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# Morphological characteristics and qualities of sheep carcasses admitted to the slaughterhouse in the Poro region

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**ABSTRACT:** The present study was carried out at the slaughterhouse in the town of Korhogo to assess the morphological characteristics and quality of sheep carcasses. For this purpose, all sheep admitted to the slaughterhouse were considered. On these animals, different parameters such as determination of age, sex, live weight and body condition score were evaluated before slaughter. The criteria for assessing the quality of the carcasses (state of fattening, conformation and coloring, carcass weight and yield), carried out according to evaluation grids after slaughter. The results showed that Djallonke sheep were the most slaughtered in this slaughterhouse (91.3% of total numbers), including females over 4 years old (37.1%). However, Sahelian breed sheep had a higher carcass yield (47.93%) ($P \leq 0.05$) than that of the Djallonkes (46.16%). The carcasses were mainly category D (83.77%) and conformation E (41.15%). However, the proportion of red coloring carcasses was highest in the Djallonké breed (64.97%) than in the Sahelian breed (5.92%). From the analysis of these results, it appears that most sheep admitted to the Korhogo slaughterhouse are females who have not finished their career in extensive breeding. Which could be detrimental to the sustainability of farms.

**KEYWORDS:** sheep, morphological characteristics, carcasses qualities, slaughterhouse, Korhogo.

## 1 INTRODUCTION

In Africa, livestock farming is of great importance in agricultural production systems. Millions of people earn their income from livestock farming [1]. The contribution of livestock farming to Côte d'Ivoire's GDP (less than 5%) is low compared to the sub-regional average, yet the country has significant consumption needs for animal food products [2]. Despite this low contribution, ruminant farming plays an important role in maintaining food security, reducing poverty and driving economic growth. Among ruminants, small ruminant farming, particularly sheep, are the most raised animal species in tropical and Sahelian zones [3].

In Côte d'Ivoire, sheep farming is mainly practiced by rural populations who own more than 40% of the national livestock. The northern and central areas of the country constitute the main sheep farming areas. Unfortunately, these have been severely affected by a decade of military-political crisis [4] which has negatively impacted livestock production. Since the bulk of national sheep production is meat, an assessment of its quality would allow the various stakeholders to make decisions. According to Dognon et al. [5], meat quality has nowadays become a real challenge for producers and processors who must meet local and international requirements. Unfortunately, the notion of quality is less perceived in the small ruminant sector. In slaughterhouses, only health inspections are carried out diligently. After inspection, all edible carcasses are treated the same despite their condition and origin [6]. However, considering the characteristics of sheep admitted to the slaughterhouse would make it possible to categorize carcasses and improve the quality and, by extension, the level of production in farms. The

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objective of this study is not only to help improve the quality of meat made available to the population but also to encourage stakeholders to put certain concepts into practice to optimize production.

## 2 MATERIAL AND METHODS

### 2.1 MATERIAL

In this study, the biological material consisted of all the sheep brought to the slaughterhouse. However, only live animals bleed on site were considered. As for the technical material, it consisted of sheets bearing the scoring criteria for recording the various parameters of the animals, a Generic brand scale with a capacity of 150 kg with an accuracy of 0.01 kg for weighing the animals and carcasses, two ropes for restraining the animal for bleeding and weighing.

### 2.2 METHODS

#### COLLECTION OF DATA ON MORPHOLOGICAL CHARACTERISTICS

The evaluation of morphological characteristics and carcass quality was carried out on all sheep admitted to the slaughterhouse at the start of the rainy season. On these sheep, the age, sex, and body condition score were determined before bleeding. Thus, upon arrival of the animals, the sex and breed were determined considering the size (at the withers, ears, tail, etc.). However, two breeds (Djallonké and the Sahelian breed) were considered, due to the difficulty of determining them due to the anarchic matings carried out. The age was determined through the incisors according to the method of Salami [7]. Regarding live weight, each animal was restrained with ropes and weighed using a scale. As for the body condition score, it was determined according to the method described by Vall [8].

#### COLLECTION OF DATA ON THE CONDITION OF THE CARCASSES

Before slaughter, the ante-mortem inspection was carried out and the animals intended for slaughter were placed in the waiting pen. The animals were sent individually to the bleeding site and restrained using ropes. The animal, thus immobilized on the ground, the throat was cut using a sharp-tipped knife. Dressing was carried out just after bleeding. The slaughtering began early in the morning at 7 am and ended at 3 pm. The hot carcasses were weighed just after evisceration and post-mortem inspection and the carcass yield was calculated. The category, conformation and fattening status of the carcass were made according to the regulation of European Community [9]. As for the carcass coloring, it was determined according to the Moëvi abacus [10].

#### STATISTICAL ANALYSE

Data collection was entered using Microsoft Excel 2016 software. The same software was used for plotting histograms. Weight and body condition data were analyzed using Statistica 7.1 software and Student's t-test was used to compare means at the 0.05 threshold.

## 3 RESULTS

### 3.1 CHARACTERISTICS OF SHEEP

#### DISTRIBUTION OF SHEEP ACCORDING TO BREED AND SEX

Fig. 1 shows the breeds and sex of the sheep slaughtered at the slaughterhouse in the Poro region. Two breeds were recorded, namely the Djallonké breed and the Sahelian breed. Among all the three hundred and forty-five sheep slaughtered, the Djallonke breed sheep had a higher percentage (91.3%) than those of the Sahelian breed (8.7%). Within the Djallonké breed, there were more females (83.76%) than males (7.54%). In the Sahelian breed, the same observation was made with 5.8% females and 2.9% males.

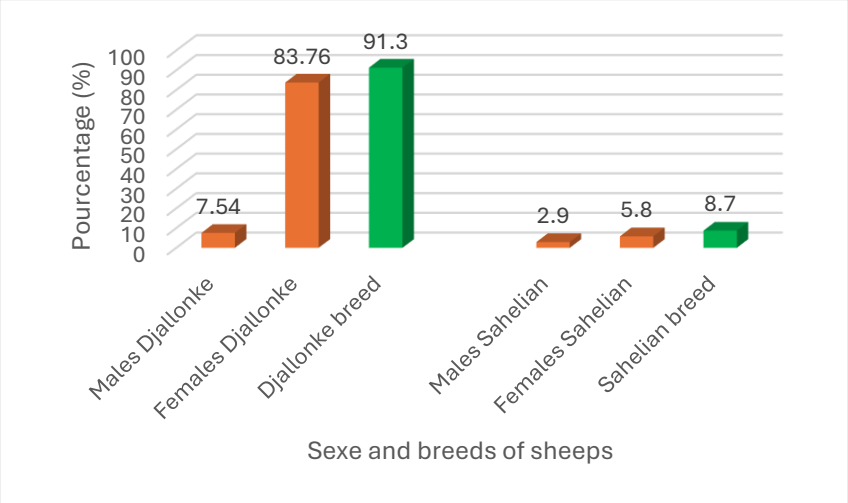


***Fig. 1. Distribution by race and sex***

**DISTRIBUTION OF SHEEP ACCORDING TO AGE OF SHEEP**

Table 1 shows the different age classes of sheep slaughtered according to breed. The most slaughtered age class of sheep (40%) was that of 4 years and over. This age class consisted only of females. On the other hand, the age class of 0 to 1 year was the least slaughtered (26.96%). Females made up most of the population with 18.84% at the level of the age class of 0 to 1 year; 30.72% at the level of the age class of 2 to 3 years and 40% at the level of the age class 4 years and over against respectively 8.1%; 2.32% and 0% for males.

Indeed, in the Djallonké breed, sheep whose age was between 4 years and over were the most numerous (37.1%). On the other hand, at the Sahelian breed level, it was sheep in the age group between 2 and 3 years that were slaughtered the most (3.77%).

***Table 1. Distribution by age***

| AGE CLASS | Sexes | Djallonke breed | | | | Sahelian breeed | | | | The two breeds | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Wf. | P (%) | T Wf. | TP (%) | Wf. | P (%) | T Wf. | TP (%) | Wf. | P (%) | T Wf. | TP (%) |
| [0;1] | M | 22 | 6,36 | 86 | 24,93 | 6 | 1,74 | 7 | 2,03 | 28 | 8,1 | 93 | 26,96 |
| | F | 64 | 18,55 | | | 1 | 0,29 | | | 65 | 18,84 | | |
| [2;3] | M | 4 | 1,16 | 101 | 29,27 | 4 | 1,16 | 13 | 3,77 | 8 | 2,32 | 114 | 33,04 |
| | F | 97 | 28,11 | | | 9 | 2,61 | | | 106 | 30,72 | | |
| [4 et plus] | M | 0 | 0 | 128 | 37,1 | 0 | 0 | 10 | 2,9 | 0 | 0 | 138 | 40 |
| | F | 128 | 37,1 | | | 10 | 2,9 | | | 138 | 40 | | |

***M:** Male, **F:** Female; **Wf:** Workforce; **P:** Pourcentage; **T Wf.:** Total Workforce; **TP**: Total Pourcentage*

**AVERAGE LIVE WEIGHT AND BODY CONDITION SCORE OF SHEEP**

Table 2 presents the different average live weights and body condition scores of sheep slaughtered at the Korhogo slaughterhouse. Overall, Sahelian breed sheep had an average live weight (36.40 ± 14.82 kg) significantly higher ($P < 0.05$) than that of Djallonke (21.78 ± 4.62 kg). In Djallonke breed sheep, females had an average live weight of 22.29 ± 4.18 kg significantly higher ($P < 0.05$) than that of males (16.09 ± 5.54 kg). However, in Sahelian sheep, the average live weight of females (36.67 ± 14.11 kg) was significantly identical ($P > 0.88$) to that of males (35.85 ± 16.95 kg).

Djallonke breed sheep had a mean body condition score (3.90 ± 0.73) that was significantly identical ($P > 0.05$) to that of Sahelian breed sheep (4.15 ± 0.72). Djallonke males had a mean body condition score (3.78 ± 0.83) lower than that of Djallonke females (3.91 ± 0.72), without being significantly different ($P > 0.05$). However, within the Sahelian breed, males had a significantly higher ($P \leq 0.05$) mean body condition score (4.55 ± 0.49) than Sahelian females (3.95 ± 0.74).

*Table 2. Average live weight and body condition score for sheep*

| Breeds | Sexes | Average live weight (kg) | | Body condition score | |
|---|---|---|---|---|---|
| Djallonke | Males | 16,09±5,54 **a** | 21,78±4,62 **b** | 3,78±0,83 | 3,9±0,73 |
| | Females | 22,29±4,18 **a** | | 3,91±0,72 | |
| Sahelian | Males | 35,85±16,95 | 36,40±14,82 **b** | 4,55±0,49**a** | 4,15±0,72 |
| | Females | 36,67±14,1 | | 3,95±0,74**a** | |

*Values with the same letters in the same column are significantly different (P≤0.05)*

### 3.2 CHARACTERISTICS OF SHEEP CARCASSES

#### AVERAGE CARCASS WEIGHT AND CARCASS YIELD OF SHEEP

Table 3 shows the average carcass weights and carcass yield of sheep slaughtered at the Korhogo slaughterhouse. For all the sheep slaughtered, the average weight of the carcasses of female sheep (10.88 ± 2.20 kg) was significantly higher (P < 0.05) than that of male sheep (10.37 ± 4.84 kg). In the Djallonke breed, females (10.31 ± 2.29 kg) had a significantly higher average carcass weight than that of Djallonke males (7.48 ± 2.46 kg), unlike the Sahelians where females (17.55 ± 7.33 kg) had a mean carcass weight significantly closer to that of Sahelian males (17.85 ± 9.33 kg).

In Djallonke, males had a higher carcass yield (46.95%) than females (46.09%). The same was true for Shaelian breed sheep, with 48.62% for males and 47.58% for females respectively. However, Sahelian breed sheep had a higher carcass yield (47.93%) (P ≤ 0.05) than that of Djallonkes (46.16%).

*Table 3. Average carcass weights*

| Breeds | Sexes | Average carcass weights (kg) | | Carcass yield (%) | |
|---|---|---|---|---|---|
| Djallonke | Males | 7,48±2,46 | 10,07±2,43 | 46,95 | 46,16 |
| | Females | 10,31±2,29 | | 46,09 | |
| Sahelian | Males | 17,85±9,33 | 17,65±7,89 | 48,62 | 47,42 |
| | Females | 17,55±7,33 | | 47,58 | |

#### CATEGORIES OF CARCASSES

Table 4 shows the distribution of carcass categories of slaughtered sheep. First, the carcasses of slaughtered sheep were mainly category D (sheep that had already given birth) with a proportion of 78.55% for Djallonke sheep and 5.22% for Sahelian sheep. Then come the carcasses of categories A (Carcasses of young uncastrated sheep under 2 years old) and E (Carcasses of other female animals) in Djallonke sheep which are respectively 6.09% and 5.51%. In Sahelian sheep, it is category B (Carcasses of other uncastrated animals) and carcasses of category C (carcasses of castrated sheep) with a proportion of 1.16%.

*Table 4. Carcass categories*

| Categories | Sexe | Djallonke breed | | Sahelian breeed | |
|---|---|---|---|---|---|
| **A** | Males | 5,8% | 6,09% | 0,87% | 0,87% |
| | Females | 0,29% | | 0 | |
| **B** | Males | 1,16% | 1,16% | 1,16% | 1,16% |
| | Females | 0% | | 0% | |
| **C** | Males | 0 | 0 | 0,29% | 0,29% |
| | Males | 0 | | 0 | |
| **D** | Females | 0,58% | 78,55% | 0 | 5,22 |
| | Males | 77,97% | | 5,22% | |
| **E** | Females | 0 | 5,51% | 0,58% | 1,16% |
| | Males | 5,51% | | 0,58% | |

### CARCASS CONFORMATION

Table 5 shows the distribution of carcass conformations of sheep slaughtered at. Carcasses of excellent conformation (E) were the most represented with a proportion of 41.15% for Djallonke sheep and 3.48% for Sahelian sheep. Among these 41.15%, the carcasses of male Djallonké represented 2.32% and those of females were 38.83%. In Sahelian sheep, carcasses of S and E conformation were the most represented (3.48%). After the carcasses with excellent conformation (E), comes that of Very good conformation (U) with a significant proportion which is 24.64% within the carcasses of Djallonke sheep and 1.45% within the Sahelian breed.

***Table 5. Conformation of the carcasses***

| Conformation | Sexe | Djallonke breed | | Sahelian breeed | |
|---|---|---|---|---|---|
| **S** | Males | 1,45% | 16,81% | 1,74% | 3,48% |
| | Females | 15,36% | | 1,74% | |
| **E** | Males | 2,32% | 41,15% | 0,87% | 3,48% |
| | Females | 38,83% | | 2,61% | |
| **U** | Males | 2,32% | 24,64% | 0,29% | 1,45% |
| | Males | 22,32% | | 1,16% | |
| **R** | Females | 0,58% | 4,35% | 0 | 0 |
| | Males | 3,77% | | 0 | |
| **O** | Females | 0,85% | 4,24% | 0 | 0,28% |
| | Males | 3,39% | | 0,28% | |
| **P** | Males | 0 | 0 | 0 | 0 |
| | Females | 0 | | 0 | |

***S:** Superior; **E:** Excellent; **U:** Very good; **R:** Good; **O:** Fairly good; **M:** Male and **F:** Female*

### FATTENING STATUS OF THE CARCASS

Most carcasses of Djallonké sheep slaughtered at the Korhogo slaughterhouse had a lean fattening state (62.9% for the Djallonke breed). In this breed, female carcasses had a high proportion (55.94%) of lean fattening state while the proportion of male carcasses of this state was 6.96%. In Sahelian sheep, most carcasses had a low fatness with a proportion of 4.35% (i.e. 2.9% for females and 1.45% for males). No carcass had a fatty or very fatty fatness (Fig. 2).

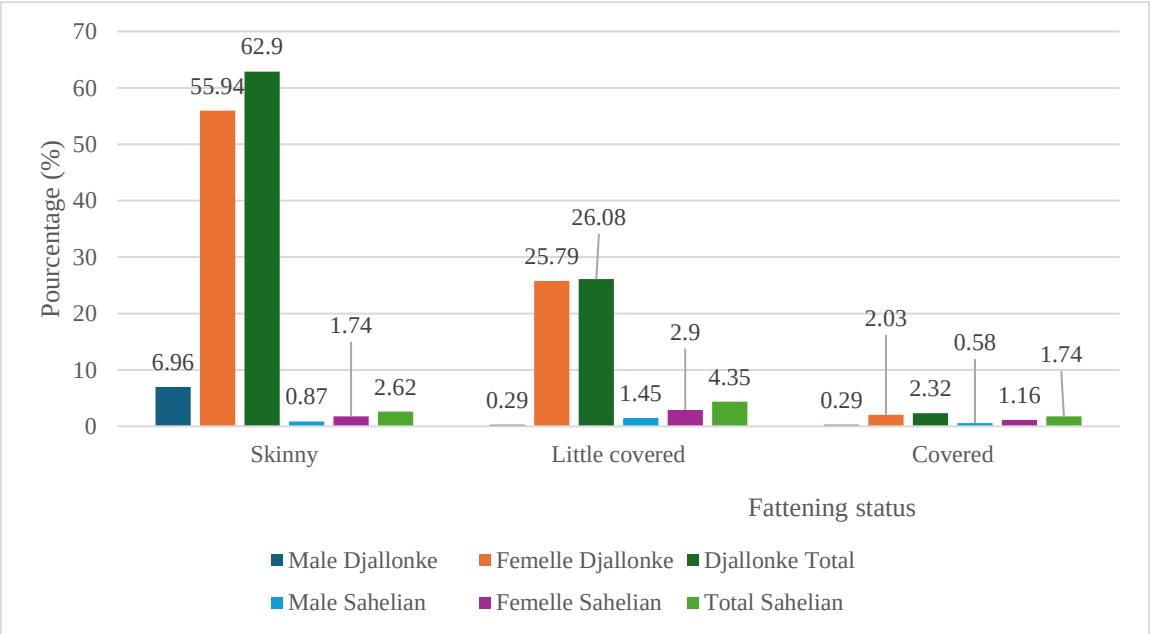


***Fig. 2. Fattening status of carcasses***

**CARCASS COLORING**

Fig. 3 shows the different colorations of sheep carcasses at the Korhogo slaughterhouse. However, the proportion of red coloration of the carcasses was the highest (64.97% for Djallonke sheep carcasses and 5.92% for Sahelian sheep carcasses). In Djallonke sheep, red-colored male carcasses represented 1.69% while those of females represented only 63.28%. In Sahelian sheep, female carcasses had a proportion of 3.95% compared to 1.97% for males. In this breed, no light pink and white carcasses were observed.

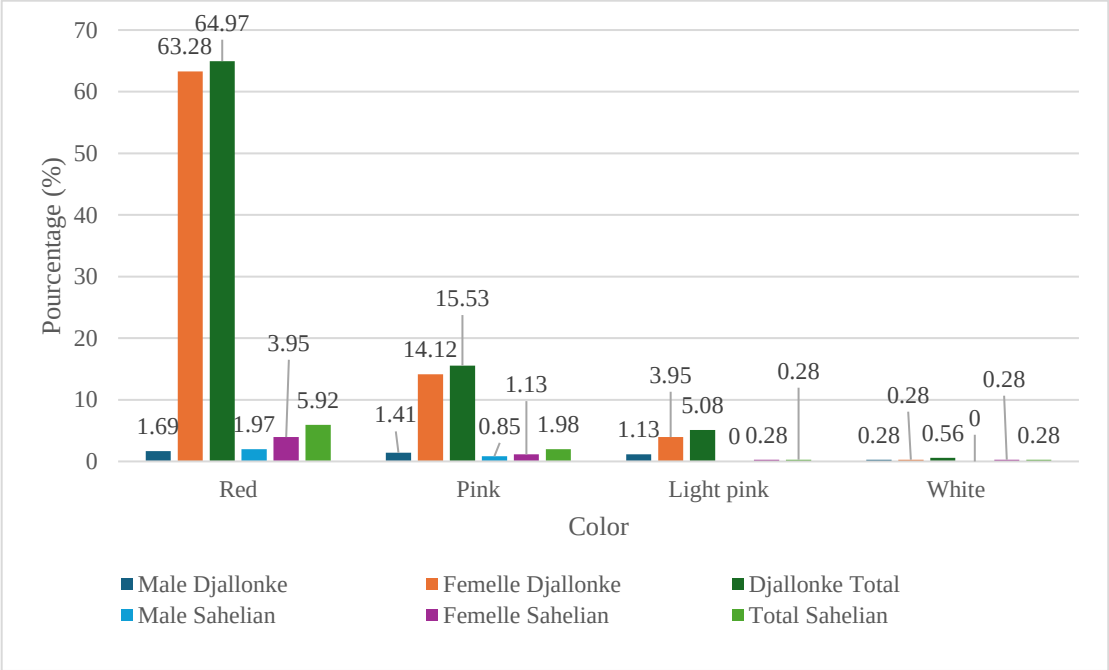


***Fig. 3. Carcass coloring***

## 4 DISCUSSION

This study conducted at the slaughterhouse in the city of Korhogo showed that Djallonke sheep were the most slaughtered breed (91.3%) than Sahelian sheep (8.7%). These results are contrary to those of Youan et al. [11] who reported during their study that Sahelian sheep were the most slaughtered (67.5%) at the Port-Bouët slaughterhouse. This could be explained by the fact that northern breeders prefer the Djallonke breed thanks to their adaptation to climatic conditions and their resistance to diseases encountered in this area. Also, the Port-Bouët slaughterhouse is generally supplied with livestock by the sub-region, most of whose sheep are Sahelian breeds. Their low proportion at the Korhogo slaughterhouse could also be explained by the high price of their purchase on the market. The most slaughtered sheep were those aged between 4 years and over. However, most of these slaughtered animals were females (37.1%). This is explained by the fact that rams are mostly reserved for the Tabaski festival. Thus, to ensure a supply of sheep meat, breeders sell older females. A study conducted by Bamba et al. [4] in three regions of the country (Touba, Bouake and Korhogo) showed that the herds were mainly made up of females of breeding age (67.09% females. According to these authors, maintaining a high number of females in the herds was fueled by the breeders' concern to conserve breeding females in order to ensure continued reproducibility of the herd. Youan et al. [11] found that the sheep most slaughtered were mainly those aged 3 years or older. For them, the slaughter in large numbers of sheep aged 3 years or older would be justified by their low productivity within the herds. The Sahelian breed of sheep had an average live weight (36.40 ± 14.82 kg) significantly higher ($P < 0.05$) than that of the Djallonke (21.78 ± 4.62 kg). This could be explained by the genetic difference between the two breeds. Within the Djallonké breed, females had a significantly higher weight (22.29 ± 4.18 kg) than males (16.09 ± 5.54 kg). This difference could be linked to the age of the sheep. Indeed, most of the slaughtered sheep were females aged 4 years and over compared to 6.36% of males who were less than one year old. Djenontin et al. [12] found a live weight at slaughter of 43.94 kg in Sahelian sheep compared to 23.43 kg in Djallonke in Benin. For him, considering sex, the ewes were the oldest and heaviest at slaughter compared to the Antenais. Regarding the average carcass weights, the Djallonke females (10.31± 2.29 kg) had a significantly higher average weight ($p < 0.01$) than that of the males (7.48 ± 2.46 kg). Our results are in agreement with those of Mopate et al. [13], where the carcass weight of ewes (17.8

± 6.3kg) was higher than that of rams (13.2 ± 5.3kg). This could be explained by the fact that rams are very often slaughtered at a young age than ewes. Their use for the Tabaski festival and baptisms among Muslims was recurrent.

The carcass yield of male sheep was higher than that of females. The same observation was made within the Djallonke breed, with 46.95% for males and 46.09% for females. For the Sahelian breed, the results of 48.62% for males and 47.58% for females were obtained. It should be noted that males had a higher carcass yield than females. These results are consistent with those of Mopaté et al. [13] who obtained 55.5% for males and 53.7% for females. For these authors, it is preferable to slaughter males for their better carcass yield compared to females. Moreover, the slaughter of pregnant females is likely to lead to reproductive losses (females and young). These losses are often neglected or ignored even though they are significant. However, they can have a negative impact on the renewal of sheep and negatively affect the sustainable meat production of small ruminants in the long term. Moreover, Nana et al. [14] specify that if pregnant females are spared from slaughter, the number of small ruminants could increase. The carcasses of slaughtered sheep were mainly category D with a proportion of 83.77%. Among them, the carcasses of the Djallonke represented 78.55% (i.e. 0.58% males and 77.97% females) and those of the Sahelians, 5.22%. It should be noted that categories A (Carcasses of young uncastrated sheep under 2 years old) and E (Carcasses of other female animals) where the proportions are almost equal with respectively 6.96% and 6.67%. Which agrees with the results of Nana et al. [14] where different carcass categories were recorded with similar proportions (81%) of category D. Carcasses with excellent conformation (E) were the majority (41.15% among the carcasses of the Djallonké and the Sahelians (3.48%). It should also be noted the presence of carcasses with Very good conformation (U) with a significant proportion of 24.64% among the Djallonké and 1.45% among the Sahelians. Follow-up of carcasses with superior conformation (S) (16.81% for the carcasses of Djallonke sheep and 3.48% for the Sahelian breed). Carcasses with good conformation (R) and good conformation (O) were the least represented with respective proportions of 4.35% and 4.24% (all Djallonke). These results are different from those of Einarsson et al. [15] who obtained higher percentages of 84; 84 and 61% respectively for classes O, R and U. The study reveals that more than half of the sheep slaughtered at the Korhogo slaughterhouse had a lean carcass fattening status of 62.9%. These results are contrary to those reported by Einarsson et al. [15] who obtained 69 to 73% of fatty carcasses.

This could be explained by the breeding system. Indeed, the carcasses of animals obtained at the Korhogo slaughterhouse are mainly from animals from extensive breeding where the basic food is fodder. According to Lebret et al. [16], the fattening state of a carcass depends essentially on the stage of maturity reached by the animal at slaughter. The higher the stage of maturity of the animal, the fatter the carcass. The main factors that play an important role in the potential weight of a lamb are the breed, sex and weight of the lamb at birth. Most of these carcasses had a red color with a proportion of 64.97% for carcasses of Djallonke sheep and 5.92% for those of the Sahelian breed. This could be due to the feeding system based mainly on green fodder [17], as these authors point out.

## 5 CONCLUSION

At the end of this study, the results showed that Djallonke sheep were the most slaughtered, with a population of 315 heads (91.3%) for an age between 4 years and more (40%). These Djallonke sheep were mainly females with an average live weight of 22.29 ± 4.18 kg. Carcasses of excellent conformation (E) were the most represented in the Djallonke breed (41.15%). The fattening status of lean carcasses was the most represented among the latter (62.9%).

It appears that the sheep admitted to the Korhogo slaughterhouse are females who have not completed their career in extensive breeding. This could be detrimental to the sustainability of breeding. Additional studies should be conducted to evaluate the organoleptic and biochemical qualities of the carcasses to better assess the quality of the sheep meat.

## ACKNOWLEDGMENT

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