Overview of breeding and zootechnical performance of the Azawak cattle breed in sub-saharan Africa

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Abstract

The African continent shelters several animal genetic resources, some of which are better known due to the large numbers of studies carried out on them. Among those that are still little known from a scientific point of view is the Azawak cattle. This document presents a review of the scientific knowledge available on this breed over the last ten years. The information collected provides information on the origin, physical traits, growth and reproduction performances as well as improvement crosses performed with the Azawak breed. The results showed that the Azawak cattle is a zebu with impressive physical traits with a dual-purpose use. In fact, this zebu mainly provides milk and meat to the indigenous populations of countries such as Niger, Mali, Burkina Faso and Benin. Given its highly appreciated performance, it has particularly benefited from an improvement program at the Toukounous station in Niger since the 1950s. In addition, it is used in the neighboring regions of Niger and Mali as an improvement breed for several African cattle breeds such as the Borgou, the Lagunaire in Benin, and the Fulani zebu in Burkina Faso. Furthermore, the Azawak zebu has itself been improved by crossbreeding with other exotic breeds such as the Brune des Alpes. However, in view of the work examined, it should be noted that the Azawak cattle is a zebu with high potential but with little-explored performance.

Keywords: Azawak cattle; characteristics; performance; Africa

Introduction

In Africa, cattle farming is characterized by a diversity of local breeds used for various purposes such as prestige, milk, meat, traction, manure and also to provide some income for some households that are totally dependent on them (FAO, 2019; Cao et al., 2021; Ouédraogo et al., 2021; Azalou et al., 2023) . On the other hand, it is documented that traditional cattle farming is facing challenges such as low milk and meat production performance in several breeds, climate change leading to the scarcity of pastoral resources (Djohy et al., 2013; Balehegn et al., 2021; Amole et al., 2022; Junca Paredes et al., 2023; Montcho et al., 2024). The growth in local demand for milk and meat in most developing countries requires consideration of improving indigenous livestock production methods (Siddo et al., 2015). Efforts to improve livestock production (mainly milk and meat) are most often observed in state breeding stations and are generally marked by the use of exotic breeds, generally European and/or Asian. In Mali, for example, local cattle breeds are crossed with exotic breeds either by artificial insemination or by crossbreeding with bulls such as the Montbéliard, the Rouge des Steppes and the Holstein (Toure et al., 2019). In Benin, crossbreeding between local breeds and exotic breeds such as the Girolando and the Gir has also been the subject of experimentation. However, most attempts to introduce these non-African exotic breeds have resulted in unsatisfactory results in the medium term, in particular the difficulties of adapting imported breeds to African environmental conditions. Thus, the failure of local breed improvement programs via exotic seeds or breeders has led African researchers to look towards prospects for livestock improvement through selection, feeding and even conservation of local animal resources with greater involvement of traditional breeders (Mueller et al., 2015; Worogo et al., 2020; Camara et al., 2020). Thus, African trends show improvement crosses through the use of breeds present in neighboring countries. For example, in Burkina Faso, we can see the use of the Azawak cattle breed (from Niger) for the improvement of local breeds (Ouédraogo et al., 2021) ; in Benin, the use of the Azawak cattle breed (from Niger) for the improvement of local breeds (Kassa et al., 2016; Adambi Boukari, 2020; Worogo et al., 2020). However, this improvement implies a better knowledge of african indigenous breeds to better guide the development objectives of the animal sector. As such, the Azawak zebu is one of the West African breeds whose zootechnical potential is little explored. Due to the renewed interest in improving indigenous african breeds, it seems appropriate to document current knowledge of these to better guide decision-making for the safeguarding and promotion of local breeds in general. From this point of view, this review is particularly interested in synthesizing the most recent information on the Azawak cattle breed.

Methodology

This synthesis aims to take stock of the achievements of research on the Azawak zebu in Africa. To achieve this objective, we carried out documentary research on theses, scientific articles and internet sources. The main internet sources studied were www.scholar.google.com; www.tropicultura.org; www.researchgate.net; www.aginternetwork.net; www.oaresciences.org/fr; www.doaj.org; http://hal.archives-ouvertes.fr and https://www.scopus.com and Web of science. Articles and documents published between 2014 and 2024 were selected. The selected articles were found online through the combination of several keywords: Azawak , breeding, fertility, calving, productivity, milk, reproduction, health. These words were also translated into French to broaden the search. A total of twenty-two (22) articles met the selection criteria. Most of the selected articles retained focus on the analysis of zootechnical parameters (reproduction, genetics, growth, milk production) under the different forms of breeding of the Azawak breed in Africa with diversified results.

Results

Origin of the breed

With regard to the selected documents, several areas are mentioned as the origins of the Azawak breed. The Azawak cattle breed is found in Nigeria and is said to have originated from the Azawak Valley in northeastern Nigeria according to (Kubkomawa, 2017) . In Mali, the north of the country is considered to be the cradle of the breed (Toure et al., 2019). According to the Centre pour la Sécurité Alimentaire et Nutritionnelle (CSAN Niger, 2019), the name "Azawak" given to this cattle comes from its area of origin, a region located across the border between Niger and Mali. In fact, the name " Azawak " refers to a portion of sandy land with unmarked relief in Tamajeq in Niger. It is part of the cattle raised by the Arabs and Tuaregs of the Azaouak Valley and in eastern Mali according to the same source.

Geographic distribution

Azawak zebu is present in several African countries (Figure 1) such as Niger, Mali, Nigeria, Benin, Burkina Faso, Chad and Central Africa according to the available literature (Kubkomawa, 2017; Traoré et al., 2015; CSAN Niger, 2019; Ouédraogo et al., 2021). In Niger, this breed is present throughout the national territory, representing more than 2/3 of the country's cattle population (CSAN Niger, 2019). In this country, it has been the subject of selection since 1954 at the Toukounous station in Niger, with the main objectives of milk and

meat production and genetic improvement (Siddo et al., 2018). In Nigeria, the Azawak cattle is distributed along the northwestern border of the country (Kubkomawa, 2017). According to the same source, Azawak cattle can be observed in almost all regions of Nigeria throughout the year, with a high proportion of subjects undergoing seasonal transhumance. They are also present on the northern and western border of Sokoto; some can also be found in the northwest of the Borgu region and scattered along the border from Sokoto to Katsina. In Burkina Faso, scattered nuclei can be observed at some traditional cattle farms (Ouédraogo et al., 2021). In Mali, the Azawak cattle is present in extensive peri-urban livestock farms (Toure et al., 2019; Touré et al., 2019). In Benin, its presence is also reported both in State breeding stations (Okpara Breeding Farm and Samiondji Breeding Farm) and in traditional environments (Soulé, 2015; Worogo et al., 2020; Adambi Boukari, 2020; Worogo et al., 2022)

Physical characteristics of Azawak cattle

Azawak cattle (Figure 2) is a zebu with particular characteristics. The Azawak cattle present in Nigeria are of light build and have medium-length horns. However, the Azawaks entering Nigeria are generally light fawn in color, although they can also be white, brown, piebald and black (Kubkomawa, 2017). In the Republic of Niger, the Azawak cattle is also described as a rustic animal with an aesthetic appearance with a coat of varied colors ranging from fawn red to mahogany, with however gray, white and sometimes black subjects with a skin of medium thickness (CSAN Niger, 2019). According to the same source, the Azawak zebu is a medium-sized animal with a height at the withers of 122 to 130 cm and a live weight at adulthood of 350 and 500 kg for the male and 300 and 410 kg for the female. Its carcass yield is estimated at between 48 and 52%. The dewlap and ventral fold have an imposing appearance. Its hump, 12 to 16 cm thick, is massive but narrow. However, the horns of the Azawak zebu are very rarely developed and the ear, approximately 21 cm) is of average size in adult females. Among the local cattle breeds present in Niger, Azawak is the one that has undoubtedly benefited, since the 1950s, from a long phenotypic selection, particularly at the Toukounous experimental station. The Azawak zebu is considered the best dairy breed in Niger and is also used for animal traction.

Weight growth in purebred form

A recent study conducted by Siddo et al. (2018) provides information on the growth performance of Azawak cattle under semi-improved breeding conditions at the Toukounous station in Niger. At birth, the Azawak breed weighs 22.3 ± 1.9 kg with specimens reaching 34 kg. At birth, the smallest subjects weigh around 10 kg. At 12 months, the subjects weigh around 156.2 ± 30 kg with a maximum of up to 279 kg. During this age group, the average daily gain (ADG) was around 365.7 ± 80.9 g/day with a maximum of 701 g/day. After 18 months of age, growth performance of 189.5 ± 38.2 kg were recorded with extremes of 326 kg. After 20 months of age, weights of around 212.5 ± 35.3 kg were recorded with a minimum of 113 kg and a maximum of 344 kg. According to another source in Niger (CSAN Niger, 2019), birth weights of 23.47 ± 0.25 kg were reported for calves compared to 22.1 ± 0.21 kg for females. In Benin, the growth performance of Azawak cattle was assessed in station (Okpara Breeding Farm) by Adambi Boukari (2020). According to this source, at birth, the animals showed a weight of 22.03 ± 0.88 kg for males compared to 21.75 ± 0.65 kg for females. At 6 months of age, growth performance was 88.13 ± 3.53 for males versus 80.30 ± 2.41 kg. At 12 months of age, weights of the order of 145.55 ± 5.82 kg were recorded for males versus 137.15 ± 4.11 kg for females. At 18 months of age, the animals displayed weights of 190.08 ± 7.6 kg for males versus 168.22 ± 5.05 kg for females. At 24 months, the males reached a weight of 222.98 ± 8.98 for males versus 201.98 ± 6.08 for females. At 24 months, the ADG of Azawak calves was around 277.91 g/day for males and 248.93 g/day for females.

Growth performance under crossbreeding

The growth performances of crossbred subjects (Azawak x Borgou) were documented in station by (Adambi Boukari, 2020) . According to this source, at birth, crossbred calves showed a weight of 18.91 ± 0.57 kg for males against 18.60 ± 0.65 kg for females. After 6 months of age, growth performances were 80.87 ± 2.43 for males against 75.55 ± 2.64 kg. After 12 months of age, weights of the order of 135.52 ± 4.07 kg are recorded for males against 129.10 ± 4.52 kg for females. At 18 months of age, the animals weigh 170.95 ± 5.13 kg for males versus 154.90 ± 5.42 kg for females. After 24 months, the males reach a weight of 206.59 ± 6.20 for males versus 191.20 ± 6.69 for females. In 24 months, the ADG of crossbred calves (Azawak x Borgou) is around 260.67 g/d for males and 239.72 g/d for females.

Purebred reproductive characteristics

In a controlled breeding environment at the Toukounous station (Niger), the reproduction of Azawak cattle is mainly carried out by natural mating with a sex ratio of one bull for 50 to 60 cows. However, the breeding periods are organized according to four periods of the year: from February to March, from November to December, from June to mid-July and from mid-August to September in order to distribute births throughout the year and to have continuous milk production. However, artificial insemination (AI) trials have been carried out

experimentally since 2007 at this station (Siddo et al., 2018). Furthermore, an age at first calving of 35 to 40 months, an interval between calving of 11 to 13 months and a fertility rate of 70 to 75% are reported by CSAN

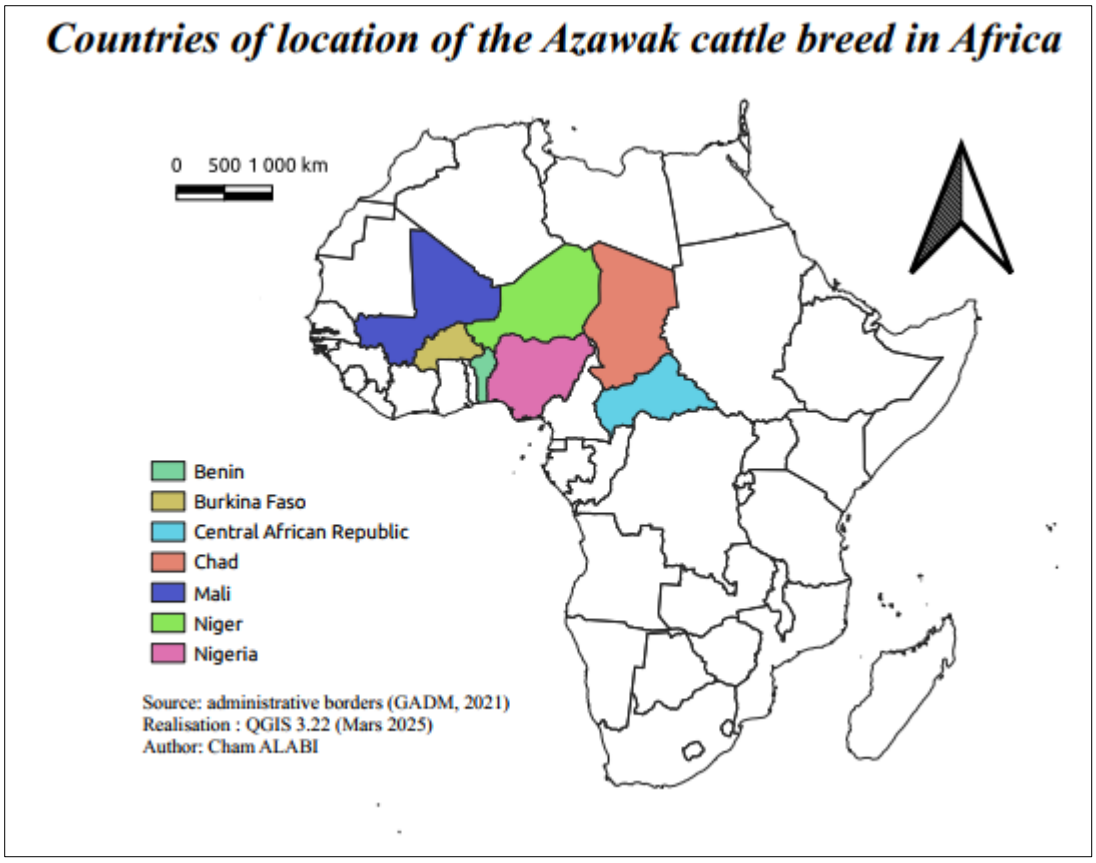

Figure 1: Countries of location of the Azawak cattle breed in Africa

Figure 2: Male and female Azawak breed

Source : Touré et al. (2019)

Niger (2019) in Niger. In Mali, the calving intervals documented by Toure et al. (2019) was 450 ± 93 days within peri-urban herds. In order to improve the reproductive performance of Azawak cows in Niger, ultrasound studies conducted by Moussa Garba et al. (2015, 2021) consisted of evaluating follicular growth by induction of estrus in Azawak zebu females using two processes: PGF2α and progesterone. The results obtained by these authors enabled to better characterize the estrous cycle of cows. The results showed a similar proportion of estrus for the two treatments (81%). Furthermore, the mean time before the onset of estrus was longer after injection of a PGF2α (84.8 ± 26.0 h) than after withdrawal of PRID® (59.2 ± 5.8 h). The mean duration of estrus was significantly shorter after its induction by PGF2α (12.6 ± 2.6 h) than after its induction by progesterone (22.9 ± 2.7 h). The interval between the onset of estrus and ovulation in animals treated with PGF2α and progesterone did not vary for both treatments (28.4 h to 30.3 h). In contrast, the authors reported that injection of PGF2α was accompanied by a significantly lower pregnancy rate than that obtained after treatment of animals with progesterone (31.2 vs 54.5%). Furthermore, according to the same source, the dose of eCG administered to cows only increased the follicular population without, however, showing significant differences. Administration of eCG to animals induced marked follicular growth and maturation and also an increase in growing follicles and ovulations. The authors state, however, that a dose of 800 IU could induce super ovulation and, by extension, twin gestation. On this basis, it would be appropriate to adapt an insemination policy to hormonal treatment for the induction of estrus in the Azawak cow.

Azawak bull semen was assessed by Tapsoba et al. (2023) in Burkina Faso. According to this study, morphologically, the Azawak bull has a scrotal circumference of 33 cm with a testicular volume of 200 cm^3. Its ejaculate has a milky white and sometimes yellowish white appearance and the average volume of the ejaculate is 2.34 ± 0.89 cm3 with a pH of 6.71 ± 0.15. On a scale of 1 to 5, the mass motility of spermatozoa (spz) was estimated at 3.81 ± 0.98. Individual sperm motility was estimated at 80% with a vitality of 83%. The abnormal sperm count is around 10 ± 0.05 and the sperm concentration has an average value of 2.59 ± 0.97 x 109 spz /ml. In Benin, the Azawak bull was also analyzed on testicular measurements and sperm quality by Akpo et al. (2018) . The values provided by these authors were 15 ± 1.41 cm for the length of the left testicle, 15.5 ± 0.71 cm for the length of the right testicle, 6.5 cm for the width of the left testicle, 6.5 cm for the width of the left testicle and 27.5 ± 2.12 cm for the scrotal circumference. The testicles have an average temperature of 34.05 ± 0.64°C. The mean volume of ejaculate collected was 5.16 ± 2.06 ml. The mass and individual motilities were 4.58 ± 0.51 and 4.75 ± 0.45, respectively. The number of spermatozoa per ejaculate was 4.20 ± 3.69 x 109 spz with a mean concentration of 0.74 ± 0.33 x 109 spz /ml. The authors reported a percentage of abnormal spermatozoa of 8.41 ± 3.29%.

Azawak purebred milk production

In purebred, the milk production performances of Azawak cows are provided by Halidou et al. (2021) at the Toukounous station in Niger. These Azawak cows exhibited an average daily milk production of 4.10 ± 1.55 kg. For primiparous cows, this value is 4.10 ± 1.03 kg. Multiparous cows, on the other hand, display an average of 4.84 ± 1.15 kg/day. Over 305 days of lactation, Azawak cows display a standard production of 251.04 ± 313.96 kg for primiparous cows and 1442.61 ± 334.99 kg for multiparous cows. Their total productions were estimated at 1349.59 ± 393.40kg and 1301.72 ± 420.49kg respectively for primiparous and multiparous animals. As part of the Azawak Zebu Diffusion Support Project (PSDZA) Phase II in Burkina Faso, the milk production recorded for pure Azawak zebu was 625 ± 198 kg in 186 days of lactation (Ouédraogo et al., 2021). The milk production of Azawak cows can reach 15 L per day in the rainy season (CSAN Niger, 2019). In Mali, the average milk production of cows is estimated at 3.17 ± 1.31 kg for an average lactation duration of 192 ± 87 days in peri-urban farms (Toure et al., 2019). Total milk production per lactation is estimated at 636 ± 43.3 kg according to the same source. In another study conducted by Abdou et al. (2022), colostrum from the Azawak cow was used to measure the effect of its supplementation in newborn goats during the first 15 days of life in semi-intensive farming conditions in Niger. The results were satisfactory since the experiment enabled to improve the growth rate of the kids until weaning, to modify certain barometric changes and to improve the health status of the kids and to reduce the mortality rate.

Milk production under crossbreeding

In the framework of the PSDZA Phase II in Burkina Faso, milk production was 516 ± 218 kg for F1 crossbreeds with Fulani zebu in 186 days of lactation (Ouédraogo et al., 2021). In Benin, the average daily milk production was reported at 0.69 ± 0.24 kg for a lactation duration of 213.43 ± 73.15 days for Azawak x Lagunaire crossbreeds (Kassa et al., 2016).

Use of the Azawak zebu for crossbreeding and genetic improvement

In its cradle, the Azawak cattle is the subject of genetic improvement through the use of exotic breeds. For example, the study of Halidou et al. (2021) mentioned that Azawak females were crossed with males of

Brune des Alpes. The results seem satisfactory insofar as the milk production (average, standard and total) of the crossbreeds obtained were higher than those of pure Azawak cows.

On the other hand, in other neighboring countries, it is Azawak males that are used for crossbreeding with other indigenous breeds to improve their performance. For example, several studies carried out in Benin showed that the Azawak breed is present in many herds both in traditional environments (Worogo et al., 2020) and in two state stations (Okpara Breeding Farm and Samiondji Breeding Farm) (Kassa et al., 2016; Akpo et al., 2018). It is also considered one of the breeds leading to genetic dilution in the Borgou breed in Benin given the more appreciated beef and dairy performances of the Azawak breed (Worogo et al., 2022). In Burkina, the Azawak zebu was introduced and benefited from a breeding program in the period from 2000 to 2015 with the main objective of milk production within the framework of the Azawak Zebu Diffusion Support Project (PSDZA) Phase II to supplement local production under the funding of the Belgian Technical Cooperation (CTB) (Ouédraogo et al., 2021). During this project, Azawak breeders' associations were set up, which led to the creation of the National Union of Azawak Zebu Breeders. The objectives were to promote a participatory strategy for genetic improvement, optimize animal management to increase milk and meat production and improve breeders' skills. The project conducted intra-breed selection for the Azawak breed, while the Azawak and Sudanese Fulani zebu were subjected to absorption crossbreeding involving Azawak Zebu bulls. Pure Azawak zebu bulls aged 9 to 12 months were used for performance testing as well as artificial insemination. The work carried out under the project resulted in an increase in the Azawak zebu population (up to 20%); an increase in the F1 crossbreed population by 364% and F2 crossbreeds by 500%. A study by Siddo et al. (2015) assessed the breeding criteria and willingness to appropriate improved Azawak breeding stock in Niger from the perspective of traditional farmers. According to the results of these studies, the most important morphological attributes for breeders in the selection and adoption of breeding stock were coat color, body size, docility, milk production of the offspring of the sire of the male concerned, and milk production of the sire of the male concerned.

Sensitivity of the Azawak cattle breed to pathologies

A study conducted in Benin by Yessinou et al. (2018) revealed that Azawak cattle were vulnerable to parasitic infestations, including those of three species of *Amblyomma ticks variegatum*, *Rhipicephalus microplus* and *Hyalomma spp*. These authors reported infestation indices (animal infestation over average herd infestation) of 0.93, 12.82 and 0.13 respectively by these tick species on the Azawak breed. The average parasite intensities (ratio between the total number of individuals of a parasitic species in a sample of hosts and the number of infested hosts in the sample) of these species were 8.25 ± 1.40, 98.81 ± 16.76 and 1.18 ± 0.34. According to the same source, infestations due to these three tick species can be located in several body regions in Azawak cattle, including the head, neck, ears, back, rump, abdominal and ventrogenital regions, tail and even legs. However, compared to other bovine species considered in their study, Yessinou et al. (2018) stated that Azawak females as well as crossbreeds were the least infested by these three tick species. Another study conducted in Niger by Issa et al. (2016) consisted of evaluating the clonality of *Staphylococcus aureus* isolated from California Mastitis Test (CMT) positive cows on Azawak zebu herds at the Sahelian experimental station of Toukounous . The *S. aureus isolates* belonged to 14 different pulsotypes. Seventy-five *S. aureus isolates* were studied in depth for their virulotypes, capsular antigens and biofilm production. According to these authors, most surface factors, leukocidins and haemolysins were detected in more than 75% of the isolates and were evenly distributed among pulsotype A, B and D isolates. The majority of the 72 *S. aureus positive with cap5H* or *cap8H* PCR produced the capsular antigen *CP5* (82%) or CP8 (88%), respectively. Biofilm production by the 57 *icaA -positive isolates* was high for 8 isolates, moderate for 31 isolates and low for 18 isolates. The authors conclude that a small number of *S. aureus clones* circulate within the studied herds and that their specific properties associated with virulence still require further study.

Conclusion

This review on Azawak cattle revealed that breed is mainly present in West Africa. That breed has the advantage of being used as an improver animal of other indigenous breeds of Africa. However, despite its interesting characteristics, it has been the subject of a little scientific study to reveal its potential for more appreciable performance. Regarding the fact that most of the Azawak cattle herds are held by farmers who dominantly practice extensive livestock farming, there is need to develop community-based breeding programs in several regions of the countries where the breed is found.

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