BLOOD REFERENCE VALUES IN THE LAMB (Na, K, Ca, P, Mg, Cu, Zn, Cl, UREA, TOTAL PROTEINS, CREATININE, URIC ACID, ALKALINE PHOSPHATASE, ASPARTATE AMINO TRANSFERASE, CHOLESTEROL AND HEMOGLOBIN)

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SUMMARY

We have determined sixteen blood chemical parameters in three month-old lambs and eleven in one and a half-month old ones.

We have found that three of them were not affected by age : potassium, copper and proteins ; seven were lowered : sodium, calcium, zinc, chlorine, inorganic phosphate, urea and cholesterol ; one was enhanced : magnesium.

These reference values will be used as a basis for further controls of the flocks.

INTRODUCTION

The purpose of the present study is to establish some reference values of biochemical blood parameters in growing lambs aged 1 1/2 and 3 months, fed high-energy rations.

The values thus achieved, from apparently healthy animals, will contribute to the definition of biochemical profiles valid for that species. It is our hope that with systematic controls we will discover eventual biochemical « symptoms » before any clinical troubles appear. This will be done so that we may try to better control the concerned breedings from a nutritious and sanitary point of view,

TABLE I

Composition of food

Composition des aliments

M 201 :

Composition:

    1) corn,
    2) molasses, lucerne,
    3) peanuts, soya,
    4) minerals and vitamins.

	(%)
Maximum humidity	14
Maximum cellulose	5
Maximum mineral mat.	8
Minimum proteic mat.	13,5
Minimum fats	1,8

Vitamins per 100 kg:

A (U_1)	900 000
D_3 (U_1)	420 000
E (mg)	440
C (mg)	1 200

M 111 :

Composition:

    1) oats, wheat, corn, molasses,
    2) soya, peanuts,
    3) Minerals and vitamins.

	(%)
Maximum humidity	14
Maximum cellulose	4,5
Maximum mineral mat.	6,5
Minimum proteic mat.	16
Minimum fats	2

Vitamins for 100 kg:

A (IU)	1 000 000
D_3 (IU)	400 000
B_1 (mg)	100
B_2 (mg)	100
PP (mg)	160
C (mg)	1 000

Supplement per 100 kg:

Aureomycine (g)	2
Terramycine (g)	30
Spiramycine (g)	15

EXPERIMENTAL PROCEDURE

1. — *The animals*

The blood samples were taken from two hundred and eighty-one crossbred lambs of the same breeding :

— 29 lambs, 1. 5 month-old still weaning, weighing about 12 kg,
— 252 lambs, 3 months-old weighing between 25 and 30 kg.

Usually, this type of lamb is slaughtered at 3.5 months. The lambs were fed to appetite with a pelleted ration (M 111 for the 1.5 month-old lambs and M 201 for the 3 months-old lambs (see table one). They were also given water and hay *ad libitum*, and were kept on straw bedding in groups of 100 animals, in pens with dynamic ventilation.

2. — *The techniques*

2. 1. — *Blood sample.*

A single 10 ml blood sample has been taken of each animal by jugular vein puncture. The blood is collected in a tube containing heparin-lithium.

Within two hours following the blood sampling, 1 ml of that blood is taken to titrate the hemoglobin, the rest of it is centrifuged for 5 minutes at 3 000 r.p.m. The plasma is then separated.

The analyses are carried out :

— the same day for all the organic substances and enzymes,
— the following day for the minerals (plasma is stored at 4°C).

2. 2. — *Analytical methods.*

The analytical methods used are the usual procedures of our laboratory as described in a previous paper (RICO *et al.*, 1976). For calcium, magnesium, copper and zinc, we used atomic absorption spectrophotometry, automatized according to RAYNAUD (1967) for calcium and magnesium.

RESULTS

1. — *3 Months-old animals*

The results are shown in the form of histograms in the figures 1 to 4. They are expressed :

— in mEq/l for ions Na^+, K^+, Ca^{++}, Mg^{++},
— in g/l for the urea, the total proteins, the hemoglobin, the cholesterol,
— in mg/l for the creatinine, the uric acid, the inorganic phosphate, the copper and the zinc (the concentrations of those two last elements are often expressed in p.p.m.),
— in U/l for the enzymes. International Units of enzymatic activity (U) per litre.

These histograms show the distribution of the experimental data. We have mentioned the following parameters below each of them.

$\overline{M}$: mean
N : number of data analysed

TABLE 2

Blood composition of lambs aged 1 1/2 or 3 months

Composition sanguine des agneaux âgés de 1 1/2 ou 3 mois

(Parameter) Paramètre		Na	K	Ca	Mg	Cu	Zn	Cl	P
(Unit) Unité		mEq · l⁻¹	mEq · l⁻¹	mEq · l⁻¹	mEq · l⁻¹	mg · l⁻¹	mg · l⁻¹	mEq · l⁻¹	mg · l⁻¹
(1.5 month lambs) Agneaux de 1.5 mois	$\overline{M}$	148.8	4.8	5.8	1.7	1.2	1.5	118.2	93.3
	σ	3.3	0.4	0.5	0.2	0.5	0.5	6.0	7.5
(3 months lambs) Agneaux de 3 mois	$\overline{M}$	143.1	4.8	5.0	2.0	1.3	0.9	112.9	73.4
	σ	6.0	0.5	0.8	0.4	0.4	0.2	8.3	9.9
Statistical significance (between ages) Signification statistique (entre âges)		$P < 0.01$	NS	$P < 0.01$	$P. < 0.01$	NS	$P < 0.01$	$P < 0.01$	$P < 0.01$

(Parameter) Paramètre		Prot.	(Urea) Urée	Creat.	(Uric acid) Ac. Urique	Chol.	(ALP) PAL	(SGOT) TGO	Hb
(Unit) Unité		g · l⁻¹	g · l⁻¹	mg · l⁻¹	mg · l⁻¹	g · l⁻¹	U · l⁻¹	U · l⁻¹	g · l⁻¹
(1.5 month lambs) Agneaux de 1 mois	$\overline{M}$	65.1	0.37	—	—	1.19	—	—	—
	σ	3.5	0.13	—	—	0.26	—	—	—
(3 months lambs) Agneaux de 3 mois	$\overline{M}$	65.9	0.29	7.7	2.2	0.53	230	44	124
	σ	6.9	0.08	1.6	0.7	0.13	92	8	15
Statistical significance (between ages) Signification statistique (entre âges)		NS	$P < 0.01$	—	—	$P < 0.01$	—	—	—
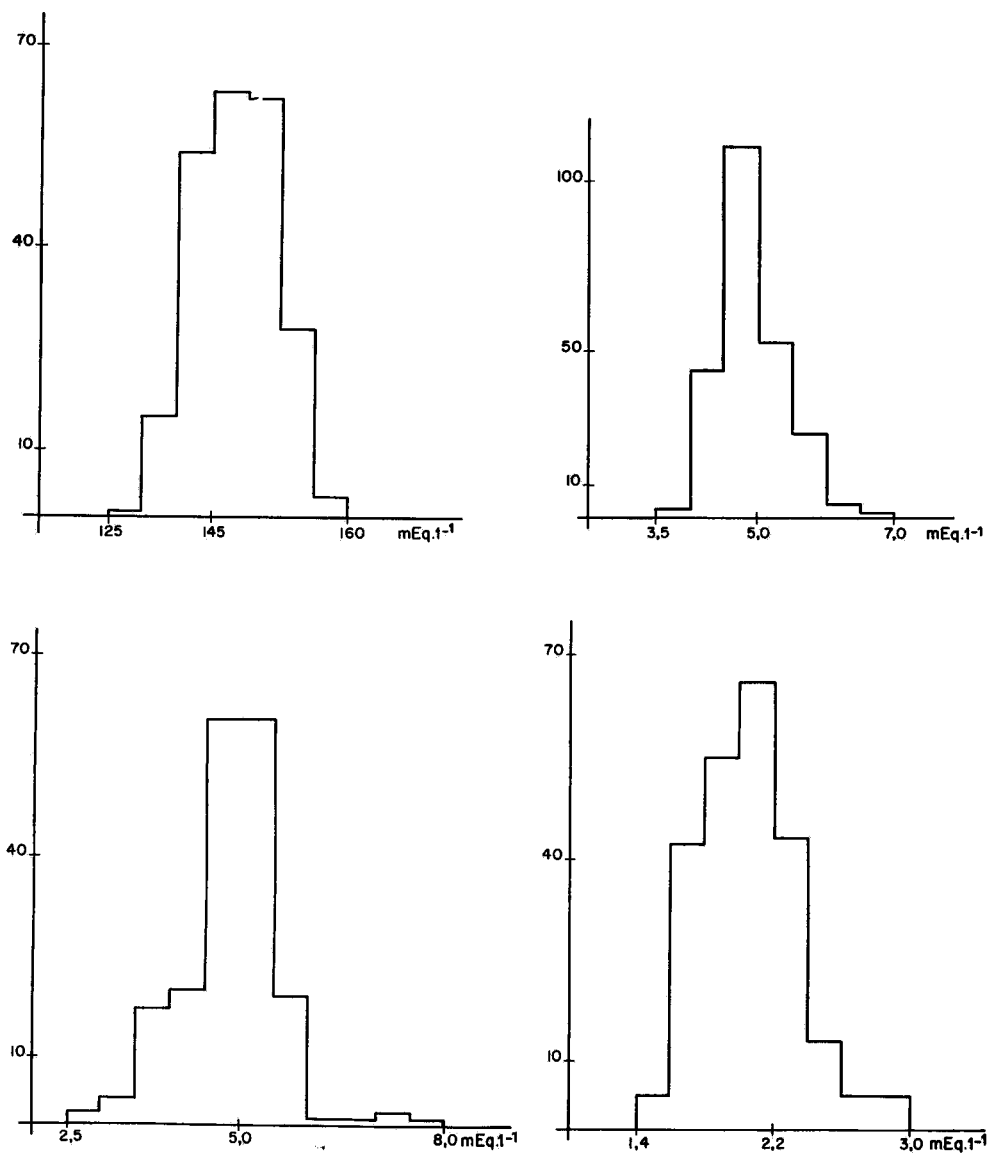
FIG. 1.

A : Sodium

| N = 233 | $\bar{M}$ = 143,1 mEq · l^{-1} | σ = 6,0 mEq · l^{-1} | d = 4,2 p. 100 |

B : Potassium

| N = 237 | $\bar{M}$ = 4,8 mEq · l^{-1} | σ = 0,5 mEq · l^{-1} | d = 10,4 p.1000 |

C : Calcium

| N = 235 | $\bar{M}$ = 5,0 mEq · l^{-1} | σ = 0,8 mEq · l^{-1} | d = 16,0 p. 100 |

D : Magnésium

| N = 235 | $\bar{M}$ = 2,0 mEq · l^{-1} | σ = 0,4 mEq · l^{-1} | d = 20,0 p. 100 |
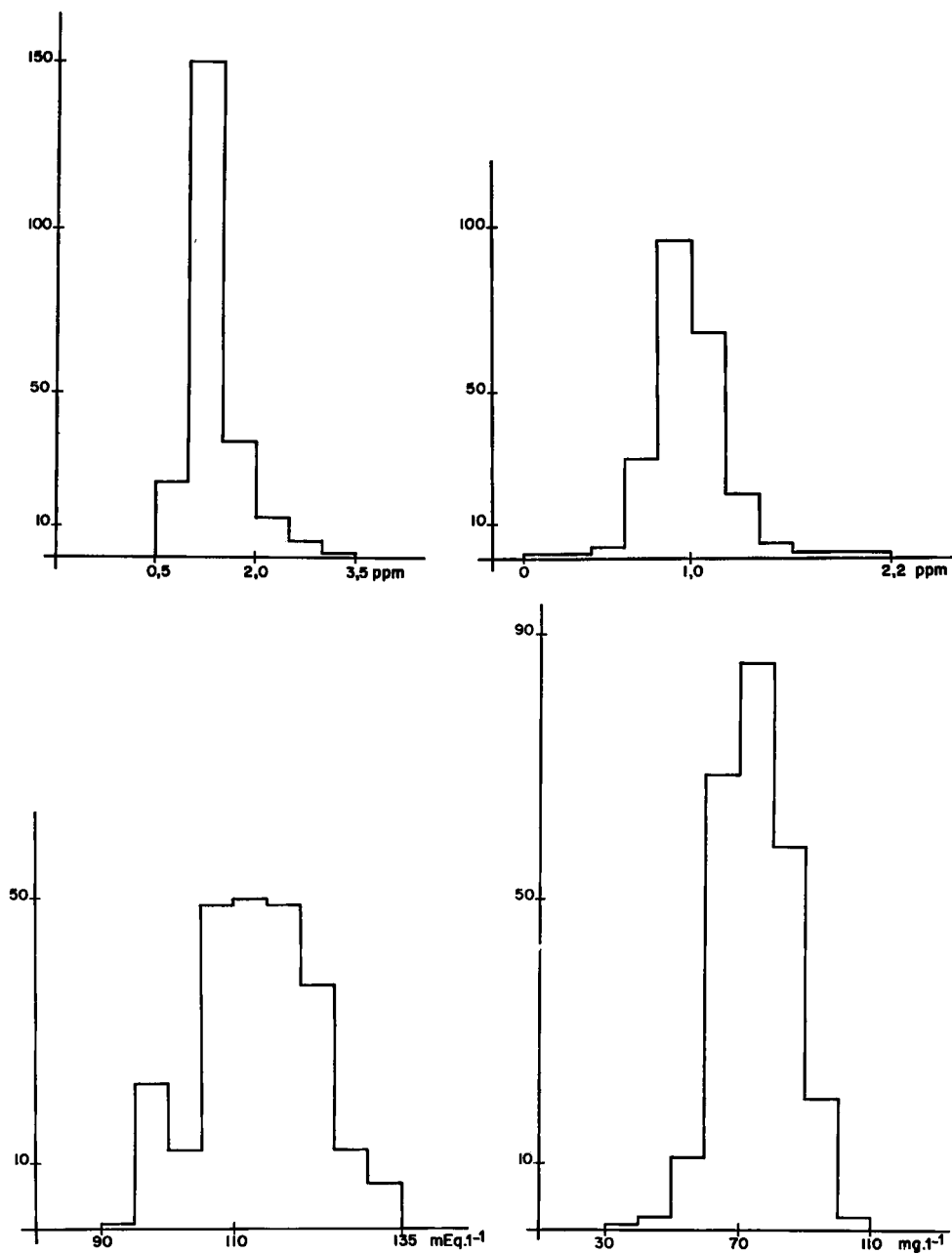
FIG. 2.

A : Cuivre (*Copper*)

$N = 232$ $\overline{M} = 1,3$ mg $\cdot$ l^{-1} $\sigma = 0,4$ mg $\cdot$ l^{-1} $d = 30,8$ p. 100

B : Zinc

$N = 231$ $\overline{M} = 0,9$ mg $\cdot$ l^{-1} $\sigma = 0,2$ mg $\cdot$ l^{-1} $d = 22,2$ p. 100

C : Chlore (*Chloride*)

$N = 237$ $\overline{M} = 112,9$ mEq $\cdot$ l $\sigma = 8,3$ mEq $\cdot$ l^{-1} $d = 7,4$ p. 100

D : Phosphate inorganique (*Inorganic phosphate*)

$N = 237$ $\overline{M} = 73,4$ mg $\cdot$ l^{-1} $\sigma = 9,9$ mg $\cdot$ l^{-1} $d = 13,5$ p. 100
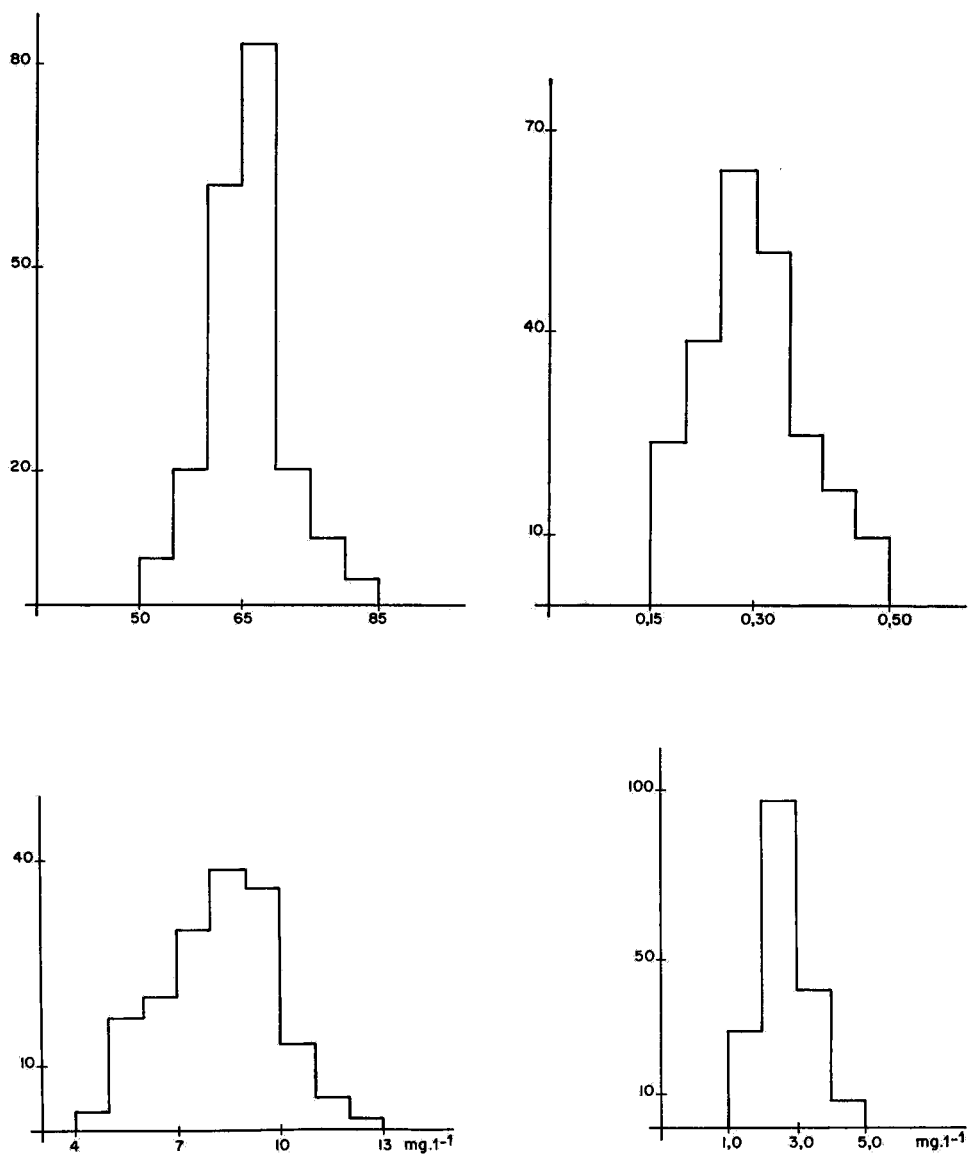
FIG. 3.

A : Protéines (*Proteins*)

N = 204	$\overline{M} = 65,9$ g · l^{-1}	$\sigma = 6,9$ g · l^{-1}	d = 10,5 p. 100

B : Urée (*Urea*)

N = 225	$\overline{M} = 0,29$ g · l^{-1}	$\sigma = 0,08$ g · l^{-1}	d = 27,6 p. 100

C : Créatinine (*Creatinin*)

N = 225	$\overline{M} = 7,7$ mg · l^{-1}	$\sigma = 1,6$ mg · l^{-1}	g = 20,8 p. 100

D : Acide urique (*Uric acid*)

N = 225	$\overline{M} = 2,2$ mg · l^{-1}	$\sigma = 0,7$ mg · l^{-1}	d = 31,8 p. 100
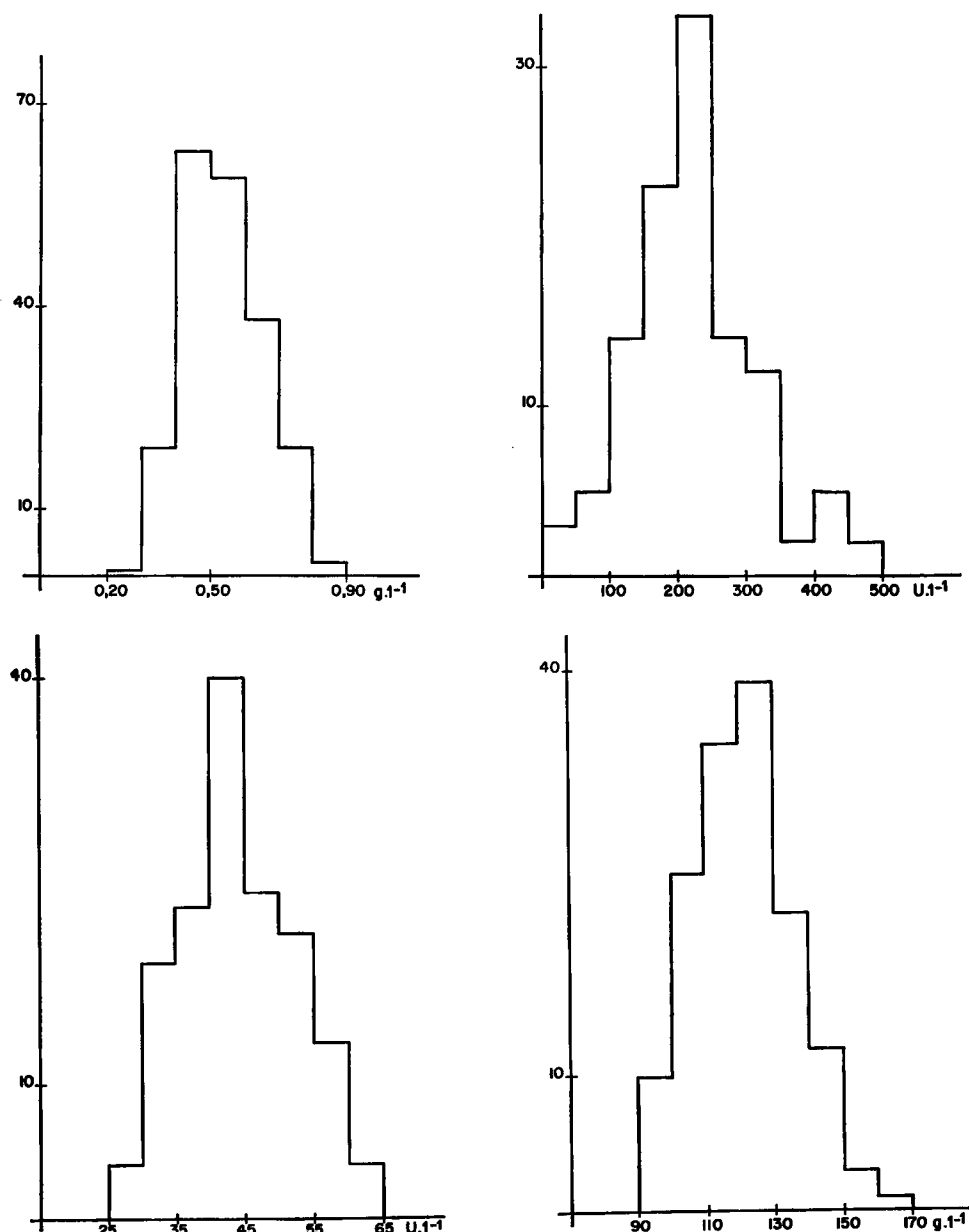
FIG. 4.

A : Cholestérol (*Cholesterol*)

N = 200 $\overline{M}$ = 0,53 g · l⁻¹   σ = 0,13 g · l⁻¹   d = 24,5 p. 100

B : Phosphatases alcalines = PAL (*Alkaline phosphatase = ALP*)

N = 113 $\overline{M}$ = 230 U · l⁻¹   σ = 92 · U · l⁻¹   d = 40   p. 100

C : Asparate-Amino-Transférase = TGO (*SGOT*)

N = 148 $\overline{M}$ = 44 U · l⁻¹   σ = 8 · U · l⁻¹   d = 18,2 p. 100

D : Hémoglobine (*Haemoglobin*)

N = 146 $\overline{M}$ = 124 g · l⁻¹   σ = 15 g · l⁻¹   d = 12,1 p. 100

$$\sigma : \text{standard deviation} = \frac{\Sigma \ (x - \overline{M})^2}{N - 1}$$

$$d : \text{percentage dispersion} = d = \frac{\sigma}{\overline{M}} \times 100$$

It can be seen that the percentage of dispersion for most of the parameters stands between 10 and 20 p. 100 which is not surprising for a population of crossbred animals.

2. — 1,5 Month-old animals

The results thus obtained have to do with only 11 parameters : the minerals, the total proteins, the urea and the cholesterol.

They are gathered in table 2 where they are compared with those obtained for the older animals.

DISCUSSION

1. — Comparison with literature

Data from the literature have been put together in table 3 ; however they are not limited to lambs, but also include older animals, which can make the comparisons more complicated.

We have deliberately omitted the results concerning the measures of enzymatic activities since they differ too much according to the technique used.

Comparing tables 2 and 3, our results agree quite well with those already published.

2. — Differences related to age

Only three out of eleven parameters do not vary with the age : these are the potassium, the copper and the total proteins. Seven elements are significantly lowered at 3 months : the sodium, the calcium, the zinc, the chlorine, the inorganic phosphate, the urea and the cholesterol. As for the magnesium, on the contrary its plasma level is increased.

However, it may be advisable to ask whether the variations observed are linked exclusively to age, or rather, as HEALY (1974) thinks, to the superposed effects of both age and the kind of feeding : the youngest animals being only weaned while the 3 month-old subjects are undergoing fattening.

CONCLUSION

Sixteen biochemical blood parameters of lambs brought up in strictly controlled conditions have been determined. Those values will constitute a basis for us to observe flocks bred in the same conditions, in order to detect nutritional problems before they have progressed too far, and to prevent economic losses.

TABLE 3

Compared values found in bibliography for ovine blood composition

Valeurs relevées dans la bibliographie pour les principaux paramètres biochimiques sanguins des ovins

	$\overline{M}$	Dispersion	(Unit) Unité	(Author) Auteur
Sodium	146 150 330	139 à 152 σ = 6 σ = 1.1	mEq·l⁻¹ mEq·l⁻¹ mEq·l⁻¹ mg (%)	PUGH WEAVER HEALY KOLB
Potassium	18 5.7	3.9 à 5.4 5.7	mEq·l⁻¹ mg (%) mEq·l⁻¹	PUGH KOLB HEALY
Calcium	12.16 9.2 9.82 10 9.76 12.3 8.8	σ = 0.28 σ = 0.10 σ = 0.46 σ = 0.65 σ = 0.8	mg (%) — — — —	HACKETT MARSH LIPPMANN KOLB BELONJE HEALY WEAVER
Magnésium	2.5 2.9 2.43 1.9 2.4 2.25	σ = 0.3 σ = 0.13 σ = 0.48 σ = 0.3 σ = 0.08 σ = 0.21	mg (%) — — — — —	WHITE EVELETH LIPPMANN WEAVER HEALY BELONJE

	$\overline{M}$	Dispersion	(Unit) Unité	(Author) Auteur
(Chloride) Chlore	104 370	σ = 3 95 à 103	mEq·l⁻¹ mEq·l⁻¹ mg (%)	WEAVER PUGH KOLB
(Inorganic phosphate) Phosphate inorganique	4.3 5.4 5.08 5 10.2 5.5	σ = 0.9 σ = 0.11 σ = 0.51 σ = 0.3 σ = 1.8	mg (%) — — —	MARSH HACKETT LIPPMANN KOLD HEALY WEAVER
(Copper) Cuivre	1.08 1.06 60	σ = 0.11 0,5 à 2	mg·l⁻¹ — µg (%)	McCOSKER YEHYA KOLB
(Total proteins) Protéines totales	8.5 6.5 69.1 57	σ = 8 6.2 à 7.0 6.4	g (%) g (%) g·l⁻¹	WEAVER KOLB BELONJE HEALY
(Cholesterol) Cholestérol		40 à 70	mg (%)	HEALY
(Urea) Urée	29	σ = 15	mg (%)	WEAVER

RÉSUMÉ

VALEURS DE RÉFÉRENCE SANGUINES CHEZ L'AGNEAU

Chez deux cent cinquante-deux agneaux de 3 mois, on a pu déterminer les valeurs de référence sanguines suivantes :

Sodium	: 143,1 ± 6,0 mEq · l⁻¹	Potassium : 4,8 ± 0,5 mEq · l⁻¹

Sodium   : 143,1 ± 6,0 mEq · l⁻¹   Potassium   : 4,8 ± 0,5 mEq · l⁻¹
Calcium   :   5,0 ± 0,8 mEq · l⁻¹   Magnésium   : 2,0 ± 0,4 mEq · l⁻¹
Cuivre   :   1,3 ± 0,4 mg · l⁻¹   Zinc   : 0,9 ± 0,2 mg · l⁻¹
Chlore   : 112,9 ± 8,3 mEq · l⁻¹   Phosphate inorganique : 73,4 ± 9,9 mg · l⁻¹
Protéines   : 65,9 ± 6,9 g · l⁻¹   Urée   : 0,29 ± 0,08 g · l⁻¹
Créatinine :   7,7 ± 1,6 mg · l⁻¹   Acide urique : 2,2 ± 0,7 mg · l⁻¹
Cholestérol : 0,53 ± 0,13 g · l⁻¹   PAL   : 230 ± 92 U · l⁻¹
TGO   : 44 ± 8 UI⁻¹   Hb   : 124 ± 15 g · l⁻¹

Chez vingt-neuf agneaux de 1,5 mois, nous avons pu constater que certains paramètres sont significativement plus élevés :

Calcium   : 5,8 ± 0,5 mEq · l⁻¹
Sodium   : 148,8 ± 3,3 mEq · l⁻¹   Zinc   : 1,5 ± 0,5 mg · l⁻¹
Chlore   : 118,2 ± 6,0 mEq · l⁻¹   Phosphate inorganique : 93,3 ± 7,5 mg · l⁻¹
Urée   :   0,37 ± 0,13 g · l⁻¹   Cholestérol : 1,19 ± 0,26 g · l⁻¹
et un autre plus faible : Magnésium : 1,7 ± 0,2 mEq · l⁻¹.

La bonne connaissance de ces valeurs et de leurs variations devraient nous permettre, à la faveur de contrôles systématiques, de détecter d'éventuels troubles nutritionnels ou sanitaires avant qu'ils ne se manifestent sur le plan clinique et donc avant qu'ils ne se traduisent par des pertes économiques.

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