

## PROTEINS, LIPOPROTEINS AND LIPIDS OF GOAT BLOOD SERUM

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*The concentrations of proteins, lipoproteins and lipids in the sera of goats (Saanen, Alpen and crossbred) under physiological conditions, were investigated in this paper.*

*The results obtained demonstrate that the concentrations of total proteins and relative contributions of the protein fractions separated by paper electrophoresis do not differ between Saanen, Alpen and crossbred goats.*

*Goats have concentrations of total lipoproteins, beta lipoproteins and serum cholesterol significantly lower than man, but they are within the normal limits for lipid and lipoprotein in domestic animals. Only the phospholipid values were comparable with those in man.*

*In agarose gel the serum lipoproteins of goats were separated into four fractions corresponding to human beta, pre-beta and two fractions with alpha mobility: alpha and pre-alpha lipoproteins. The major part of lipoproteins in goats was found as alpha lipoproteins (65—70%). The greater part of the phospholipids (about 70%) in the serum and about 45% of the cholesterol were carried in the high density lipoprotein fraction.*

*Key words: protein, lipoprotein, cholesterol, phospholipids, beta-lipoprotein, goat.*

### INTRODUCTION

Lipids are generally insoluble in water and are stabilized and transported in plasma by association with various apoproteins. In man, three classes of serum lipoproteins are observed: low density lipoproteins (LDL) or beta lipoproteins, very low density lipoproteins (VLDL) or pre-beta lipo-

proteins and high density lipoproteins (HDL) or alpha lipoproteins. However, there is evidence that the lipoproteins in animal serum differ from those in man (Chapman 1980, Terpstra et al 1982, Vitić 1984). Since animals of various species are widely used as models to study atherosclerosis and lipoprotein metabolism, a detailed knowledge of the lipoprotein pattern of animals is very important. Such data may be useful in selecting suitable models. The structure and metabolism of serum lipoproteins have been studied predominantly in laboratory animals and domestic non-ruminant animals, but relatively little information is available for ruminant animals particularly the goat.

The aim of the present study was to investigate the serum proteins, lipoproteins and lipids of goats under physiological conditions and to examine the differences between serum proteins, lipoproteins and lipids of sheep and goats.

Few data from the literature are available which specify the cholesterol and phospholipid concentrations in the various lipoprotein fractions of animals (Mills and Taylaur 1971, Alexander and Day 1973, Champan 1980, Vitić 1984.) For this reason, the concentration of cholesterol and phospholipid in the lipoprotein fractions of this animal species was also determined.

#### MATERIALS AND METHODS

The proteins, lipoproteins and lipids were studied in the sera of 21 goats: 11 female Saanen (SG), 4 female Alpen (AG), 5 female crossbred (SG x AG) and 1 male Balkanische. Samples of blood were obtained at a private farm in Bačko Petrovo village.

Blood was obtained from apparently healthy animals by jugular vein puncture. Serum samples were obtained after allowing the blood to clot spontaneously at room temperature.

The level of total serum proteins was determined by the colorimetric method (Cartier and Picard 1957). Paper electrophoresis was used to separate the serum proteins (Nikolić 1957) and agarose gel electrophoresis was to separate the serum lipoproteins (Nikolić et al. 1958, Dyerberg and Hjrne 1970).

The concentration of total serum lipoproteins was determined using the turbidimetric method with phenol-NaCl according to Kunkel (Polonovski et al. 1957).

Beta lipoprotein concentration was determined according to the procedure of Dangerfield and Faulkner (1964) and beta lipoproteins were isolated using the heparin-MnC12 method (Burstein and Samaille 1960). Cholesterol and phospholipid levels in the serum and in isolated beta and alpha lipoproteins were estimated as described by King (1951).

#### RESULTS

Filter paper electrophoresis of the goat serum separated proteins into four fractions. Under the same conditions and using the same electro-



phoretic technique human serum proteins separated into five fractions and sheep serum proteins separated into six fractions. The goat protein fractions were analogous to: albumin, alpha, beta and gamma globulins (Figure 1).

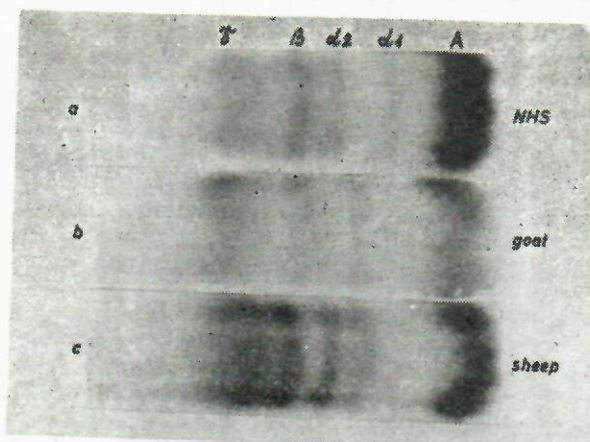


Figure 1. Filter paper electrophoresis of blood serum: a — human serum (control), b — goat and c — sheep.

The results obtained demonstrated that there was no difference in concentration of total serum protein and in the relative contributions of the protein fractions separated by paper electrophoresis between Saanen (SG), Alpen (AG) and crossbred goats (SG x AG).

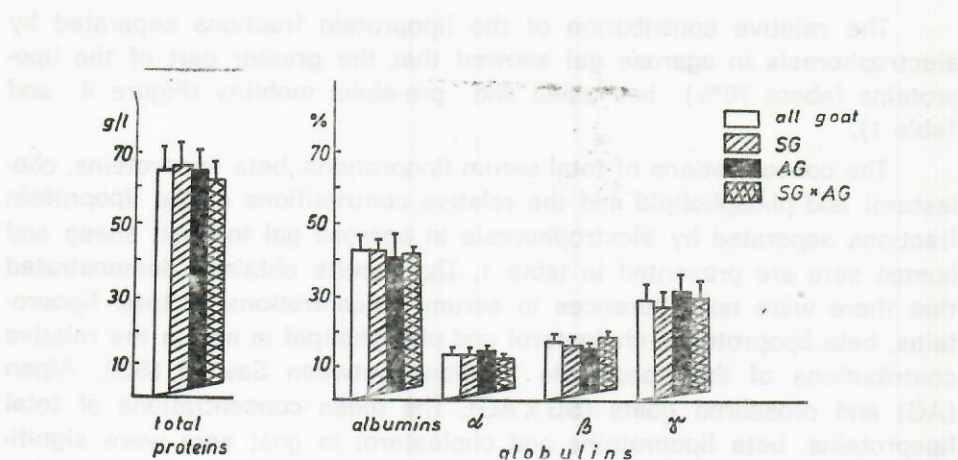


Figure 2. Concentration of total proteins and relative contribution of the protein fractions separated by paper electrophoresis in goat sera.

Serum lipoproteins of the studied animals were separated by electrophoresis in agarose gel and were compared with the lipidograms of normal human serum. In agarose gel the serum lipoproteins of goats were separated into four fractions corresponding to human beta, pre-beta and two fractions with alpha mobility: alpha and pre-alpha (Figure 3).

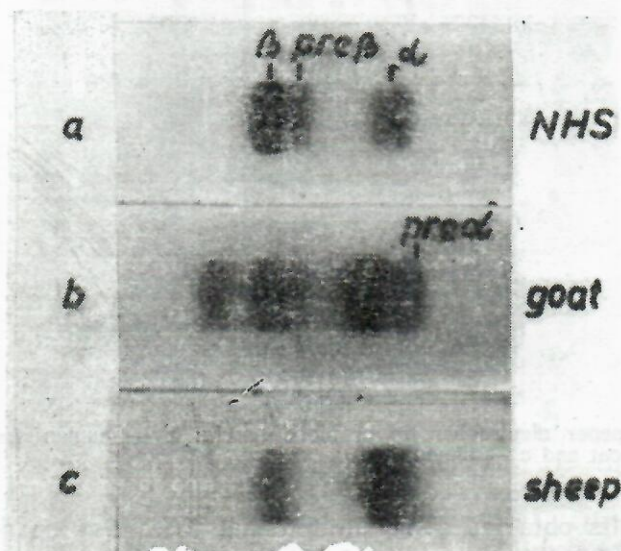


Figure 3. Agarose gel electrophoresis of serum lipoproteins of a — man (control), b — goat and c — sheep.

The relative contribution of the lipoprotein fractions separated by electrophoresis in agarose gel showed that the greater part of the lipoproteins (about 70%) had alpha and pre-alpha mobility (Figure 4 and Table 1).

The concentrations of total serum lipoproteins, beta lipoproteins, cholesterol and phospholipid and the relative contributions of the lipoprotein fractions separated by electrophoresis in agarose gel in goat, sheep and human sera are presented in table 1. The results obtained demonstrated that there were no differences in serum concentrations of total lipoproteins, beta lipoproteins, cholesterol and phospholipid in and in the relative contributions of the lipoprotein fractions between Saanen (SG), Alpen (AG) and crossbred goats (SG x AG). The mean concentrations of total lipoproteins, beta lipoproteins and cholesterol in goat sera were significantly lower than in man, but the phospholipid values were comparable with those in normal human serum.

Table 1. The serum concentrations of total lipoproteins, beta lipoproteins, cholesterol and phospholipids in goat sera and relative contributions of the lipoproteins fractions separated by agarose gel electrophoresis

	Total lipo- proteins g/l	Beta lipo- proteins g/l	Chole- sterol mmol/l	Phospho- lipid mmol/l	% of lipoprotein fraction neutral lipids	beta	alpha
Saanen goat (SG) n = 11	5.96 ± 0.17	3.62 ± 0.95	0.67 ± 0.08	1.95 ± 0.31	10.0 ± 4.0	25.0 ± 5.0	70 ± 6.0
Alpen goat (AG) n = 4	6.17 ± 0.29	3.52 ± 0.80	0.72 ± 0.09	1.93 ± 0.28	9.0 ± 3.0	23.0 ± 4.0	65 ± 3.0
Crossbred goat (SG x AG) n = 5	5.96 ± 0.18	3.87 ± 0.67	0.68 ± 0.07	1.86 ± 0.49	11.0 ± 2.5	20.4 ± 3.0	68.0 ± 2.0
Sheep (n = 30)	6.10 ± 0.14	2.04 ± 0.67	1.39 ± 0.6	1.18 ± 0.36	25.0 ± 9.0	31.0 ± 8.0	46 ± 12.0
Man (control)	6.67 ± 0.55	4.65 ± 0.65	4.47 ± 0.88	2.06 ± 0.38	19.6 ± 6.2	43.3 ± 8.3	35.0 ± 10.2



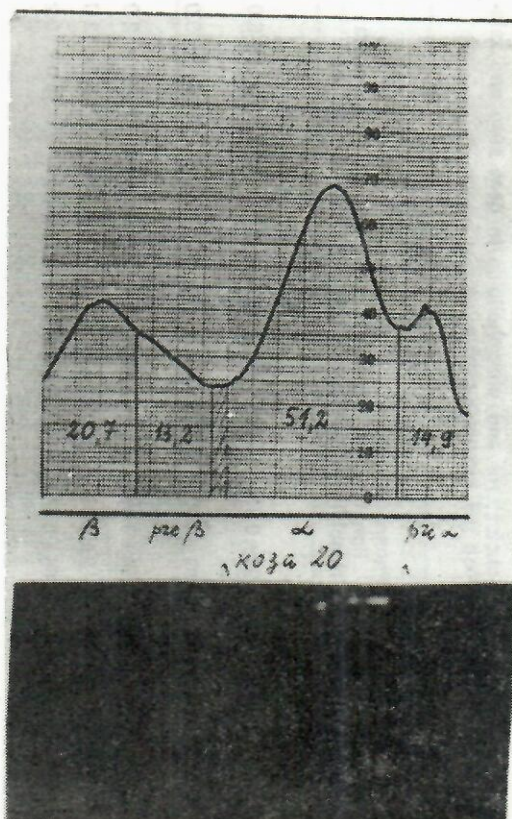


Figure 4. The relative contribution of the lipoprotein fractions in goat serum separated by electrophoresis in agarose gel.

The major part of the lipoproteins in the goats were found to be alpha lipoproteins (65—70%) and beta lipoproteins (20—25%) while neutral lipids accounted for a small part (9—11%). Investigating the ratio of the lipids cholesterol and phospholipid in the separated alpha and beta lipoproteins it was found that goats had about 55% of total cholesterol in beta lipoproteins and 45% in the alpha lipoprotein fraction. However, the greater part of the phospholipids (about 70%) was found in alpha lipoproteins and a small concentration of phospholipid occurred in the beta lipoprotein fraction (about 30%), (Table 2).

#### DISCUSSION

The results demonstrate that goat serum proteins were separated by electrophoresis on filter paper into 4 fractions, while human serum proteins were separated by the same method into 5 fractions and sheep serum proteins into six fractions. The concentration of total serum protein

Table 2. The ratio of cholesterol and phospholipids in separated beta and alpha lipoproteins in goats, sheep and man

	Cholesterol		Cholesterol in isolated beta lipopr. %	Phospholipids		Phospholipid in isolated alpha lipopr. %
	in beta lipoprotein mmol/l	in alpha lipoprotein mmol/l		in beta lipoprotein mmol/l	in alpha lipoprotein mmol/l	
Goat	0.40±0.04	0.32±0.03	55	0.78±0.05	1.37±0.2	64
Sheep	1.06±0.28	0.33±0.24	76	0.43±0.10	0.75±0.38	65
Man (control)	3.36±0.97	1.11±0.07	70—50	0.76±0.23	1.30±0.15	60



and the relative contributions of the protein fractions do not differ between Saanen, Alpen and crossbred goats.

In goats four major serum lipoprotein fractions were observed. These classes might correspond with beta lipoproteins, pre-beta lipoproteins, alpha lipoproteins and pre-alpha lipoproteins in man. The major part of the lipoproteins was found as alpha lipoproteins (65—70%) and beta lipoproteins (20—25%).

The values obtained for the components of lipid and lipoprotein systems tested in goat serum are within normal limits for lipid and lipoprotein concentrations in domestic animals (Alexander and Day 1973, Chapman 1980, Vitić 1984). Goats have concentrations of total lipoproteins, beta lipoproteins and serum cholesterol significantly lower than man. Only serum phospholipid values are comparable with those in man.

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#### REFERENCES

1. Alexander, C. and Day, C. E. 1973. Distribution of serum lipoproteins of selected vertebrates. *Comparative Biochemistry and Physiology* 46 B, 295—312.
2. Brustein, M. et Samaille, J. 1960. Sur un dosage rapide du cholestérol lié aux alpha et aux beta-lipoprotéines du sérum. *Clinica Chimica Acta*, 5, 609.
3. Cartier, P. and Picard, J. 1957. Etude comparée de quelques méthodes récentes de dosages des protéines dans les liquides biologiques. *Annales de Biologie Cliniques*, 15, 459.
4. Chapman, M. J. 1980. Animal lipoproteins: chemistry, structure and comparative aspects (Review) *Journal of Lipid Research*, 21, 789—854.
5. Dangerfield, W. G. and Faulkner, G. 1964. Estimation of serum lipoproteins using sulphated polysaccharides. *Clinica Chimica Acta* 10, 123—133.
6. Dyerberg, J. and Hjorne, N. 1970. Quantitative plasma lipoprotein estimation by agarose gel electrophoresis. *Clinica Chimica Acta* 28, 203—208.
7. King, E. J. 1951. Microanalysis in Medical Biochemistry, Churchill, London.
8. Mills, G. L. and Taylaur, G. E. 1971. The distribution and composition of serum lipoproteins in eighteen animals. *Comparative Biochemistry and Physiology*, 40 B, 489—501.
9. Nikolić, V. 1957. Belančevine u krvi čoveka, *PhD Thesis*, SAN.
10. Nikolić, V., Nikolić, B., Pavlović-Kentera, V., Perišić, V. 1958. Normalne vrednosti lipoproteida seruma. *Srpski Arhiv*, 7—8, 1—7.
11. Polonovski, J., Dupuis, J. et Jaöle, M. F. 1957. Etude de la réaction de précipitation de Kunkel on fonction de la concentration en chlorure de sodium. *Annales de Biologie Clinique* 7—9, 411—417.
12. Terpstra, A. H. M., Sanchez-Muniz, F. J., West, C. E. and Woodward, C. J. H. 1982. The density profile and cholesterol concentration of serum lipoproteins in domestic and laboratory animals. *Comparative Biochemistry and Physiology*, 71 B, 669—763.
13. Vitić, J. 1984. Comparative studies of the serum lipoproteins and lipids in some domestic and laboratory animals. *Acta Veterinaria*, 34, 307—322.



## PROTEINI, LIPOPROTEINI I LIPIDI KRVNOG SERUMA KOZA

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### SADRŽAJ

Ispitivani su serumski proteini, lipoproteini i lipidi koza pod fiziološkim uslovima. Dobijeni rezultati pokazuju da su vrednosti ukupnih lipoproteina, beta lipoproteina i holesterola u serumu koza statistički značajno niže nego kod ljudi, ali su u granicama normalnih vrednosti za lipide i lipoproteine domaćih životinja. Samo su vrednosti fosfolipida u granicama normalnih vrednosti fosfolipida ljudi. Serumski lipoproteini koza se pri elektroforezi u gelu agaroze razdvajaju na 4 frakcije koje odgovaraju beta, pre-beta, alfa i pre-alfa lipoproteinima u serumu ljudi. Glavni deo lipoproteina koza javlja se u obliku alfa lipoproteina (65—70%). Najveći deo fosfolipida (oko 70%) i oko 45% holesterola seruma koza nalazi se u lipoproteinskoj frakciji koja ima alfa i pre-alfa elektroforetsku pokretljivost.

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