoseh@gmail.com; Tel : (00228) 90 16 34 40.

ABSTRACT

The objective of this study was to determine after 48 months of age, the growth and viability of crossbreds resulting from Artificial Insemination (AI). The methodology used was the follow-up of 39 crossbreds from IA with 40 local sisters whose births coincided. The data collected concerned the weight of calves, mortalities and their causes. The adaptation of mestizos in the environment was evaluated. The results showed that the weights of Mestizos calves from birth 20.65 ± 6.54 kg (Local x MO) and 23.30 ± 5.34 kg (Local x HO) to three months of age 55.12 ± 4.95 kg (Local x MO) and 56.65 ± 5.08 kg (Local x HO) was higher ($p \leq 0.05$) than those of their local counterparts (17.32 ± 3.74 kg and 42.05 ± 11.89 kg). The pre-weaning mortality rate (18.19%) was higher ($p \leq 0.05$) than that obtained in the post-weaning period (11.48%) and is mainly due to calf diarrhea (37,30%). The Local x MO crossbreds seem better adapted than those resulting from the Locales x HO in the climatic conditions of Togo in terms of consumption skills and sensitivity to heat. In conclusion, the survival of crossbreeds requires permanent health monitoring and good farm management.
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Keywords : artificial insemination, cross-breeding, viability, adaptability, Togo.

INTRODUCTION

In Togo, dairy cattle breeding is essentially of the traditional type characterized by a low level of production (Seme et al., 2016). However, the Togolese have been directing their diet for several decades towards a diet increasingly rich in animal protein (Adanlehoussi and Adomefa, 2004). To meet this growing demand, a study on animal biotechnology, initiated in Southern Togo, on

bovine artificial insemination with the use of seeds from Holstein and Montbéliarde dairy breeds (Seme, 2017). Indeed, animal biotechnology is the application of biological organisms, systems or processes to animal production, i.e. the production of meat, milk, leather, etc. (Leng, 1996). Among the biotechnologies available in animal production, artificial insemination is the most widely used in the world. It mainly concerns

bovine, ovine, caprine, porcine and equine species as well as rabbits and poultry (turkeys, ducks and hens). Artificial insemination has several advantages including the easy dissemination of genetic progress, the introduction of foreign breeds through semen in regions where live animals cannot withstand climates and pathologies, the fight against venereal contact diseases and reduce male maintenance costs on farms (Knox, 2016). In Africa, the aim of artificial insemination is the dissemination of genetic progress in farms and the introduction of exotic genetic material through genetic improvement programs (FAO, 2008). The method of use of this tool means that it is used less and does not contribute effectively to the development of livestock farming.

In Togo, existing information on artificial insemination dates back to 1980 at the Avétonou station and 2000 in rural areas in the Agou prefecture (ITRA, 2005). But no data exists so far on the viability and adaptability of mestizo female cattle resulting from these artificial inseminations in Togo. It is with this in mind that cows from artificial insemination (AI) from 2015 and 2016 were monitored from birth to 48 months of age in order to assess their viability and adaptability in our climatic conditions.

MATERIALS AND METHODS
Study areas

This study was carried out on private dairy cattle farms in semi-intensive mode in Southern Togo. Six (06) cattle farms were included in this study, four (04) from the Maritime region and two (02) from the Plateaux. These are farms selected for a study on the genetic improvement of milk production through artificial insemination (Seme et al., 2017). These study farms are those established for at least five years, periodically using feed supplements and regularly treating their animals against trypanosomosis and gastrointestinal parasites. This study area enjoys a subequatorial climate with two rainy seasons, the duration of which is highly variable, ranging from March to mid-July for the main rainy season and from mid-September to November for the short rainy season. The vegetation is of the Guinean wooded savannah type and that of wooded and shrubby savannahs with a few islands of dense forests which are gallery forests along the main rivers (Mono and its tributaries, Zio and Haho). Precipitation varies from 800 mm on the coasts to 1,600 mm on the mountains with an average temperature oscillating between 20° and 35°C (Seme et al., 2017).

Animals

39 crossbreds resulting from artificial inseminations from the genetic improvement program for bovine milk production in Southern Togo, namely 25 Local crossbreds x Montbeliarde (Figures 1 and 2) and 14 Local crossbreds x Holstein (Figure 3) were followed up to 48 months of age. Alongside these crossbreds, 40 local calves (sisters), from Local x Local crosses whose births coincided with those of the crossbreds were also monitored (Table 1).

Weighing of calves and data collection

Movable spring scales with a capacity of 100 kg and a sensitivity of 1 kg were used for weighing calves up to three months of age. Calf restraint equipment consists of ropes and jute bags. Monitoring and data collection sheets were developed and maintained regularly throughout the experiment.

Breeding conditions for crossbreeds and their local counterparts

The crossbreds resulting from artificial inseminations are reared under the same conditions as their local counterparts.

Feed

The calves' diet was exclusively cow's milk until one (01) month of age. After this time, in addition to milk, they are fed with a food supplement consisting of lick stone and cooking salts up to three (03) months of age. The calves were suckled as soon as the cows arrive from the pasture in the evening and very early in the morning for the induction of milk. Watering of calves was done *ad libitum*. After weaning on average at six (06) months of age,

the feeding of the calves was essentially on a natural course with contributions from supplementation consisting essentially of cooking salt and the salt lick, *Panicum maximun* hay, straw from *Oryza sativa* (rice), etc.

Veterinary care

Up to three months of age, these calves were treated once against trypanosomosis followed by gastrointestinal deworming. Beyond three months, they received, at a frequency of three times a year in the Maritime region and four times a year in the Plateaux region, treatment against trypanosomosis and gastrointestinal parasites. Trypanocides (Trypamidium 1g and Veriben 236g) and acaricides (Deltamethrin and Top-line) are veterinary products used as a preventive and curative measure against trypanosomosis. With regard to gastrointestinal deworming, Albendazole, Levamisole 10% and Ivermectin are the deworming agents used during the experiment. In addition to this prophylaxis, these animals received specific treatments depending on the appearance of certain clinical signs.

Most veterinary care was administered by herdsmen and rarely by livestock technicians. Veterinarians are often called upon on these farms for vaccinations against anthrax and contagious bovine pleuropneumonia (CBPP) or even in some cases for complicated treatments.

Female mestizo adaptability

The adaptation of mestizo female cattle in the environment was assessed by direct visual observation of their behavior using the qualitative behavioral assessment method, QBA (Qualitative Behavioral Assessment) described by Patricia et al. (2016). It has been associated with another method of free choice of descriptive profiles, FCP (Free Choose Profiling) (Wemelsfelder et al., 2001). The QBA method not only describes the body, but also takes into account the whole animal in the qualitative aspects of its response and reaction to its environment. This behavior is called behavioral expression, body language or appearance (Wemelsfelder et al., 2012). In addition to the physical and physiological state of the animal, these methods also provide for the evaluation of its emotional or affective state (Boissy et al., 2007 ; Rutherford et al., 2012 ; Murphy et al., 2014). However, Patricia et al. (2016) reported the importance of an animal's body language on its wellbeing (state of physical and mental health) and its adaptability in an environment.

Frequency of data collection

Calves were weighed at 10 days intervals from birth to three (03) months of age corresponding to the age when it was impossible to weigh them given the capacity of the rocker and the difficulties of calf restraint. The weighings were made in the mornings before watering the animals.

Beyond the three months of age of the cows, the frequency of monitoring was monthly up to 48 months of age. The assistance of the herdsmen was very decisive in the collection of data on the survival of calves, mortalities and their probable causes and the adaptability of crossbreeds.

Parameters measured

$$Mortality\ rate(\%) = \frac{Number\ of\ dead\ females}{Initial\ number\ of\ females}\ x\ 100\ (1)$$

$$Survival\ rate\ (\%) = \frac{Number\ of\ surviving\ females}{Initial\ number\ of\ females}\ 100\ (2)$$

$$Survival\ rate\ (\%) = 100 - Tmortality\ rate$$

Statistical analysis

The results were expressed as a percentage, mean ± standard deviation and the differences were considered significant at the 5% probability threshold. In addition, the effect of the different variables was assessed using ANOVA. The computer software used was the GraphPad Prism version 8.

Figure 1 : Calf : Zebu Goudali x Montbeliarde (One week old)

Figure 2 : Calf: N'Dama x Montbeliarde (Two weeks old)

Figure 3 : Calf : Zébu Goudali x Holstein (Twelve months old)

Table 1: Calves included in the study.

Provenance cross type	Effectif
Local x Local	40
Local x MO	25
Locale x HO	14

MO = Montbeliarde ; HO = Holstein

RESULTS

Weight of calves

The birth weight of crossbred Local x MO (20.65 ± 6.54 kg) and Local x HO (23.30 ± 5.34 kg) calves up to three months of age respectively of 55.12 ± 4.95 kg and 56.65 ± 5.08 kg were significantly higher ($p \leq 0.05$) than that of their local counterparts (17.32 ± 3.74 kg and 42.05 ± 11.89 kg). In addition, the evolution of the weight of crossbreds showed that from birth to one month of age, the weight of Locale x HO was significantly higher ($p \leq 0.05$) than that of Locale x Montbéliarde; but remain insignificant ($p > 0.05$) from the second to the third month of age (Table 2).

Mortality rate

The pre-weaning mortality rate (18.19%) was significantly ($p \leq 0.05$) higher than that obtained post-weaning (11.48%). Moreover, at all ages, the mortality rate of female cattle mestizos ($p \leq 0.05$) was significantly higher (24% among Locals x MO and 50% among Locals x HO) compared to that of their local counterparts (15%). Finally, the statistical analysis of the mortality rate of mixed races showed that it was significantly high among Locals x HO in comparison with that of Locals x MO (24%) (Figure 4).

Causes of mortalities

Calf diarrhea (37.30%) was the main cause of death for mixed-race and local calves in the study area. It was followed by dermatophilosis (25.40%) which affected female cattle mestizos (Figure 5).

Mixed race adaptability

After continuous observation of the animals in the barn, on pasture and during periods of feed distribution, it appeared that the Local x HO crossbreds seem to be less adapted in the environment than the Local x MO crossbreds in terms of aptitudes, consumption and heat sensitivity (Table 3).

Table 2: Calves weight from birth to three months of age.

Crossing	Birth	1st month (30 days)	2nd month (60 days)	3rd month (90 days)
Local x MO	20.65 ± 6.54^a	31.86 ± 11.70^a	44.71 ± 16.59^a	55.12 ± 4.95^a
Local x HO	23.30 ± 5.34^b	37.70 ± 14.20^b	44.28 ± 9.20^a	56.65 ± 5.08^a
Local x Local	17.32 ± 3.74^c	28.19 ± 9.16^c	37.89 ± 6.82^c	42.05 ± 11.89^c

The weights of the same column surmounted by the letters a, b and c are significantly different ($p \leq 0.05$)
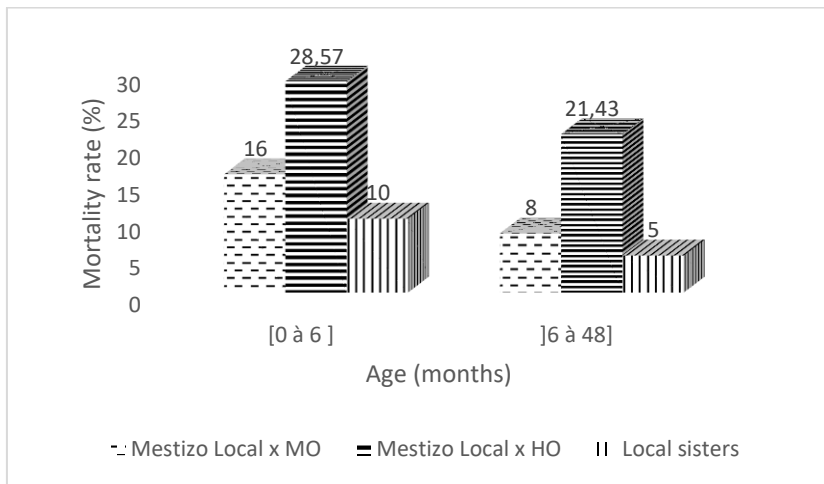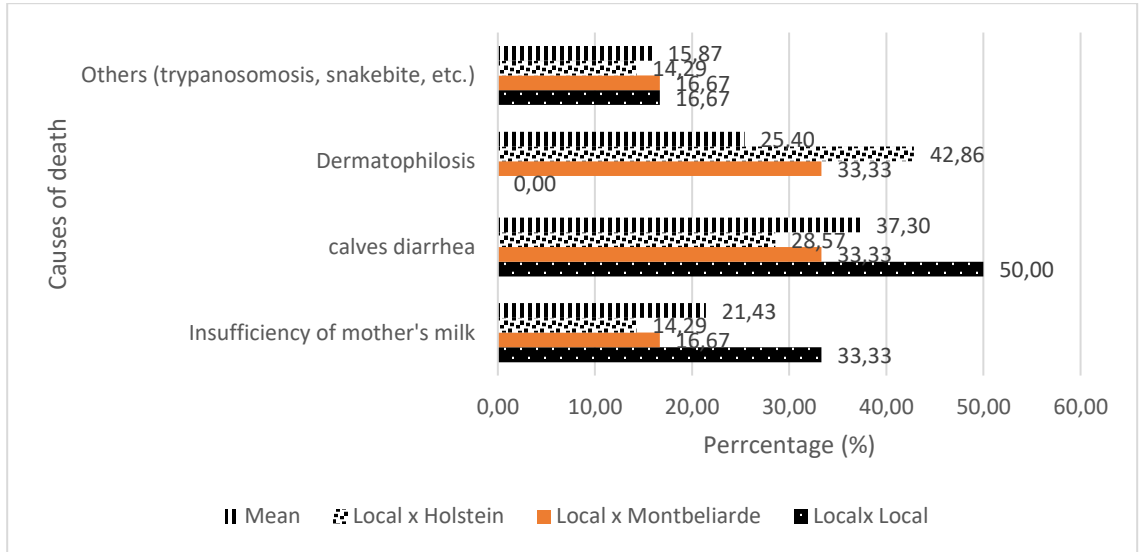

Figure 4 : Mortality rate (%).

Figure 5 : Causes of death.

Table 3 : Evaluation of the adaptability of mestizos in the climatic conditions of Togo.

Variables	Modalities	Mestizo (Local x MO)		Mestizo (Local x HO)	
		Numbers	Proportions (%)	Numbers	Proportions (%)
Temperament	Docile/calm	12	48[a]	6	42.9[a]
	Curious and affectionate	7	28[b]	4	28.6[b]
	Nervous	5	20[b]	3	21.4[b]
	Anxious/Worried	1	4[c]	1	7.1[c]
Suitability for consumption	Non-selective	19	76[a]	6	57.1[a]
	Selective	6	24[b]	8	42.9[b]
Heat sensitivity	No	14	56[a]	5	35.7[a]
	Yes	11	44[a]	9	64.3[b]
Apparent heart rate	Normal	21	84[a]	11	78.6[a]
	Accelerated	4	16[b]	3	21.4[b]
Lameness	No	15	60[a]	8	57.1[a]
	Yes	10	40[a]	6	42.9[a]
Herd management ability of females	Leaders	13	52[a]	8	57.1[a]
	Subordinates	12	48[a]	6	42.9[a]
Crossbreed Breeding Suitability	Confirmed	16	84,2[a]	5	71.4[a]
	Not confirmed	3	15,8[b]	2	28.6[b]

The different letters a, b and c: the difference is significant

DISCUSSION

Effect of crossbreeding on cattle growth performance

This study showed the effect of the genetic type on the weight was favorable in mestizos. The crossbreeds resulting from a cross between local breeds and exotic breeds (Montbéliarde and Holstein) were recognized as efficient as reported by Alassane et al. (2018) and Allaire et al. (2018). This difference in weight growth is strongly linked to the effect of heterosis enjoyed by mixed race women. The heterosis effect or hybrid vigor is the phenotypic superiority of crossbred individuals (F1) compared to the parental phenotypic average. This superiority can be explained by the fact that crossing reduces the frequency of homozygous alleles (pair of identical genes) and increases the number of heterozygous alleles. As a result, most recessive, unfavorable characters are masked by dominant and favorable characters (Houessou, 2018). The weights of crossbreds from birth of Local x MO (20.65 ± 6.54 kg) and Local x HO (23.30 ± 5.34 kg) of three months of age representing respectively 55.12 ± 4.95 kg and 56.65 ± 5.08 kg from this study is comparable to those found by Kouamo et al. (2015, 2014) during their research on the effect of interbreeding (with exotic breeds) on the weight performance of local cattle in Sénégal in F1 crosses (products from the insemination of female Gobra with Holstein semen or Montbeliarde). Indeed, these authors found average weights from birth to three months of age of 24.5 ± 0.5 kg and 46 ± 1.7 kg respectively, in calves (n=59) reared permanently in enclosing and receiving *ad libitum* straw, crop residues, industrial concentrate feed. These weights rose respectively to 21.64 ± 1.2 kg and 33.2 ± 4.28 kg in the calves (n=178) led in semi-extensive mode with natural grazing during the day thanks to a shepherd and fed with residues of harvests (cassava leaves and stalks, corn stalks, peanut shells) in the evening in the enclosure after returning from the pasture. These studies show that the weight expression of the genetic potential of crossbreeds depends on the breeding conditions.

Effect of type of crossbreeding on viability of cattle

Cow mortality was higher in the pre-weaning period (18.19%) due to less developed immunity (natural or acquired) at this age. This could be explained by the effect of calving induction which would have negatively affected the viability of born calves in the medium term. This mortality rate fell sharply after weaning following the acquisition of immunity by calves. This immunity was reinforced by regular health monitoring (antibiotics, deworming and vaccinations). This allowed the calves to gradually adapt to their environments.

The type of crossbreeding influenced the viability of cattle. The survival rate up to 48 months of age for the Local x MO (76%) and the Local x HO (50%) crossbreds was significantly lower than that of their local counterparts (85%). Overall, the Local x MO and Locale x HO crosses had an acceptable weaning viability rate. Among these hybrids, the Local x MO had the best viability performance. These different types of crosses improve the genetic level of cattle, namely the numerical productivity of herds by the number of products born per calving, the number of products born-alive and the number of products alive at weaning. Breeding traits are poorly heritable and crossbreeding is the best way to improve them. Heritability is a genetic parameter that gives the share of measurable phenotypic performance progress within a breed from one generation to the next (Houessou, 2018). Similar studies were conducted in Benin on the evaluation of the growth performance of calves in a semi-improved system and showed that the viability rate at weaning of Borgou x Montbéliarde crossbreds was significantly (p<0.05) higher, followed in descending order by the half-breeds Borgou x Girolando and Borgou x Tarentaise. As a result, the effect of genetic type was significant (p<0.05) on the weight of cattle in favor of crossbreeds (Houessou, 2018). The adaptation of crossbreds obtained from artificial insemination with the use of exotic seeds is controversial both in peri-urban and traditional breeding. Furthermore, the

studies conducted by Blagna et al. (2020) in extensive and semi-intensive farms in the Cascades region of Burkina Faso on F1 crossbreeds resulting from crosses between Brune des Alpes and Zébu Peul cattle gave a calf survival rate at 42 months estimated at 88% with a significant difference (p < 0.05) between seasons before weaning and between rearing systems after weaning.

Causes of death

The main cause of cow mortality was diarrhea (37.30%). This prevalence is lower than that found by Kotoé et al. (2020) during their study on the epidemiology of calf diarrhea in 45 traditional cattle herds in the prefectures of Agou, Avé and Haho located in the Plateaux and Maritime regions and the herd of the breeding station in Avétonou located in the prefecture of Agou at the Forest Zone Agronomic Research Center (CRAF) of the Togolese Institute for Agronomic Research (ITRA). Indeed, they had found in this study area a prevalence of 40% which caused 30% calf mortality. Calf diarrhea is one of the major constraints in cattle farms because it prevents the herd from progressing well. Assessing the health status of calves and determining the causes of diarrhea are of great importance for the revival of cattle breeding. Considering the bacteriological, coprological and survey results of the research by Kotoé et al. (2020), it is possible to estimate that *Salmonella* sp. and *Escherichia coli* were the main causes of diarrhea in calves with a fairly high mortality rate, the contributing causes of which would be the lack of hygiene and the breeding method practiced in the herds. Admittedly, these microorganisms are part of the normal microflora of the gastric environment of ruminants. However, it is necessary to identify the serotype of these Enterobacteriaceae. On the other hand, the multifactorial etiological nature of the disease makes it possible to suspect the co-infestation of bacteria and viruses, in particular rota virus, corona virus and (BVD). Virological studies must be carried out to complete this work.

In adulthood, the pathological constraints of mixed-race young female were

mainly dermatophilosis (25.40%). Sensitivity was higher to dermatophilosis than to trypanosomoses (p < 0.05). Regarding the causes of mortality, Blagna et al. (2020) found that 76% of F1 mongrels had heartwater, dermatophilosis, foot-and-mouth disease or trypanosomosis before and after weaning. Also, very close monitoring is essential for better survival of crossbreds from AI with seeds of exotic breeds.

Adaptability

The large proportion of half-breeds (76% in the Local x MO and 71.5% in the Local x HO) were docile and affectionate compared to 24% and 28.5% respectively of the ovelles who developed nervous and worried or fearful behavior. These docile and affectionate characters can be assets for the intensification of animal production in the tropics. Nevertheless, 4% and 7.1% of these mestizos were anxious and distressed. This isolationist behavior could be explained by the fact that these animals grew up orphans following the death (accident or too old) of their mother from a young age and forced to suckle by adoption or artificially. The food attitude of animals on pasture showed that 76% of Local x MO crossbreds had a non-selective palatability with respect to the pastures of the study area against 57.1% for Local x HO. Thus, the Local x MO and the Local x HO crosses preserved the hardiness of the local breed in the F1. Although the sunshine and heat of the hot dry season (February - April) was unbearable, the proportion of Local x MO mestizos who tended to seek shade during the day did not differ from those who did not (p > 0.05). On the other hand, in the Local x HO crossbreds, this sensitivity to heat was significant. Similarly, the majority of the Local x MO (84%) and Local x HO (78.6%) crossbreds had a normal heart rate against respectively a minority of 16% and 21.6% with an accelerated heart rate (p < 0. 05). This justifies a good adaptability of the F1 crossbreds to the Sudano-Guinean breeding conditions with a slight superiority of the Local x MO crossbreds in terms of eating skills and sensitivity to heat. The low recurrence of lameness in these mestizos can

probably be explained by the low prevalence of foot-and-mouth disease in the study area. In all, 84.2% of the Local x MO and 71.4% of the viable Local x HO crossbreds were used effectively in reproduction.

Conclusion

This study showed that the birth weight of mixed-race calves up to three months of age is significantly higher ($p \leq 0.05$) than that of their local counterparts. Regarding their survival, a pre-weaning mortality rate of 18.19% was recorded and was significantly ($p \leq 0.05$) higher than that obtained post-weaning mortality evaluated at 11.48%. Regarding the causes of these deaths, calf diarrhea (37.30%) was the main cause in the study area. It was followed by dermatophilosis (25.40%) which affected the mixed race. The continuous observation of the animals in the barn, on the pasture and during the periods of food distribution makes it possible to affirm that the Local x HO crossbreds seemed to be less adapted in our climatic conditions than the Local x MO crossbreds on the plans. Eating skills and heat sensitivity. Finally, this study offers real opportunities for the genetic improvement of the cattle herd through artificial insemination. Also, it is important that its application in farms be accompanied by the improvement of cattle breeding conditions for its good success.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

KS, WP and BB designed the protocol and write the manuscript; KS, KGS, FC, MDK, LKK and KAK collected and analyzed the data.

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