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Morphobiometric Characteristics of Pregnant Goats, Placentomes, and Products of Conception: Case Study of Selected Slaughter Facilities in Lubumbashi City

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Abstract

Background: In ruminants, the assessment of fetal development and maternal Body Condition Score (BCS) is essential for optimizing zootechnical and reproductive performance. In the Democratic Republic of the Congo, caprine production relies heavily on extensive farming systems. This study aimed to evaluate the impact of placentome morphobiometric characteristics, maternal profiles, and environmental factors on fetal growth and weight in local pregnant goats in Lubumbashi. **Methods:** A descriptive cross-sectional study was conducted from October 1, 2023, to October 31, 2025, across various slaughter facilities in Lubumbashi (Kamalondo, Kampemba, and Lubumbashi municipalities). A total of 271 pregnant goats and their uterine contents were analyzed. Maternal anthropometric data (age/dentition, body length, body weight, BCS, slaughter season) and fetal variables (weight, length, sex, pregnancy type and stage, placentome morphology) were recorded and processed using SPSS v26 software. **Results:** The majority of slaughtered goats were adults (28.4%) with 4 adult permanent incisors [4DA], small-framed (66.1%), with an average body length of 71 ± 10.2 cm and normal BCS (79.0%, mean 2.7 ± 0.5). Slaughter of pregnant goats predominated during the rainy season (72.3%). Advanced fetal

stage (95.6%) and the third trimester of gestation (42.1%) predominated. Twin pregnancies were the most frequent (57.9%). Regarding placental morphology, the mixed shape was overwhelmingly dominant (78.2%), followed by flat (13.7%) and concave (4.8%) shapes. **Conclusion:** This study shows that in the local goat of Lubumbashi, fetal growth and weight depend mainly on gestational stage, type of gestation, maternal BCS, and placentome morphology, with the concave shape being the most favorable. The high rate of slaughter of pregnant goats, especially in the third trimester, represents a major loss for herd productivity and calls for better slaughterhouse control and protection of pregnant females.

Subject Areas

Global Health

Keywords

Local Goat, Placentome, Fetal Growth, Fetal Weight, Morphobiometrics, Gestation, Lubumbashi (DRC)

1. Introduction

Gestation in ruminants involves several critical physiological stages, including implantation, placentation, as well as placental and fetal growth. The initial event of gestation is the implantation process, corresponding to the attachment of the embryo to the maternal endometrium [1].

Body Condition Score (BCS) reflects an animal's organic reserves, specifically the amount of lipid (fat) and protein (muscle) reserves available for maintenance, reproduction, and production. Evaluating body condition represents a valuable tool for livestock producers, enabling them to optimize meat and milk yield, nutritional management, reproductive efficiency, and overall animal welfare [2]. In goats, BCS is evaluated on a scale from 1.0 to 5.0, in increments of 0.5 [2].

Birth weight is a vital growth trait in caprines and ovines, carrying substantial productive and economic significance for efficient meat production. Birth size in these species reflects the prenatal growth and development process, which is dictated by genetics alongside diverse environmental factors. Knowledge of the determinants of birth weight is of interest not only to breeders but also to farmers, as this parameter strongly influences weaning weight in kids and lambs and, consequently, total herd meat production [3].

2. Materials and Methods

2.1. Study Design

A descriptive cross-sectional study was conducted to evaluate the morphobiometric characteristics of placentomes in pregnant goats slaughtered across selected slaughter facilities in Lubumbashi city, as well as their morphometric fea-

tures and those of embryos and fetuses, from October 1, 2023, to October 31, 2025.

2.2. Study Framework & Location

The study took place in Lubumbashi, Democratic Republic of the Congo, across 11 slaughter facilities located in the municipalities of Lubumbashi, Kamalondo, and Kampemba.

Lubumbashi experiences a humid tropical climate classified as Cw according to Köppen, featuring three distinct seasons: Rainy season (November to March), Dry season (May to September), and Transition seasons (April and October). The mean annual temperature is 22.4˚C, with October being the warmest month (25.5˚C) and July the coolest (18.5˚C). Mean annual rainfall is 1098 mm, peaking in January and reaching a minimum in June. Relative humidity ranges from 50% in the dry season to 84% in the rainy season. This climatic contrast is a determining factor for forage availability and justifies our seasonal comparison (See **Figure 1**).

The city's hydrographic network belongs to the Lualaba sub-basin of the Congo River basin, dominated by the Kafubu River. Soils are predominantly ferrallitic, sandy-clay, and silty-clay, characterized by low organic matter content, elevated heavy metal content (copper, cobalt) due to mining pollution, and low phosphorus availability [4]. The natural vegetation belongs to the Miombo woodland type (Brachystegia and Julbernardia), which faces strong anthropogenic pressure [5].

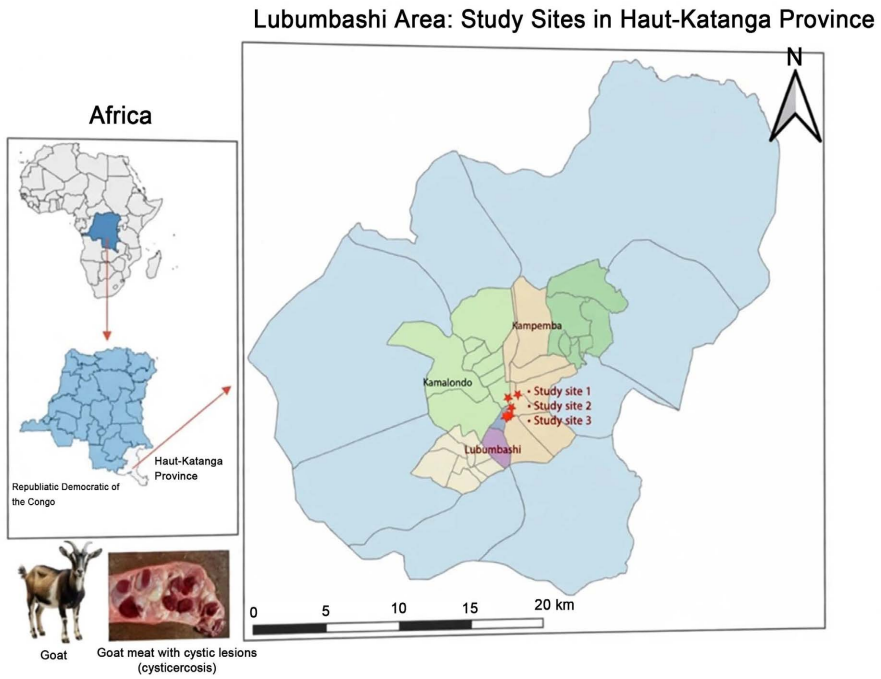


Figure 1. Location of sampled slaughter facilities across Kamalondo, Kampemba, and Lubumbashi municipalities. Note: Study Framework: Lubumbashi Municipalities (Kamalondo, Kampemba, Lubumbashi); 11 Sampling Slaughter Facilities; N = 71 Pregnant Goats.

As the second-largest city in the DRC, Lubumbashi has an estimated population of 2.5 million in 2024. Goat farming is essentially small-holder and informal, characterized by small herd sizes (3 - 12 local goats per household), free-roaming grazing, and an absence of veterinary care or dietary supplementation [6] [7].

2.3. Study Population & Sampling

The study population comprised pregnant female goats and their uterine contents (embryos or fetuses) slaughtered in Lubumbashi slaughterhouses during the investigation period. Two-stage sampling was employed: cluster sampling for selecting slaughter sites (clusters) and non-probability snowball sampling for selecting animals. "Eleven (11) slaughter facilities were selected for sampling, and our sample size consisted of 271 pregnant goats." "The slaughterhouses in Lubumbashi are well known. We selected the three municipalities as clusters, and within each cluster, we chose one site. Each site allowed us to access another site."

2.4. Variables & Data Collection

Maternal variables included age (incisor dentition), body length, live weight, Body Condition Score (BCS), season, gestational stage, evolutionary stage, pregnancy type, placentome morphology, and fetus count per uterine horn. Fetal variables included fetal weight, sex, and crown-rump length. Data were encoded in Microsoft Excel and analyzed using SPSS Version 26.

3. Results

A total of 271 pregnant goats were sampled and analyzed across the target slaughterhouses (See Tables 1-6 and Figure 2).

Table 1. Distribution of slaughtered goats according to age (incisor dentition).

Dentition Class (Age)	Frequency (n)	Percentage (%)
0DA (Milk teeth)	62	22.9
2DA (2 permanent incisors)	42	15.5
4DA (4 permanent incisors)	77	28.4
6DA (6 permanent incisors)	44	16.2
8DA (Full mouth)	46	17.0
Total	271	100.0

Table 2. Distribution of goats according to body length.

Body Length (cm)	Frequency (n)	Percentage (%)	Mean ± SD	Min - Max
<55 cm	20	7.4	71.0 ± 10.2	34 - 103
55 - 65 cm	46	17.0	-	-
>65 cm	205	75.6	-	-
Total	271	100.0	71.0 ± 10.2	34 - 103

Table 3. Distribution of goats according to frame size and live body weight.

Size/Weight Category	Frequency (n)	Percentage (%)	Mean Weight ± SD (kg)	Min - Max
Small frame	179	66.1	56.2 ± 6.1	36 - 89
Medium frame	91	33.6	-	-
Large frame	1	0.4	-	-
Total	271	100.0	56.2 ± 6.1	36 - 89

Table 4. Distribution of goats according to Body Condition Score (BCS).

Body Condition Score (BCS)	Frequency (n)	Percentage (%)	Mean BCS ± SD	Min - Max
Lean/Thin (BCS < 2.5)	31	11.4	2.7 ± 0.5	2.0 - 4.0
Normal (BCS 2.5 - 3.5)	214	79.0	-	-
Fat (BCS > 3.5)	26	9.6	-	-
Total	271	100.0	2.7 ± 0.5	2.0 - 4.0

Table 5. Distribution of slaughtered goats by season, gestational stage, evolutionary stage, and pregnancy type.

Season/Gestational Parameter	Frequency (n)	Percentage (%)
Dry Season	75	27.7
Rainy Season	196	72.3
Gestation Stage: 1st Trimester	65	24.0
Gestation Stage: 2nd Trimester	92	33.9
Gestation Stage: 3rd Trimester	114	42.1
Evolutionary Stage: Embryonic	12	4.4
Evolutionary Stage: Fetal	259	95.6
Pregnancy Type: Single	114	42.1
Pregnancy Type: Twin	157	57.9

Table 6. Distribution of goats according to placentome morphological shape.

Placentome Shape	Frequency (n)	Percentage (%)
Mixed shape	212	78.2
Flat shape	37	13.7
Concave shape	13	4.8
Convex shape	6	2.2
Round shape	3	1.1
Total	271	100.0

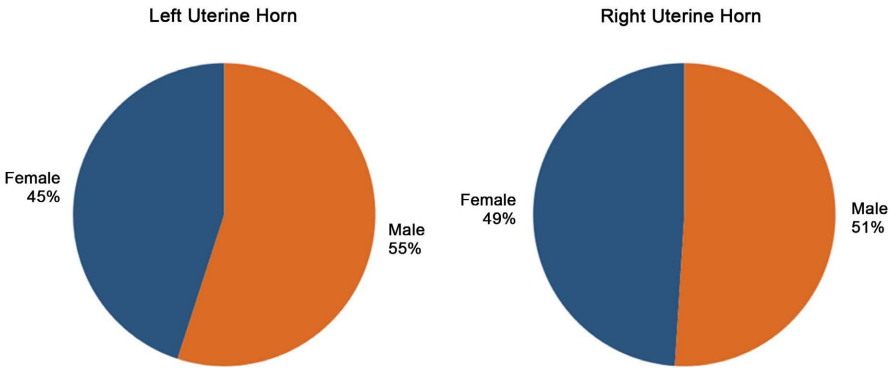


Figure 2. Distribution of fetuses by sex across left and right uterine horns.

4. Discussion

4.1. Demographic & Morphological Profile of Slaughtered Goats

In our series, pregnant goats had a mean body length of 71 ± 10.2 cm, with 66.1% displaying a small frame size (**Table 2**). These results exceed values reported in Lubumbashi by Idi Ngona *et al.* [8] (mean length 53 ± 4.1 cm). Dentition analysis revealed a high proportion of adult females (4DA: 28.4%, 8DA: 17.0%) (**Table 1**). Mean live weight (56.2 ± 6.1 kg) was higher than values reported in Lomami Province (41.5 ± 4.8 kg) and earlier local estimates [8].

The majority of animals (79.0%) possessed a normal Body Condition Score (mean 2.7 ± 0.5) (**Table 4**). The high proportion of pregnant adult females sent to slaughter highlights a critical zootechnical management issue and unregulated slaughter of reproductive stock in tropical abattoirs, echoing findings in Uganda [9] and Switzerland [10]. The dominance of small frame size (**Table 3**) is characteristic of the Copperbelt local goat, belonging to the Small East African type [11] [12].

4.2. Seasonality & Gestational Dynamics

Slaughter of pregnant goats was significantly higher during the rainy season (72.3% vs. 27.7% in dry season) (**Table 5**). Advanced gestations predominated (3rd trimester: 42.1%, 2nd trimester: 33.9%, 1st trimester: 24.0%), with fetal stage accounting for 95.6% of cases. The seasonal slaughter peak coincides with local festive periods (Christmas/New Year) and agricultural cash flow demands [13].

4.3. Pregnancy Type & Placentome Morphobiometrics

Twin gestations were predominant (57.9%) (**Table 5**), contrasting with findings in Nigeria where singletons predominated [14]. Placentome shape was dominated by the mixed morphology (78.2%), followed by flat (13.7%) and concave (4.8%) forms (**Table 6**).

5. Conclusion

The elevated proportion of adult pregnant goats slaughtered at advanced gesta-

tional stages highlights a major zootechnical challenge and economic loss in the region. Enhanced farmer awareness and systematic pregnancy screening at slaughter facilities are strongly recommended to safeguard reproductive caprine stock.

Author Contributions

Conceptualisation and methodology: Emilie Bisibo Sikabwe**,** Simon Ilunga Kandolo and Abdallah Ngona Idi; **Software**: Simon Ilunga Kandolo and Emilie Bisibo Sikabwe; **Validation**: Emilie Bisibo Sikabwe, Simon Ilunga Kandolo, Louis Bitwange Kifuvyo, Didier Tshikung Kambol, Pieter Cornillie and Abdallah Ngona Idi; **Formal analysis**: Simon Ilunga Kandolo; **Investigation**: Emilie Bisibo Sikabwe; **Resources**: Emilie Bisibo Sikabwe; **Data curation**: Emilie Bisibo Sikabwe and Simon Ilunga Kandolo; **Writing review and editing**: Emilie Bisibo Sikabwe, Pieter Cornillie, Abdallah Ngona Idi and Didier Tshikung Kambol; **Visualisation**: Emilie Bisibo Sikabwe, Simon Ilunga Kandolo, Louis Bitwange Kifuvyo, Didier Tshikung Kambol, Pieter Cornillie and Abdallah Ngona Idi; **Project administration**: Emilie Bisibo Sikabwe; **Funding acquisition**: Emilie Bisibo Sikabwe. All authors read and agreed to the published manuscript.

Ethical and Conflict of Interest Declaration

This study was conducted in accordance with animal ethics guidelines and approved by the Medical Ethics Committee of the University of Lubumbashi.

Conflicts of Interest

The authors declare no conflicts of interest.

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