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Zootechnical characteristics and ovarian potential of Kouri cows slaughtered in the Lake Chad Region

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The present study was conducted on the zootechnical characterization and ovarian potential of Kouri cows slaughtered in four slaughterhouses in the Lake Chad region. For this purpose, a total of 100 cycled cows and 20 pregnant cows were used. Before each cow was slaughtered, its age, weight and body condition score were determined. At the slaughterhouse, the ovaries were removed and transported in a portable cooler at room temperature in the laboratory for analysis. In the laboratory, after removing tissue debris from the ovaries, they were weighed and the follicles presented on the surface of the ovary were counted and measured with a caliper and classified into three categories: small (Φ<3 mm), medium (3≤Φ≤8 mm), and wide (Φ>8 mm). For pregnant cows, the weight and age of the fetus was determined. The body condition score determined before slaughtering the cows helped to classify cow into three categories: lean: 1-2, medium: 3, and fat: 5. As results, the average age of these cows is 4.8 years old, the average weight is 356.17 kg, and the body condition score is 3.90. The pregnant cows were 4 to 6 years old. Apart from the fact that the number of small follicles increased, the other ovarian characteristics considered were not significantly influenced by the age of the cattle at slaughter. Ovarian weights increased with body condition score 5 (p≤0.05) and the number of follicles of any size was not significantly influenced (p≤0.05) by the body condition score. The number of follicles in any size was not significantly influenced (p≤0.05) by slaughter weight. Thus, the Kouri cows slaughtered in the four slaughterhouses of Lake Chad region are young cows with a large follicular stock that can be used to produce embryos *in vitro*.

Key words: Kouri cows, Lake Chad region, follicular population, ovarian potential, body condition score.

INTRODUCTION

Livestock play a crucial role in the livelihoods of rural populations in sub-Saharan Africa. Around 200 million

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people practice livestock breeding (Koussou et al., 2013). It is a source of employment and a means of combating poverty. In Chad, the livestock sector counts more than 93.8 million heads of ruminants creating employment to 40% of the country's population (FAO, 2020). Among the ruminants in Chad are cattle with more than 20 million head, in which is found Kouri bulls. The Kouri breed of cattle is a unique breed, only reared in around the shores of the Lake Chad. It is a large animal, with a developed bone structure and whose weight ranges from 400 to 500 kg in females and 400 to 700 kg in males. It is distinguished above all by its spectacular horning. Its capabilities are interesting for both meat and milk production (about 4 to 6 L/day) (Zafindrajaona et al., 1999). However, it is an endangered species and is traditionally raised with few genetic improvement programs. Genetic, health and reproductive problems have been identified as the factors responsible for the low productivity of cattle in Chad (Ebangi et al., 2011).

As a solution to these problems, new reproductive techniques such as Artificial Insemination and Embryo Transfer have been developed (Margaux, 2022). These new reproduction techniques constitute essential biotechnologies in animal production improvement schemes and contribute to the intensification of the genetic improvement of livestock (Mbaïndingatoloum, 2011). They also make it possible to exchange breeding stock of high genetic value throughout the world, while minimizing the risks linked to the importation of live animals. However, in Chad, this technique is poorly developed in the cattle herd, which leads to poor genetic improvement of the local cattle herd. *In vitro* embryo production which is an alternative to Artificial Insemination allows the preservation of the genetic potential of sub-fertile or dead animals (Deuleuze et al., 2009). They promote female genetic potential. *In vitro* embryo production first involves oocyte collection and maturation (Christian, 2008). Ovaries collected from animals after slaughter are the largest source of oocytes for large-scale embryo production (Margaux, 2022; Souleyman, 2023) and transfer to the recipient. The Kouri cattle breeds of Lake Chad, due to their low natural reproductive performances (Tellah et al., 2015), will be able to offer a high oocyte yield capable of contributing to the improvement of reproductive potential. However, the success of oocyte maturation would be linked to endogenous and/or exogenous factors (Azafack et al., 2019). The work was initiated with the general objective of evaluating the ovarian potential and variation factor of cows slaughtered in the slaughterhouses of Lake Chad.

MATERIALS AND METHODS

Site and period of the study

The study was carried out between March and April 2024 in four slaughterhouses in Lake Chad region (Abattoirs Frigorique de Farcha, Abattoir de Diguel, Abattoir de Goudji and Abattoir de Ngueli) with part of the work carried out in the laboratory of the Institute of Livestock Research for Development (IRED) in the region of Chari Baguirmi, in the peri-urban area of Ndjamena. The average annual precipitation is between 226.10 and 711.20 mm (minimum and maximum). The relative humidity is 74% on average and the wind speed is around 18 km/h. The temperature oscillates between 22 and 37°C.

Animal

A total of 100 cycled and 20 pregnant Kouri cows slaughtered from March to April 2024 in four slaughterhouses in Lake Chad were used for this trial.

Determination of age

The age of each animal was determined by simultaneous analysis of the dentition and horniness as described by Fassi et al. (2006).

For the determination of age by the horns, the following formula was used (Garba et al., 2013):

Age (in years) = N + 2,

where N represents the number of furrows and 2 a constant.

Body condition score

The body condition score was determined before slaughtering the animal according to the grid proposed by Vall and Bayala (2004). The cows were classified into 3 categories as proposed by Natumyana et al. (2008): score 1-2: Lean; score 3: Average; score 4-5: Greasy.

Weight of cows

Before slaughter, the chest circumference (CC) of each cow was measured with the tape measure. The weight was calculated according to the formula (Njoya et al., 1997):

$$\text{Weight (kg)} = 124.69 - 3.171 \times CC + 0.0276 \times CC^2$$

Physiological status

The physiological status of the cows was determined after slaughter by examination of the uterus. The uteri of pregnant females were selected, and the fetus removed to estimate its age using the method proposed by Santos et al. (2013). According to this method, age is determined from the formula:

$$Y = X\,(X+2)$$

where X represents the number of months of gestation, Y represents the neck-crust length in centimeter and 2 a constant.

Collection of the ovaries

After identification and slaughter of each cow, the ovaries were removed by sectioning the broad ligament using scissors. Then, the right and left ovaries were placed individually in conical tubes containing isotonic medium of Nacl 0.9% with penicillin streptomycin 0.5 mg/ml bearing the identification labels of each cow. The tubes containing the ovaries were then placed in an insulated container at

Table 1. Zootechnical characteristics of Kouri cows slaughtered in four slaughterhouses in Lake Chad from March to April 2024.

Feature	Minimum	Maximum	Mean ± Standard deviation
Age (year)	3	6	4.81±0.96
Weight (kg)	250	400	356.17±47.72
Body condition score	3	5	3.90±7.15

Table 2. Distribution of Kouri cows slaughtered according to age and physiological state.

Physiological state of cows		Ages of cows (years)				Total
		3	4	5	6	
Non-pregnant cows	Effective	11	31	31	27	100
	%	9.2	25.8	25.8	22.5	83.3
Pregnant cows	Effective	0	3	9	8	20
	%	0.0	2.5	2.5	6.7	16.7
Total	Effective	11	34	40	35	120
	%	9.2	28.3	33.3	29.2	100

a temperature between 30 and 32°C, then transported to the laboratory within 2 h following slaughter.

Determination of the weight of the ovaries

Once in the laboratory, the ovaries were cleared of tissue debris using a pair of scissors then cleaned three times using an isotonic NaCl solution (0.9%) and weighed using an electronic scale with a capacity of 500 g (BEL brand) and a precision of 0.01 g. Depending on their weight, the ovaries were divided into three groups: (small < 3 g; medium 3 to 8 g, and large > 8 g).

Identification of the corpus luteum

The corpus luteum was identified by naked eye observation of the ovary. The latter deforms the ovary and appears on the surface. In cows, the mature corpus luteum has a “spherical plug” shape with a gray color (Kouamo et al., 2014).

Counting and classification of follicles

The surface of each ovary was observed through a magnifying glass, the follicles present on this surface were counted and follicular diameter measured using a caliper (Kumar et al., 1997). The measured follicles were classified into three categories: (small < 3 mm, medium 3 to 8 mm, and large >8 mm) according to Duygu et al. (2013).

Statistical analysis

All data on zootechnical characteristics were subjected to descriptive analysis using SPSS 26.0. The effect of the age of cow at slaughter time, body condition score and weight of cow were tested using one-way ANOVA while the effect of age of cow at slaughter time on the variation in weight and age of fetus were tested using one t-test.

RESULTS AND DISCUSSION

Zootechnical characteristics of Kouri cows slaughtered in four slaughterhouses in Lake Chad from March to April 2024

Table 1 summarizes the characteristics of Kouri cows slaughtered in four slaughterhouses in Lake Chad from March to April 2024. It follows that the average age of these cattle is 4.8±0.96 years. Their average weight is 356.17±47.72 kg and body condition score 3.90±7.15. However, the youngest cows were 3 years old and the oldest 6 years old.

Physiological status of Kouri cows slaughtered from March to April 2024 in four slaughterhouses in Lake Chad according to the age of the cattle

The distribution of Kouri cows slaughtered in four slaughterhouses in Lake Chad from March to April 2024 according to age and their physiological status is summarized in Table 2. It appears that the ages of the cows slaughtered in the slaughterhouses considered were 3 at 6 years with the greatest proportions (33.3, 29.2 and 28.3%) in animals aged 5, respectively; 6 and 4 years old. However, the pregnant Kouri cows slaughtered were aged 4 to 6 years (2.5, 2.5 and 6.5%, respectively at ages 4, 5 and 6 years). It also appears that 17% of cows slaughtered during the investigation period were pregnant.

Table 3. Weight of some organs of the reproductive system according to the age of the cows.

Organ weight (g)	Ages of cattle (years)				p-value
	3	4	5	6	
Left ovary	4.73±2.36[b]	5.54±1.88[b]	5.78±1.60[b]	7.71±2.68[a]	<0.001
Right ovary	5.23±2.36[b]	6.04±1.88[b]	6.69±2.52[b]	8.23±2.69[a]	<0.001
Non-gravid uterus	554.55±82.02[b]	616.25±115.87[b]	600.00±107.24[b]	740.74±20.126[a]	<0.001

(a, b, c) on the same line, the values assigned the same letter do not differ significantly (p≤ 0.05). All data are expressed as means ± standard deviation.

Table 2. Effect of age at slaughter of pregnant females on their zootechnical characteristics.

Zootechnical characteristics	Age of Kouri cows (years)			P-value
	4	5	6	
Cow weight (kg)	383.33±28.87	392.22±17.16	381.25±27.39	0.72
Body condition score	4.67±0.58	4.22±0.44	4.13±0.83	0.47
weight of right ovaries (g)	6.17±2.46	7.61±4.04	7.34±2.70	0.74
weight of left ovaries (g)	5.67±2.47	7.11±4.04	7.38±2.63	0.65
Age of fetuses (months)	4.67±1.53	5.33±1.58	4.31±2.02	0.50
Fetal weight (kg)	6.00±2.00	15.31±7.44	11.56±8.48	0.57

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Cow weight (kg)	383.33±28.87	392.22±17.16	381.25±27.39	0.72
Body condition score	4.67±0.58	4.22±0.44	4.13±0.83	0.47
weight of right ovaries (g)	6.17±2.46	7.61±4.04	7.34±2.70	0.74
weight of left ovaries (g)	5.67±2.47	7.11±4.04	7.38±2.63	0.65
Age of fetuses (months)	4.67±1.53	5.33±1.58	4.31±2.02	0.50
Fetal weight (kg)	6.00±2.00	15.31±7.44	11.56±8.48	0.57

Weight of some organs of the reproductive system according to the age of Kouri cows slaughtered in four slaughterhouses in Lake Chad

The weights of the organs of the reproductive system (ovaries and uterus) of Kouri cows slaughtered in four slaughterhouses in Lake Chad are presented in Table 3. It follows that the weights of the organs considerably increased with aging. However, this increase was only significant (p≤0.05) at the age of 6 years when compared with the values of these characteristics recorded in animals at younger ages (3-5 years).

Effect of age at slaughter of pregnant cows on their zootechnical characteristics

The effect of age at slaughter of pregnant Kouri cows on their zootechnical characteristics is summarized in Table 4. These results showed that no characteristic considered varied significantly (p≤ 0.05) with the age of the animals. However, the weights of slaughtered cows, age and weight of fetuses increased slightly in cows aged 5 years in reference to the values of these characteristics recorded in animals at ages 4 and 6 years.

Effect of age at slaughter on cow weights and ovarian potential

The effect of age at slaughter on the weight of cows and their ovarian potential is summarized in Table 5. It appears that the weight of cows increased significantly with their progression in age. However, animals with the least heavy significant (p≤ 0.05) were those aged 3 years and the heaviest aged 6 years. Apart from the number of small follicles which increased significantly in cows

Table 4. Effect of age at slaughter time on the weight and ovarian potential of Kouri cows.

Characteristics	Ages of cows (years)				P-value
	3	4	5	6	
Cow weight (kg)	269.09±32.08^{d}	340.29±36.72^{c}	366.50±39.13^{b}	387.14±28.0^{a}	<0.001
Ovarian weight (g)	9.95±4.72	11.59±3.77	15.37±7.88	15.94±5.37	0.19
Number of small follicles	11.55±1.97^{ab}	12.38±1.72^{a}	10.73±2.62^{b}	11.94±2.54^{ab}	0.01
Average follicle count	6.18±2.09	7.15±1.98	6.28±2.55	6.37±2.33	0.36
Number of large follicles	2.09±1.04	2.41±1.34	2.03±1.31	2.17±1.40	0.66
Total number of follicles	19.82±4.68	21.85±4.14	18.98±6.08	20.49±5.83	0.15

(a, b, c) on the same line, the values assigned the same letter do not differ significantly (p≤ 0.05). All data are expressed as means ± standard deviation.

Table 5. Effect of body condition score on ovarian weight and follicle sizes.

Characteristics	Body Condition Score			P-value
	3	4	5	
Ovarian weight (g)	10.82±4.13b	14.23±5.82ab	18.02±7.93a	0.04
Number of small follicles	11.68±1.68	11.64±2.64	11.52±2.174	0.96
Average follicle count	6.38±1.95	6.57±2.53	6.72±2.46	0.84
Number of large follicles	2.16±1.04	2.22±1.39	2.12±1.59	0.94
Total number of follicles counted	20.22±4.10	20.37±5.99	20.28±6.06	0.99

(a, b, c) on the same line, the values assigned the same letter do not differ significantly (p≤ 0.05). All data are expressed as means ± standard deviation.

Table 6. Variation in the number of follicles per size depending on the weight of the cows slaughtered.

Characteristics	Weight range (kg)			P-value
	250-300 (32)	301-356 (32)	357 and more (56)	
Ovarian weight (g)	10.62±3.19b	12.22±4.34ab	16.88±15.31a	0.02
Number of small follicles	11.78±1.79	11.81±1.92	11.43±2.89	0.70
Average follicle count	6.78±2.14	6.53±2.28	6.41±2.49	0.77
Number of large follicles	2.19±1.06	2.34±1.31	2.09±1.48	0.69
Total number of follicles	20.75±4.42	20.63±4.94	19.88±6.26	0.72

(a, b, c) on the same line, the values assigned the same letter do not differ significantly (p≤ 0.05). All data are expressed as means ± standard deviation.

slaughtered at the age of 4 years compared to that recorded in cows aged 5 years at slaughter, all other characteristics relating to the ovary were not influenced significantly (p≤ 0.05) by the age of cows at slaughter.

Effect of body condition score on ovarian weight and follicle sizes

The effect of the body condition score on the weight of the ovary and the sizes of the follicles is summarized in Table 6. It follows that the weight of the ovaries increased with the body condition score of the animals. However, this increase was significant (p≤ 0.05) only in cows with the body condition score 5 at slaughter in comparison to the value recorded in cows at body condition score 3. The number of follicles regardless of the caliber considered was not significantly (p≤0.05) influenced by body condition score.

Variation in the number of follicles per size depending on the weight of the cow at slaughter

Table 7 presents the variation in the weight of the ovary and the number of follicles per size depending on the

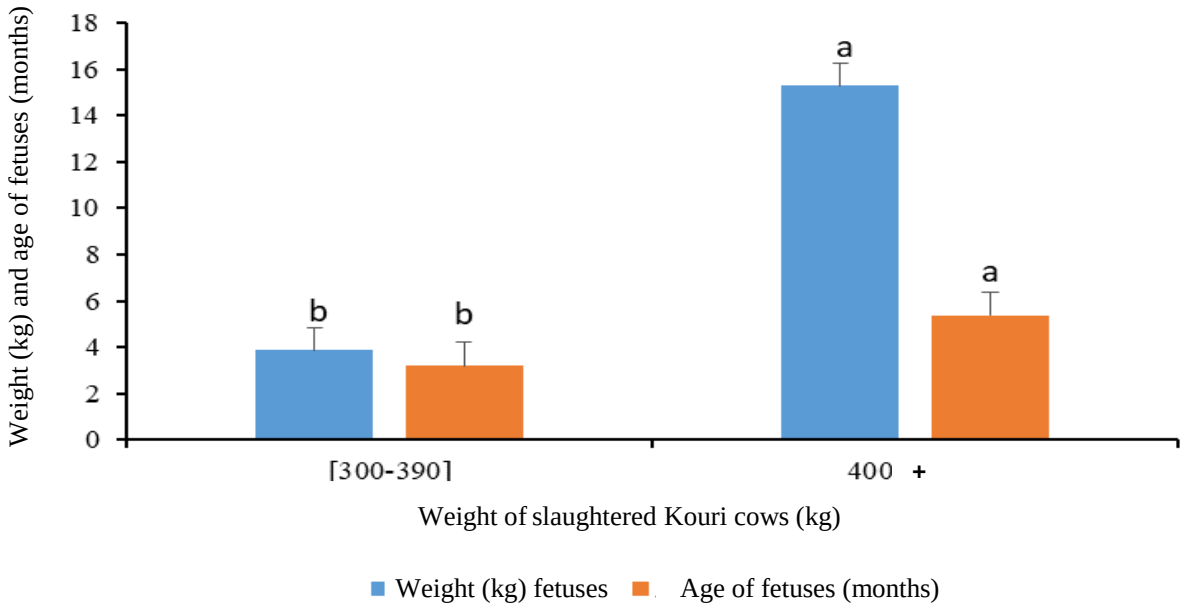

Figure 1. Variation in weight and age of the fetus depending on the weight of the cow at slaughter. a, b: Bars colored the same affected with the same letter do not differ significantly (p≤ 0.05).

weight of the cow at slaughter. It appears that the weight of the ovary increased with the evolution of the weight of the cows but this increase was significant (p≤0.05) only in animals aged 357 kg and over compared to the value recorded in cows weighing less than 300 kg. The number of follicles whatever the caliber considered was not significantly influenced (p≤ 0.05) by the weight of the cows slaughtered.

Variation in weight and age of the fetus depending on the weight of the cow at slaughter

The variations in fetal weight and age according to the cow weight at slaughter are summarized in Figure 1. As a result, fetal weight and age from cows with weights of 400 kg was significantly (p≤ 0.05) higher in reference to the values of these characteristics recorded in cows weighing between 300 and 390 kg at slaughter.

Variation in fetal weight and age depending on the body condition score of slaughtered cows

The variation in the weight and age of the fetus according to the body condition score of the cows slaughtered in the four slaughterhouses of Lake Chad are presented in Figure 2. It appears that the values of the weight and age of the fetuses recorded in cows with body condition scores 4 and 5 were comparable but significantly (p≤ 0.05) higher in reference to the values of these characteristics noted in cows with body condition score 3.

DISCUSSION

In the present study, which aimed to define the ovarian potential of Kouri cows slaughtered in four slaughterhouses in the Lake Chad region, it appears that the average age of Kouri cows slaughtered is 4.81±0.96 years. The age of these animals is in line with the observations of Souleyman (2023) in the same country. Indeed, this author reported that Kouris cows aged 3 to 5 years were mainly those slaughtered during the period from August 2020 to April 2021. These results sufficiently prove that there are no regulations prohibiting the slaughter of young cows in the Lake Chad region. Also, the age of cattle slaughter in this study would be justified by consumer preferences. According to Bastien (2000), the quality of carcasses and meat, especially tenderness, deteriorates with the increase in age of the animals.

The average weight of the Kouri cows slaughtered was 357.17 kg. This weight is significantly higher than the 177 kg reported by Natumanya et al. (2008) in Ankole zebus slaughtered in Cameroon in the Adamaoua region. This average weight noted in the present investigation could be explained by the rainy season in which this work was carried out. The abundance of good quality fodder in the rainy season would have allowed the cows to meet their nutritional needs for good body development (Ngoucheme et al., 2019).

The body condition score is an indicator that makes it possible to indirectly assess the energy status of an animal by evaluating its surface fattening state (Thi et al., 2020). This study found that slaughtered cows had an average body condition score of 3.90. This value is

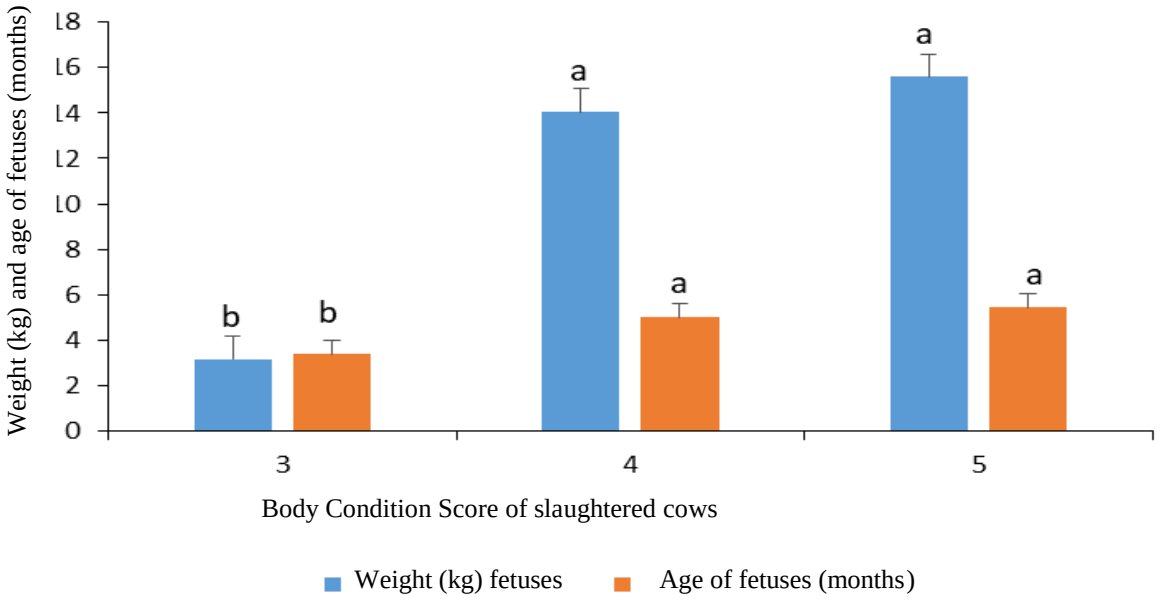

Figure 2. Variation in fetal weight and age depending on the Body Condition Score of slaughtered cows. a, b: Bars colored the same affected with the same letter do not differ significantly (p≤ 0.05)

significantly higher than that mentioned in the work of Fassi et al. (2005) and Azafack et al. (2019), that is, 2.94 and 2.93, respectively in Morocco and Cameroon. This higher value could be explained on one hand by the fact that the animals were selected before entering the slaughterhouse and on the other hand by the fact that the study was carried out at the end of the rainy season, period during when there are plenty of fodders .

The results of the present study show that 17% of slaughter cows were pregnant with 6.7% of cows aged 6 years. This result is close to that of Souleyman (2023) who diagnosed 18.93% of the cows slaughtered in the slaughterhouses of Lake Chad region as pregnant, and Tchoumboué (1984) who observed that 16.61% of the cows slaughtered at the Yaoundé slaughterhouse were pregnant. The slaughter of pregnant cows can be explained by the lack of diagnosis of pregnancy when the animals are introduced to the slaughterhouse. Also, this result could be explained by cow farming dominated by the extensive system in Chad. Indeed, this system does not allow the farmer to know the modalities of reproduction in a herd. Mating occurs naturally and randomly when female animals are on heat.

The weight of the right (8.2 g) and left (7.7 g) ovaries of the 6-year-old cows were significantly ($p < 0.05$) higher when compared with the values of these same characteristics recorded in the 3-year-old animals which had the weight of the right ovaries (5.2 g) and left (4.5 g). This result showed higher weight of ovaries than that of Azafack et al (2019) on the average weight of the ovaries (3.78 g) following the progression in age for the goulali red and white Foulani breeds in Cameroon. This increase in ovarian weight in cows aged 6 years would be the result of the weight of these animals which was already high.

The number of small follicles was significantly higher in cows slaughtered at 4 years of age compared to the value obtained in cows aged 5 years. This result is comparable to that of Santos et al. (2013) in Angola. This result is justified by the entry into puberty of Kouri cows between 3.5 and 4 years old. Indeed, at this age cows are still at the start of their reproductive career with a large stock of follicles likely to be used for the benefit of reproduction.

The weight and age of the fetuses at slaughter period were significantly higher in the heaviest cows (400 kg and more) compared to the values of these characteristics noted in cows weighing between 300 and 390 kg. This result could be explained by the large size of the higher cows which disrupts the assessment of the physiological state of the animals. The results of the present study are in agreement with those of Souleyman (2023) who reported that large-format heavy cows are those slaughtered with the heaviest and oldest fetuses.

Conclusion

At the end of this study based on the characterization of slaughtered female Kouri cattle and the ovarian potential in the four slaughterhouses of the Lake Chad region, it appears that age influences cow weights and body condition score. The weights of the right and left ovaries of 6-year-old cows were significantly higher when

compared with the values of these characteristics recorded in 3-year-old animals. The number of small follicles was significantly higher when the cow enters reproduction from 3 and a half years and the oocyte reserve is almost complete. In the next investigations, we wish to initiate a quick and easy pregnancy diagnostic test in slaughterhouses to avoid the slaughter of pregnant females.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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