Journal of Applied Veterinary Science and Technology
http://e-journal.unair.ac.id/javest

OPEN ACCESS

Research Reports

Reproductive Performances of SIMGOUD Crossbreed Cows and The Effect of Concentrate Feed Supplementation on The Production and Chemical Composition of Milk

Performa Reproduksi Sapi Persilangan SIMGOUD dan Pengaruh Suplementasi Pakan Konsentrat terhadap Produksi dan Komposisi Kimia Susu

Mouchili Mama*[1], Edouard Aimé Pouachiyouen Pechangou[2], Emile Miegoué[2], Jules Lemoufouet[2], Fernand Tendonkeng[2]

[1]Department of Biological Sciences Applied to Agriculture, Faculty of Sciences, University of Ebolowa, Ebolowa - Cameroon
[2]Animal Production and Nutrition Research Unit, Department of Animal Production, FASA, University of Dschang, Dschang - Cameroon

ABSTRACT

Background: The performance of milk production remains very weak. This low performance is mainly explained by the low genetic potential of local breeds (1 to 3 litre of milk/day or even less in the dry season compared to 40 to 50 l/day for Holstein cows in Europe). **Purpose:** The present study on the evaluation of the reproductive performance of Simgoud crossbreed cows and the effect of feeding on the production and chemical composition of milk was conducted at the SODEPA ranch of Faro in Adamaoua Cameroon between July and August 2023. **Method:** The Simgoud cow is a cross between the exotic Simmental and the local Goudali breeds. The animals were divided into two batches of six cows and six calves per batch, of comparable physiological condition. **Results:** The age at first calving was 39 months, and the crossbreeding allowed the farmer to decrease the age at first calving of the Goudali by 24%. The observed calving interval was 18 months with a variation rate of 16.20%. The total amount of milk produced in 90 days by the cows that received a feed supplement (concentrate) was estimated at 810 liters for an average daily production of 9.66 liters, compared to 666 liters over the same lactation period in the cows that did not receive a supplement, an average of 7.46 liters per day. Supplementation had a significant effect on milk production. The analysis of the chemical composition of the milk shows that apart from the pH, the supplementation of Simgoud cows with concentrate had a significant effect, improving the content of all other parameters studied. **Conclusion:** Supplementation is recommended for the improvement of the milk production parameters in Simgoud cows.

ARTICLE INFO

Received: 20 May 2024
Revised: 30 July 2024
Accepted: 26 September 2024
Online: 31 October 2024

***Correspondence:**
Mouchili Mama
E-mail: mamamouchili@yahoo.fr

Keywords: Chemical Composition; Simgoud; Supplementation; Milk Production; Reproductive Performance

ABSTRAK

Latar Belakang: Kinerja produksi susu masih sangat lemah. Kinerja yang rendah ini terutama disebabkan oleh potensi genetik yang rendah dari ras lokal (1 hingga 3 liter susu/hari atau bahkan kurang di musim kemarau dibandingkan dengan 40 hingga 50 l/hari untuk sapi Holstein di Eropa). **Tujuan:** Penelitian saat ini tentang evaluasi kinerja reproduksi sapi persilangan Simgoud dan pengaruh pemberian pakan terhadap produksi dan komposisi kimia susu dilakukan di peternakan SODEPA Faro di Adamaoua Kamerun antara Juli dan Agustus 2023. **Metode:** Sapi Simgoud merupakan persilangan antara sapi Simmental eksotik dan ras lokal Goudali. Hewan-hewan tersebut dibagi menjadi dua kelompok yang masing-masing terdiri dari enam sapi betina dan enam anak sapi per kelompok dan memiliki kondisi fisiologis yang sebanding. **Hasil:** Usia pertama kali melahirkan adalah 39 bulan, persilangan tersebut memungkinkan penurunan usia pertama kali melahirkan sapi Goudali sebesar 24%. Interval melahirkan yang diamati adalah 18 bulan dengan tingkat variasi 16,20%. Jumlah total susu yang diproduksi dalam 90 hari oleh sapi yang menerima suplemen pakan (konsentrat) diperkirakan sebesar 810 liter untuk produksi harian rata-rata 9,66 liter, dibandingkan dengan 666 liter selama periode laktasi yang sama pada sapi yang tidak menerima suplemen, yaitu rata-rata 7,46 liter per hari. Suplementasi memiliki efek yang signifikan terhadap produksi susu. Analisis komposisi kimia susu menunjukkan bahwa selain pH, suplementasi sapi Simgoud dengan konsentrat memiliki efek yang signifikan dalam meningkatkan kandungan semua parameter lain yang dipelajari. **Kesimpulan:** Oleh karena itu suplementasi direkomendasikan untuk peningkatan parameter produksi susu pada sapi Simgoud.

Cite This Article:
Mama, M., Pechangou, E.A.P., Migoue, E., Lemoufouet, J., and Tendokeng, F., 2024. *Reproductive Performances of SIMGOUD Crossbreed Cows and The Effect of Concentrate Feed Supplementation on The Production and Chemical Composition of Milk.* Journal of Applied Veterinary Science and Technology.5(2): 140-145. https://doi.org/10.20473/javest.V5.I2.2024.140-145

Kata kunci: Kinerja Reproduksi; Komposisi Kimia; Simgoud; Suplementasi; Produksi Susu

INTRODUCTION

Over the 5-year period from 2011 to 2016, milk production in the Cameroonian territory increased by nearly 70,000 tons, from 109,000 to 172,000 tons (MINEPIA, 2016). Despite this increase, this statistic reveals a production deficit of just over 120,000 tons since, according to internal sources at MINEPIA, the national demand from households and milk processing industries is estimated to be around 297,000 tons per year. In 2015, economic operators in Cameroon spent 31 billion CFA francs to import milk. In the same process, the government, through the PRODEL livestock development project, imported cows of the Montbéliard breed from Europe to strengthen milk production. The local breeds are fairly good for butchering, and the local livestock satisfies almost half of the population's demand for meat, with the rest being covered by the production of short-cycle species (sheep, goats, and poultry) and imports (ACDIC, 2006).

The performance of milk production, on the other hand, remains very weak. This low performance is mainly explained by the low genetic potential of local breeds (1 to 3 litre of milk/day or even less in the dry season compared to 40 to 50 l/day for Holstein cows in Europe). Interbreeding between exotic and local breeds seems to be one solution; a previous study revealed that the F1 genotypes resulting from these crosses improve the milk yield of local breeds (Djoko *et al.,* 2003). This process also increases the profitability of dairy farms (Pingpoh *et al.,* 2019), with milk yields being 3 to 4 times higher in hybrids (Mbah *et al.,* 1987).

It is therefore in this context that the Company for the Development and Exploitation of Animal Productions (CDEAP), in its strategic vision, has undertaken since 2013 a genetic improvement program based on crossing by artificial insemination the local Goudali breed and Simmental; a mixed breed with strong meat and dairy performance. This is with a view of offering, as part of its mission of supervision to breeders, animals with high genetic potential adapted to their environment. Given the growing interest in these hybrids for dairy producers, it seems necessary to describe the biological material which remains little known, especially from the point of view of reproductive performance and milk production. A study carried out at the CDEAP ranch in Dumbo and Jakiri revealed that the product of this cross (Simgoud) showed good beef performance in bulls with a growth rate approximately 4 times higher than that of the local Goudali breed (Bessong *et al.,* 2018). However, reproduction and milk production performance in Simgoud cows still remains to be determined, hence this study to determine the reproduction and milk production parameters of hybrid cows (Simgoud) resulting from the cross between local Simmental and Goudali breeds.

MATERIALS and METHODS

Location

The Faro Ranch is an operational unit of SODEPA, located in the Adamaoua Region, Faro and Deo Department, Tignere District. It was created by Decree No. 74/182 of March 8, 1974, amended and supplemented by Decree No. 81/395 of September 9, 1981. It is located between 7th and 8th degrees North in latitude, and 12th and 13th degrees East in longitude.

Climate and Vegetation

The climatic data is for the district of Tingère. The rainy season lasts 7-8 months; it begins in April and ends in May. There is also a dry season of 4-5 months, from November to March. The average rainfall is 1500 mm per year, with temperatures reaching 37°C recorded, while the average for the year remains at 22°C. The annual average relative humidity in this area is 65%, with a maximum oscillating between 98.5 and 68.5%. The vegetation being a reflection of the climate, it corresponds to a wooded savannah, consisting of a clear forest traversed by dry season fires. It is therefore typical of a tropical savannah and has two types: the Sudano Guinean savannah on the mountains is characterized by its elaborate appearance and contrast with the shrubby savannah on the plains. The herbaceous cover is composed of *Hyparrhenia spp., Aristida kertingii, Landetia flavida, Andropogons spp.* and *Brachiaria ruziziensis.*

Animal Material

The biological material that is the subject of our study here consists of crossbred "SIMGOUD" cows resulting from crossing by artificial insemination between the SIMMENTAL and GOUDALI breeds, and calves resulting from the same crossing. The age of the cows varied between 3 and 6 years, with a weight between 350 and 400 kg, and having between one and two parturitions. The age of the calves was between 14 and 150 days at the start of the trial. The body condition score (BCS) for the cows was between 3 and 4.

Accomodation

Two-night pens were built with barbed wire and poles to park and restrain the animals. In addition, a shed built of temporary materials was designed to position the feeders but also to isolate the calves.

Health Protection

The animals were vaccinated for all mandatory prevalences, and any clinical cases were treated regularly. External deworming was done once a week with a spray (shower) and the internal deworming of the calves was done one month after birth, and systematically every six months. In the clinical cases, there was streptothricosis in particular, to which these animals are particularly sensitive.

Conduct of The Trial

One month prior to the data collection, the cows involved in the trial were trained for milking. Similarly, a few calf weighing simulations were done to get them used to handling. The animals were divided into two batches of comparable number and physiological state. These consisted of 6 cows and 6 calves per batch. The collection material consisted of a milking plate, a graduated beaker of 1 liter capacity, a graduated seal, ropes for restraining cows, and cords for the calves. Two linear feeders for the feed supplement and a portable

mechanical scale with a capacity of 150 kg (accuracy 1 kg) for weighing the calves were also used.

Feeding

The breeding system practiced by SODEPA is extensive. The animals were mainly fed on natural pastures dominated by *Hyparrhenia spp*. For the animals involved in this study, one batch received, in addition to natural pasture, a food supplement (concentrate) composed of crushed corn, cottonseed meal, soybean meal and wheat bran mixed with salt for a bromatological value calculated at 34, 1% cp, 2622kcal/kg DM metabolizable energy, 8.4% DM cellulose, 0.14% Ca, 0.34% P and 0.034% Na. The quantity of food served per day to the supplemented batch was 30 kg. Each animal consumed 5 kg of supplement/day. Watering was ad libitum for these animals.

Data Collection and Parameter Studied

Reproduction Performance

The exploitation of breeding logbooks and various codifications (notches on the ears) for information on the dates of birth, weaning and calving allowed us to evaluate parameters such as: Age at first calving (age of the female at the birth of her first calf) and Calving interval (number of days between two consecutive calvings to the same female).

Milk Production Performance

The determination of the daily amount of milk produced per cow was done in two ways: For cows whose calves were less than or equal to three months old, we performed the double weighing method. This consisted of weighing before and after feeding in the morning and in the evening, and bringing the daily estimate in line according to the formula proposed by *Sepchat et al.,* (2017):

$$PL\ (Kg/d) = X = (d1+d2) \times 24/H1-H0$$

Hand milking was performed on cows whose calves were older than three months. Milking was done twice a day, morning and evening, for the direct measurement of the daily quantity of milk.

Milk analysis

Twelve samples were taken from two batches of animals each month for three months for a total of 36 samples of raw milk analyzed. During the sample collection, the sterilizing instructions cited by Hogan *et al.,* (1999) were followed in order to reduce the risk of contamination by the numerous microorganisms present in the medium, on the cow's skin and the cow's teats. Approximately 500 ml of milk was collected after the rejection of the first milk squirt from all batches. The 100 ml flakes were labeled and immediately kept cool in a cooler containing dry ice and ice packs. As soon as the samples arrived at the analysis laboratory, the temperature was brought down to 20°C in order to carry out the physical and chemical analyses.

Physical Analysis

PH was measured using a pH meter after calibration at pH 7.02 and 4.00 by soaking it in a small volume of milk taken from a beaker.

Chemical Analysis

Dry matter

The dry matter content was estimated by evaporation in a water bath at 70°C before drying the sample (10 ml) for 3 hours in an oven at 103 ± 2°C (AOAC, 1990).

Ashes

The percentage of ash to dry matter was determined by incinerating the dry samples in a muffle furnace for 6 hours. After determining the percentage of milk dry matter, the crucibles and previous samples were placed in a muffle furnace at 500°C for 6 hours. The whole sample (crucible and white ashes) was then cooled in a desiccator and weighed again (Pf). The ash content was calculated using the following formula:

$$\%Ash = (Pf-Pc)/P0\ X\ 100$$

Where: Pf = Weight of the crucible and sample after 6 hours in the oven; Pc = Weight of the empty crucible; Po = Sample weight.

Fat

The principle of this method is based on the dissolution of the fat to be measured by sulfuric acid. Under the influence of centrifugal force and thanks to the addition of a small quantity of iso-amyl alcohol, the fat separates into a clear layer whose butyrometer graduations reveal the rate (AOAC, 1990). Following this, 10ml of sulphuric acid is introduced into a butyrometer. Using a graduated pipette, 11 ml of milk is added while avoiding the premature mixing of the milk with acid. Then, iso-amyl alcohol is poured over the surface. By plugging the butyrometer, the casein is stirred until completely dissolved. The butyrometer was then placed in the centrifuge at 1000-1200 rpm for 5 to 6 minutes. The fat content expressed in g/L is equal to (N-N') x 10 with:

N: the value reached by the upper level of the fatty phase.
N': the value reached by the lower level of the fatty phase.

Crude Protein

The determination of crude protein was done by titrimetric measurements after mineralization and distillation, according to the Kjeldahl method applied to milk (AOAC, 1990). A quantity of milk is mineralized using sulphuric acid in the presence of mercury oxide acting as a catalyst in order to convert the nitrogen of the organic compounds into ammoniacal nitrogen. The ammonia is released by adding caustic soda, then distilled and collected in a solution of boric acid. The ammonia is then titrated.

$$CP\ (g/L) = (Vc-Vb)/\ V0\ x\ 1.4\ x\ 6.39$$

where CP: crude protein; Vc: volume of sulphuric acid; Vb: volume of hydrochloric acid in ml used during the blank test and; V0: volume of milk used.

Lactose

Milk lactose was determined by taking the difference between dry matter and protein plus fat and ash (Malau-Aduli and Anlade, 2002).

RESULTS

Reproduction Performance

Table 1 presents the reproductive performance of Goudali, Simmental and Simgoud cows. It shows that the age at first calving is 39 months in the Simgoud cow, resulting from the crossing between Goudali and Simmental cows. Crossbreeding has thus made it possible to reduce the age at first calving of the Goudali cow by 24%. The interval between the calvings of the Simgoud cow was 18 months, with a variation of 16.21% in favor of crossbreeding. Compared to the same lactation duration, the cross made it possible to significantly improve the milk production of Simgoud cows.

Table 1. Reproduction and Milk Production Performance in The Production Unit Studied.

	Total milk production (liter)/time of lactation	First calving age (month)	Calving-calving interval (month)
Cow Goudali	810 (270 days)	51	21,48
Cow Simmental	6200 (305 days)	31	18
Cow Simgoud	869,4 (90 days)	39	18

Note: Different superscripts in the same column show the significant differences ($p < 0.05$).

Effect of Supplementation on The Lactation Curve of Simgoud Cows

The effect of supplementation on the lactation curve is illustrated in Figure 1. It appears that peak production was reached in the interval 0 to 3 months in both non-supplemented and supplemented cows. The production curve of supplemented cows was above that of the non-supplemented cows for the entire period of production.

Effect of Supplementation on the Yield and Physicochemical Composition of the Milk Produced

Table 2 summarizes the effect of supplementation on the various physicochemical parameters as well as the yield of the milk produced. It appears that supplementation significantly increased ($p<0.05$) the daily milk production in Simgoud cows. This increase is in the order of 22.77% compared to the control. Concentrate supplementation increased the dry matter content, organic matter content, ash content, crude protein content, fat content, and lactose content of the milk of the animals respectively by 27.83%; 27.5%; 38.46%; 3.6%; 21.66% and 43.32% compared to the control ($p<0.05$).

DISCUSSION

Genetic Determination

The genetic determinism of reproductive performance is classically recognized as being strongly influenced by the non-additive effects of genes (gene interactions). As a result, crossbreeding between two breeds makes it possible to benefit from the phenomenon of favorable heterosis on the characteristics that reflect reproduction, if the parent breeds are sufficiently homogeneous and different from the start to benefit from good complementarity and if the products are not placed in extreme environmental conditions. In such a situation, the problems of adaptation or antagonisms between production and reproduction characters may appear, which will limit the value attained by the latter. The results obtained in tropical countries on the reproductive performance of crossed females are very variable as a result (Kouamo *et al.,* 2014) due to an environment whose action is predominant.

Age

Age at first calving is an important factor in assessing the reproductive career of the female. The younger a female is, the more calves she will give during her breeding career. In the case of this study, age at first calving was 39 months in the Simgoud cow resulting from the crossing of the Goudali and Simmental cows. Crossbreeding thus made it possible to reduce the age at first calving of the Goudali cow by 24%. The age at first calving obtained (39 months) was higher than that of cows resulting from the cross between the Ndama and Jersey breeds (31.9 ± 2.5 months) (Diack *et al.,* 2004). The difference could be explained by the fact that the Jersey breed used in this cross would have a genetically superior reproductive performance to that of the Simmental cow used in our study. This difference is explained mainly by the environment of our study and diet, which influences physiological expression at several levels (Brisson, 2003). The cows in this study were raised in an extensive system with a minimum of five (05) months of drought (from November to April). In Senegal, Keita (2005) observed an age at first calving in Holstein and Montbéliarde crosses of 36 ± 1 month and 36 ± 2 months respectively. Sanyang and Diack (2005) observed an age at first calving of 31.8±3 months in F1 heifers in Gambia. In Benin, Alkoiret and Gbangboche (2005) observed 36 ± 6 months in the lagoon.

Calving Interval

The calving interval of the Simgoud cow was 18 months compared to that of the Goudali cow, which was 21 months. This variation was influenced by breed and calving year. In addition, Tawah and Mbah (1993) observed in the Goudali breed an interval between calving of 511-536 days and 365-730 days in the Peulh breed. Among the N'dama, Letenneur (1978) observed a calving interval of 410 days, whereas Kamga *et al.,* (2006) observed one of 398 ± 36 days. Alkoiret and Gbangboche (2005) observed an interval of 426 ± 85 days in lagoon cows in Benin. Calving intervals of 724 days (24.13 months) in the Holstein crossbred and 680 days (22.6 months) in the Montbéliarde crossbred were observed in Senegal by Keita (2005), while Letenneur (1978) reported a calving interval - calving of 11.8 months in the N'Dama X Jersey crossbreeds. Sow (1991) observed an interval of 12 ± 1.1 months and Kamga (2003) observed a calving interval of 12.3 ± 0.3 months in Holsteins.

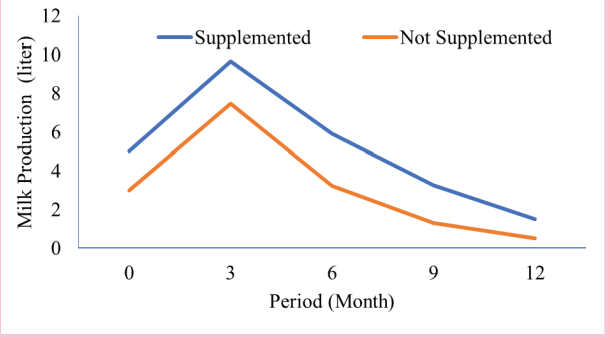

Figure 1. Effect of supplementation on the lactation curve.

Table 2. Effect of Supplementation on The Yield and Physicochemical Composition of The Milk Produced.

	Non-supplemented	Supplemented	p-value
Daily Production	7.46 ± 1.68^a	9.66 ± 1.37^b	0.03
pH	6.3 ± 0.00^a	6.4 ± 0.00^a	0.15
Dry matter (%)	9.49 ± 1.53^a	13.15 ± 1.93^b	0.01
Organic matter (%DM)	9.25 ± 1.45^a	12.76 ± 1.85^b	0.01
Ash (%DM)	0.24 ± 0.08^a	0.39 ± 0.08^b	0.02
Crude Protein (%DM)	2.93± 0.45^a	3.04 ± 0.75^b	0.01
Fat (%DM)	2.93 ± 0.85^a	3.74 ± 0.84^b	0.02
Lactose (%DM)	3.39 ± 0.40^a	5.98 ± 0.55^b	0.02

Note: Different superscripts in the same column show the significant differences ($p < 0.05$).

Milk Production

The cross also improved the average daily milk production of the Simgoud cow by 7.2 liters (without supplementation) compared to that of Goudali, which was 3 liters. This study shows that the highest average milk production was obtained in the Simmental cows, followed by Simgoud, resulting from the cross between the Simmental breed and Goudali. The exotic Simmental cattle breed is a breed resulting from the cross between the European Holstein breed, known for its milk production estimated to be more than 20 liters per day (Çilek, 2008), and the Montbeliard breed (Byishimo, 2012). The Simgoud cattle breed is genetically predisposed to milk production due to the presence of Holstein or Montbeliarde blood. Supplementation had no significant effect on the pH of the milk produced. However, whether the cows were supplemented or not, their pH (6.38-6.40) was slightly lower than the norm (6.5-6.8) (Luquet, 1985). The lowest average pH was 6.38 ± 0.20 and the highest 6.40 ± 0.15. The pH values of fresh cow's milk can be altered significantly by microbial infections; the acute forms towards acidification and chronic forms towards alkalinization (Araba, 2006). This is an important parameter that determines the subsequent destination of the latter, that is to say, its aptitude for transformation. A slight change in pH on the acid side has significant effects on the balance of minerals and on the stability of the colloidal suspension of casein (Alais and Linden, 2004). Also, the pH regulates the development of the internal and superficial flora involved in the ripening of cheese (Ramet, 1985). The cows that received the concentrate had a significantly higher dry matter content than the cows not supplemented. The differences thus observed could be explained by the concentrated feed, which could have varied the content of different nutrients in the milk. However, the milk dry matter content of the supplemented cows (13.15%) was within the norm (11.8 to 13.5%), while that of the non-supplemented cows (9.38) was below the norm. These results are different from those reported by Sissao *et al.*, (2015) in dairy farms in Bourkina Fasso (11.18 to 14.05) and could be related to the difference in animal material that produced the milks, as well as the modes of production and feed applied in these farms. The lactose content of the milk of the supplemented cows (5.98%) was also within the norm (4.5 to 5) and that of the non-supplemented cows (3.39%) was below the norm. These results are different from the average 4.33 obtained by Layou and Bouguetaib (2014) on dairy farms in the Tlemcen region of Algeria.

The cows that received the concentrate have a significantly higher organic matter, ash, crude protein, fat and lactose content than those of the cows who were not supplemented. One of the variation factors commonly put forward to explain variations in the nutrient content of milk is the proportion of concentrate in the ration. Concentrate supplementation in some batches may indeed justify the higher nutrient levels than found in the not supplemented cows.

CONCLUSION

At the end of this study on the reproductive performance of Simgoud crossbred cows and the effect of feed on the production and chemical composition of milk, it emerges that the cross between the Simmental and local Goudali breed improved the age at first calving, the calving interval and the average daily milk production of the local Goudali. The supplementation also improved the average daily milk production of the local Goudali and its chemical composition. Crossbreeding and concentrated feed are among of the possibilities that can help us improve the reproductive and milk production performance of local breeds in Cameroon.

ACKNOWLEDGEMENT

The authors would like to acknowledge the staff of the Animal Production and Nutrition Research Unit from the University of Dschang for their assistance during the processing of the data.

CONFLICT of INTEREST

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

RESEARCH FUNDING

This research is self-funded.

ETHICAL APPROVAL

This experiment was performed based on approval for the laboratory animals use by the SODEPA (Société de Développement et d'Exploitation des Productions Animales) with number [N6008/L/2023/SODEPA/DRF/CSP], Cameroon.

AUTHOR'S CONTRIBUTION

MM: conceptualization, formal analysis, investigation, methodology, writing, and the validation of the original draft. EAPP: investigation. EM: methodology and supervision. JL: methodology and supervision. FT: conceptualization supervision.

REFERENCES

ACDIC (Association Citoyenne de Défense des Intérêts Collectifs)., 2006. Filière Laitière au Cameroun. Yaounde: ACDIC, 69.

Alais, C. and Linden G., 2004. Science du Lait, Principe desTechniques Laitière, Edition: La maison rustique. Paris: Société d'édition et de promotion agro-alimentaires, industrielles et commerciales.

Alkoiret, TI., and Gbangboche, A.B., 2005. Fécondité de la vache lagunaire au Bénin. Age au premier vêlage et intervalle entre vêlage. *Revue d'élevage et de médecine vétérinaire des pays tropicaux,* 58(1), 61-68.

AOAC (Association of Official Analytical Chemist)., 1990. Official method of analysis 15th edition. Washington D.C: AOAC.

Araba, A., 2006. Conduite alimentaire de la Vache Laitière. Transfert de Technologie en Agriculture. *Bulletin réalisé à l'Institut Agronomique et Vétérinaire Hassan II,* Rabat, 136.

Byishimo J.C., 2012. Contribution à L'évaluation des Performances de Reproduction et De Production des Bovins Girolando dans la Ferme Agro-pastorale de pout au Sénégal. Thèse de doctorat en Médecine Vétérinaire école inter Etats des Sciences et Médecine Vétérinaire. [Thesis]. Université Cheih Anta Diop de Dakar.

Boubekeur S., Berber A., and Zadim., 2009. Impact du Nombre de repas de lait sur la Croissance du veau d'élevage. *Rencontres Recherches Ruminants,* 2009 (16), 71.

Diack, A., Sanyang, F.B., and Corr, N., 2004. Survival, Growth, and Reproductive Performance in F1 Crossbred Cattle Produced and Managed on Station in the Gambia. *Livestock Research of Rural Development,* 16(9), 1-4.

Djoko T.D., and Mbah, D.A., 2003. Croisement des Bovins Pour Production Laitière sous les Tropiques: Effets des Facteurs Génétiques et Environnementaux sur les Performances de génotypes Améliorés des hauts Plateaux de l'Ouest Cameroun. *Revue d'élevage et médecine vétérinaire des pays tropicaux,* 56(2), 63-73.

Kamga, P., Mbanya, J.N., Awah, N.R., Mbohou, Y., Manjeli, Y., Nguemdjom, A., Kamgo, B., Njwe, R.M., Bayemi, P.H., Ndi, C., Imélé, H., and Kameni, A., 2001. Effet de la saison de vêlage et de Quelques Paramètres Zootechniques sur la Production laitière dans le haut plateau. *Revue d'élevage et médecine vétérinaire des pays tropicaux,* 54(1), 55-61.

Keita, N.S., 2005. Productivité des Bovins Croisés Laitiers dans le Bassin Arachidier. Cas des régions de Fatick et Kaolack. [Theses]. Universite Cheikh Anta Diop de Dakar.

Kouamo, J., Alloya, S., Habumuremyi, S., Ouedraogo, G.A., and Sawadogo, G.J., 2014. Evaluation des Performances de Reproduction des Femelles Zébus Gobra et des Croisés F1 après Insémination Artificielle en Milieu Traditionnel dans la région de Thiès au Sénégal. *Tropicultura,* 32(2), 80-89

Letenneur L., 1978. Dix années d'expérimentations sur le Croisement du bétail N'Dama x Jersiais en Côte d'Ivoire. *Revue Mondiale de Zootechnie,* 27, 36-42.

Madjina, T., Fidele, M.M., and Youssouf, M.L., and Hamadou, B., 2015. Age au Premier Vêlage et Intervalle Entre Vêlage de Quatre Races Bovines en Zone Périurbaine de N'Djamena, Tchad. *Afrique Science,* 11(3), 229-240.

Mbah, D.A., 1987. Mortality due to Rickettsia, Trypanosomiasis, Piroplansmosis and Streptothricosis Among Six Genetic Groups of Cattle at Wakwa. *Science and Technology Review,* 2, 81-88.

Mbah, D.A., 1993. Adaptation of Dairy Cattle to Wakwa (Adamaoua) Environment. Resistance to Cattle Ticks Science and Technology Review. *Agronomic and Animal Sciences Series,* 2, 101-106.

MINEPIA., 2015. Elevage et pêche. Annuaire Statistique du Cameroun. Yaoundé: MINEPIA, 12.

Pingpoh DP., and Mbah DA., 2019. Profitability of Agricultural Research: The Case of Genetic Improvement of Cattle for Milk Production in Cameroon. *Journal Of The Cameroon Academy of Sciences,* 5(1), 1-8.

Sanyang, F., and Diack, A., 2005. Développement d'un Programme de Croisement Pour la Filière Basé sur les petits Exploitants dans la région de Grand Banjul, Gambie. *Procordel,* 18-120.

Sepchat, B., D'hour, P., and Agabriel, J., 2017. Production Laitière des Vaches Allaitantes: Caractérisation et étude des Principaux Facteurs de Variation. *INRA Productions Animales,* 30(2), 139-153.

Sow, A.M., 1991. Contribution à l'étude des Performances de Reproduction et de Production de la Femelle Jersiais au Sénégal, l'expérience de la SOCA. [Thesis]. Universite Cheikh Anta Diop de Dakar, 78.

Tawah, C.L., and Mbah, D.A., 1993. Amélioration génétique : Bilan et Perspectives Dans les Pays du sud. In: Maîtrise de la Production et Amélioration Génétique des Ruminants: Apport des technologies nouvelles. Dakar: NEAS, 119-143.