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Blood Lipid Profile of Sheep Intended for Consumption in the Area of Korhogo

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Abstract In order to judge the state of health of the sheep authorized for slaughter at the slaughterhouse of the city of Korhogo through their lipid profile, 82 sheep were sampled. In each of the selected animals, total blood was taken and collected under aseptic condition on fasting mornings. These samples were taken after ante-mortem inspections of the jugular vein using Venojects® needles. The blood of each sheep was collected in dry tubes. The serum obtained after centrifugation at 3000 revolutions for 5 minutes was used to determine lipid parameters (total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides) using a "RAYTO RT-9200" brand analyzer. The results indicated that over 90% of the animals declared healthy had lipid metabolism disorders. These abnormal values were significantly very high in female sheep compared to males.

Keywords: *small ruminants, lipid parameters, blood, korhogo*

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1. Introduction

Lipids are essential nutrients for the proper functioning of the body. They participate in the structure and function of cell membranes and are involved in many biological functions (hormones, vitamins, transport, storage, etc.). Lipids contain total cholesterol, low-density lipoprotein cholesterol (LDL), high-density lipoprotein cholesterol (HDL) and triglycerides. Too much LDL cholesterol in the body causes clumps that block blood circulation and cause vascular accidents [1]. Although it is an essential nutrient for the proper functioning of the body, cholesterol is a lipid whose excess is a pathological risk factor. In excess, cholesterol gradually accumulates in the walls of the arteries. This lipid deposition leads to the formation of an atherosclerotic plaque characteristic of atherosclerosis. This disease of the arteries can cause complications such as arterial hypertension, myocardial infarction, stroke, or obliterating arteritis of the lower limbs [2]. Lipid sources may be animal or vegetable. Animal sources include the meat of small ruminants, whose production is an important part of the world economy due to its consumption [3]. It was estimated at about 14 million tonnes. In Côte d'Ivoire, consumption was estimated at 11,132 tonnes [4]. Because of its global consumption, sheep meat is one of the main sources of animal protein [5]. Indeed, the meat of small ruminants in general and in particular of sheep plays a predominant role in the food balance, thanks to its great wealth of essential elements for growth and maintenance in good health. However, the influence of fat on the quality of sheep meat remains a real concern for veterinary services as well as for consumers around the world. For this reason, countries such as Belgium and France, in addition to slaughterhouse inspections, frequently rely on biological parameters not only to test quality, but also to improve sheep and goat production [6]. However, production in Côte d'Ivoire in general and in Korhogo in particular does not benefit sufficiently from scientific research on the biological parameters in sheep. Very little has been done on blood biological parameters [7,8]. In addition, the investigations conducted by [9], on the analysis of the proteoenergetic parameters of small ruminants (sheep and goats) of the slaughterhouse of Korhogo (Côte d'Ivoire) revealed abnormalities in total cholesterol. However, these anomalies can influence the quality of meat and pose a danger to consumers. Yet veterinarians have authorized the slaughter of these small ruminants after ante - mortem inspections. Given the inadequacies of these inspections and the dangers that consumers are currently facing, it is therefore necessary to evaluate the blood lipid profile of these small ruminants (sheep). With this in mind, the present study aims to investigate the blood lipid profile of sheep authorized for slaughter at the Korhogo slaughterhouse.

2. Material and Methods

Population study

This was a cross-sectional and descriptive study that took place over a period of six (06) months from November to April 2021.

After obtaining permission from the authorities of the Peleforo GON COULIBALY University of Korhogo and the consent of the Ministry of Animal Resources and Fisheries (MIRHA) to have access to the municipal slaughterhouse, sheep were selected for the study. After obtaining blood samples, the study continued in the medical biology laboratory for the analysis of the various parameters studied.

Equipment

The study required the use of blood from sheep admitted for slaughter, a RAYTO RT-9200 analyzer for biochemical analysis and a Megafuge 1.0R (Heraeus Instruments) centrifuge for obtaining serum, micropipettes, dry red tubes, 100-well polystyrene racks, cryotubes, non-sterile powdered gloves and disposable tips.

3. Methods

Sampling of subjects

Subjects were selected on the basis of veterinary inspections, namely ante-mortem inspection. This inspection, more precisely, consists of observing the natural orifices carefully enough to make sure that there is no discharge or bloody diarrhoea. Next, carefully observe the animal's behavior by head and leg movements.

Blood sampling

From each of the selected sheep, 200µL of whole blood was collected in the mornings on an empty stomach after the ante-mortem inspections. Whole blood was taken under aseptic conditions to avoid contamination with pathogenic microorganisms. The blood was collected in dry tubes and then preserved to obtain the serum. These samples were centrifuged at 3000 rpm for 5 minutes using a Megafuge 1.0R (Heraeus Instruments). The serum obtained was placed in 1.5 mL eppendorff tubes, stored at -20° Celsius and sent to the laboratory for biochemical assay with the RAYTO RT-9200 analyser.

Determination of lipid parameters

Cholesterol and trigluceride were determined by the enzymatic cholesterol oxidase colorimetric method [10,11]. HDL and LDL cholesterol were determined by the enzymatic method [12].

Statistical analysis

The data were entered into Excel® and analysed with STATICA software. The results were presented in the form of averages with their standard deviation. These tests were carried out with the computer program Statsoft Statistica version Windows 7.1 [13].

The different observed proportions of the blood biological indicators were compared by the G likelihood test or log likehood ratio test with the R.2.0.1 Windows version software [14].

Significance of the analyses was defined for a probability threshold p less than 5%.

4. Results

Characteristics of the subjects

The population of our study was composed of 82 sheep, all (100%) of the Djallonke breed, including 6 males (7.41%) and 76 females (92.68%). The average age of the sheep was 2.09 ± 0.06 years (Table 1).

Table 1. Sheep characteristics data

Characteristic	**Total Sheep** (N = 82)	
	n ESM	M ± %
Age (year)	2.09±0,06	
<1	4 4.87	
1 ≥	78 95.12	
Sex		
Males	6 7.31	
Females	76 92.68	
Race		
Djallonké	100	

M: Mean; ESM: Standard Error of mean; N Total number for each species; n: Number observed for each species; %: Percentage

Status of the lipid profile of the sheep compared to the usual values

The mean values of the different lipid parameters are given with the standard error. The averages obtained for all parameters were not within the reference ranges with the exception of triglycerides which had an average within the usual values (Table 2). These results indicate that total cholesterol, HDL-cholesterol and LDL-cholesterol levels were high. Indeed, the mean values in sheep were 0.26 g/L ± 0.02 and 0.35 g/L ± 0.02 respectively (Table 2).

Table 2. Mean values of sheep lipid profile compared to reference values

Lipid Parameters	Sheep (N=82)	
	M ± ESM	Val. réf.
Total cholesterol (g/L)	0.69 ± 0.04	0.24-0.35[a]
HDL cholesterol (g/L)	0.26 ± 0.02	0.21[b]
LDL cholesterol (g/L)	0.35 ± 0.02	0.19[b]
Triglycerides (g/L)	0.39 ± 0.03	0.14-0.44[c]

N: Total number for each species; M: Mean; ESM: Standard error of the mean; Val. réf. : Reference value, a: (**Baumgartner et Pernthaner**., 1994); b: **(Nazifi *et al.*, 2002)** et c: (**Mollereau *et al.*, 1995).**

Distribution of the main lipid parameters of sheep in all subjects

The results showed that for total cholesterol the abnormal prevalences were higher than the normal prevalences (92.68% versus 7.32% respectively). The same is true for HDL and LDL cholesterol, with 95.12% of abnormal subjects for both parameters compared to 4.88% of normal subjects for both parameters. On the other hand, at the level

of triglycerides, the animals presenting an abnormal state are slightly more numerous than those presenting a normal state. 62.20 % of the animals presented an abnormal triglyceride state and 37.80 % of the animals presented a normal triglyceride state.

Table 3. Proportions of sheep lipid parameters in all subjects

Lipid parameters	Sheep (N = 82)	
	n	%
Total cholesterol (g/L)		
Normal (0.24-0.35)	6	7.32
Abnormal		
< 0.24	2	2.57
> 0.35	74	90.11
HDL cholesterol (g/L)		
Normal (0.21)	4	4.88
Abnormal		
< 0.21	43	55.12
> 0.21	35	40
LDL Cholesterol (g/L)		
Normal (0.19)	4	4.88
Abnormal		
< 0.19	10	12.19
> 0.19	68	82.92
Triglyceride (g/L)		
Normal (0.14-0.44)	51	62.20
Abnormal		
< 0,14	6	7.31
> 0,44	25	30.48

N: Total number for each species; n: Number observed for each species; %: Percentage.

Table 4. Comparative proportions of lipid parameters in sheep according to sex

Lipid parameters	Sheep (N=82)				p
	Males N=6		Females N=76		
	n	%	n	%	
Total Cholesterol (g/L)					
Normal (0.24-0.35)	0	**0**	5	**6.58**	0.003 (S)
Abnormal (< 0.24; > 0.35)	6	**100**	71	**93.42**	0.63 (NS)
Cholesterol HDL (g/L)					
Normal (0.21)	0	**0**	4	**8.70**	0.0005 (S)
Abnormal (< 0.21; > 0.21)	6	**100**	72	**94.73**	0.71 (NS)
Cholesterol LDL (g/L)					
Normal (0.19)	0	**0**	4	**8.70**	0.0005 (S)
Abnormal (< 0.24; > 0.35)	6	**100**	72	**94.73**	0.71 (NS)
Triglyceride total (g/L)					
Normal (0.14-0.44)	5	**83.33**	48	**63.15**	0.09 (NS)
Abnormal (< 0.14; > 0.44)	1	**16.66**	28	**36.84**	0.005 (S)

N: Total number for each species; n: Number observed for each species; %: Percentage; S: Statistically significant difference for $p < 0.05$, $p < 0.01$ and $p < 0.001$; NS: Non-significant difference for $p > 0.05$.

Variation in the lipid profile of sheep by sex according to their condition

These results indicate that there was no significant difference ($p > 0.05$) between the prevalences of abnormal values of total cholesterol, HDL-cholesterol and LDL-cholesterol in males and females. Similarly, no significant difference ($p > 0.05$) was observed between normal values of total triglyceride in males and females. On the other hand, the prevalence of normal total cholesterol values was significantly higher ($p < 0.05$) in females than in males (6.58% versus 0% respectively). In this table, the prevalences of normal HDL-cholesterol and LDL-cholesterol values were significantly higher ($p < 0.001$) in females than in males ((8.70% vs. 0%) and (8.70% vs. 0%) respectively) (Table 4).

5. Discussion

With the aim of warning the population about the risks associated with the consumption of fatty meat from small ruminants (sheep) in general and sheep in particular, a study was initiated to assess the lipid profile of sheep. To do this, certain parameters such as total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides were measured. The average values of these parameters compared to the reference values obtained in the literature are abnormal, except for those of triglycerides.

These abnormalities could jeopardise the good health of the animals and have a direct influence on the quality of the meat. These abnormal mean values observed in the present study compared to the reference values established by several authors [15,16,17] were observed by [18] in 1981 in Algeria. This author reported high prevalences of abnormal lipid profile values in his study. According to the same author the high prevalence of these abnormal values may be due to the diet of these animals.

The most important observation in this study is the prevalence of abnormal values of the lipid profile in all sheep except the triglyceride level which was very low (92.68% for total cholesterol, 95.12% for HDL cholesterol, 95.11% for LDL cholesterol and 37.74% for triglyceride).

Indeed, in nephrotic syndromes, hypothyroidism, liver diseases (cirrhosis) and corticosteroid therapy, there is an increase in cholesterol levels associated with the rise in HDL and LDL levels [19,20]. These different causes could underlie the high prevalences observed in the animals in this study. These same observations were made by [21] in sheep. In the same vein, work carried out by [9] at the Korhogo slaughterhouse revealed the same high cholesterol levels in sheep. According to [20] the pathologies (steatosis, cirrhosis, hepatitis) would have degrading effects on the liver and kidney which play an important role in lipid metabolism. The high prevalence of lipid profile abnormalities in the subjects of this study may be due to these pathologies.

Furthermore, among the parameters measured, the prevalences of abnormal triglyceride values were low compared to the prevalences of other lipid profile parameters. The same observations were made in the work done by [22] on sheep and goats. According to these authors, the degradation of triglycerides is due to age. These authors found that the triglyceride level was more degraded in young people than in adults.

This abnormally high level of triglyceride in females than in males would be due to diet. The same observations

were made in the work done by [23] on sheep and goats.

The results of comparisons of lipid parameters by sex indicate that in sheep as a whole, the parameters were more degraded in females.

In addition, the abnormal LDL cholesterol levels observed in females could be due either to the onset of menopause or to the decrease in estrogen at menopause. Indeed, the onset of menopause triggers an atherogenic triad characterized by a reduction in HDL cholesterol levels, an increase in LDL cholesterol which potentiates hepatic steatosis [24]. Our results are in agreement with those obtained by [25] who worked on goats in the Burkina Faso sahel.

6. Conclusion

The results of this study show that, on the basis of the blood parameters measured, many of the animals admitted for slaughter had lipid metabolism disorders. These disorders are characterized by the high prevalence of abnormal values of the measured parameters. These values were significantly elevated in all subjects except for the triglyceride level, whose normal values were very low. Most of these parameters (total cholesterol, HDL-cholesterol and LDL-cholesterol) were more degraded in females than in males. In sum, these observed abnormalities indicate that the sheep approved for slaughter in this study have a high fat content. The presence of this high fat mass may constitute a hazard for consumers.

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Authors Contributions

All authors contributed equally in the study. They made substantial contributions to the design of the study, the collection of the data as well as the preparation and analysis of the data. They also drafted the manuscript and gave final approval for its submission to the journal for consideration of publication.

Declaration of interest

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

Animal Welfare Statement

The authors confirm that the ethical policies of the journal, as stated on the journal's author guidelines page, have been followed. Appropriate approval from the authorities of Peleforo Gon Coulibaly University and the Ministry of Animal and Fisheries Resources has been received. The authors confirm that they have followed EU standards for the protection of animals used for scientific purposes.

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