

COMPARATIVE STUDIES OF THE SERUM LIPOPROTEINS AND LIPIDS IN DOMESTIC SWINE AND WILD BOAR

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The differences between the concentrations of serum lipoproteins and lipids of domestic swine and wild boar under physiological conditions, were investigated in this paper.

The results obtained demonstrate that the major part of the lipoproteins in domestic swine and wild boars consisted of beta lipoproteins (43–54%) and alpha lipoproteins (about 30%), as in man. The concentrations of total serum lipoproteins and beta lipoproteins did not differ between domestic swine and wild boar. However, wild boars had concentrations of serum cholesterol and serum phospholipids significantly lower ($p < 0,001$) than domestic swine.

The distribution of cholesterol and phospholipids between the various lipoprotein fractions of the sera of domestic swine and wild boars was similar to that found in humans. Most of the serum cholesterol (64,0% in swine and 70,0% wild boars) was in beta lipoproteins and most of the serum phospholipids (60,0% in swine and 71,0% in wild boars) were found in the high density lipoprotein fraction.

Key words: Lipoprotein, cholesterol, phospholipids, domestic swine, wild boar.

INTRODUCTION

The main interest in lipoproteins is focused on their relationship with atherosclerosis. The pathogenesis of atherosclerosis cannot be studied experimentally in man, so animal models are used for this purpose. Atherosclerosis research with animal models as it is known today is almost 85 years old (Ignatowsky 1908). Nonhuman primates and swine, whose dietary requirements resemble those of man, are suitable animal models for research on the cause and prevention of human atherosclerosis (Ratcliffe and Luginbuhl 1971, Wissler and Vesselinovitch 1978, Vesselinovitch 1979, 1988, Chapman 1980, Vitić 1984). Spontaneous atherosclerosis in swine has a localization and histopathology very similar to that in man (Luginbuhl and Stones 1965).

The aim of the present study was to examine the differences between the serum lipoproteins and lipids of domestic swine, wild boars and man under physiological conditions.

Special attention was paid to the lipoproteins which are precipitated with heparin - MnCl_2 and to the ratio of lipids in separated alpha and beta lipoproteins.

MATERIAL AND METHODS

The lipoproteins and lipids were studied in the sera of domestic swine ($n=40$) and wild boars ($n=45$).

The domestic swine (*Sus scrofa domestica*) were of the Swedish Landrace breed and kept at Omoljica Farm. Blood was obtained from apparently healthy animals by jugular vein puncture. The wild boars (*Sus scrofa*) were in the "Belje" game reserve. Blood samples were obtained immediately after the boar was shot, by means of heart puncture. Serum samples were obtained after allowing the blood to clot spontaneously at room temperature.

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

Paper electrophoresis (Nikolić et al. 1958) and agarose gel electrophoresis (Dyerberg and Hjorrtle 1970) were used to separate the serum lipoproteins.

The beta lipoprotein concentration was determined according to the procedure of Dangerfield and Faulkner (1964) and beta lipoproteins were isolated using the heparin- MnCl_2 method (Burstein and Samaille 1960). Cholesterol and phospholipid levels in the serum and in isolated beta lipoproteins were estimated as described by King (1951).

RESULTS

The concentrations of total lipoproteins and beta lipoproteins in the examined sera of domestic swine and wild boars were compared with the values obtained in normal human sera and are presented in Figure 1a and 1b. The results obtained show that domestic swine had mean concentrations of total lipoprotein which were significantly lower than in man ($p < 0.001$). However, wild boars had total lipoprotein levels comparable with that in man.

Figure 1b shows that domestic swine and wild boars had mean concentrations of beta lipoprotein which were significantly lower than in man ($p < 0.001$).

The mean concentrations of cholesterol in the serum of domestic swine and wild boars (Figure 2a) were significantly lower than in man ($p < 0.001$). However, wild boars had cholesterol concentrations significantly lower than in domestic swine ($p < 0.001$).

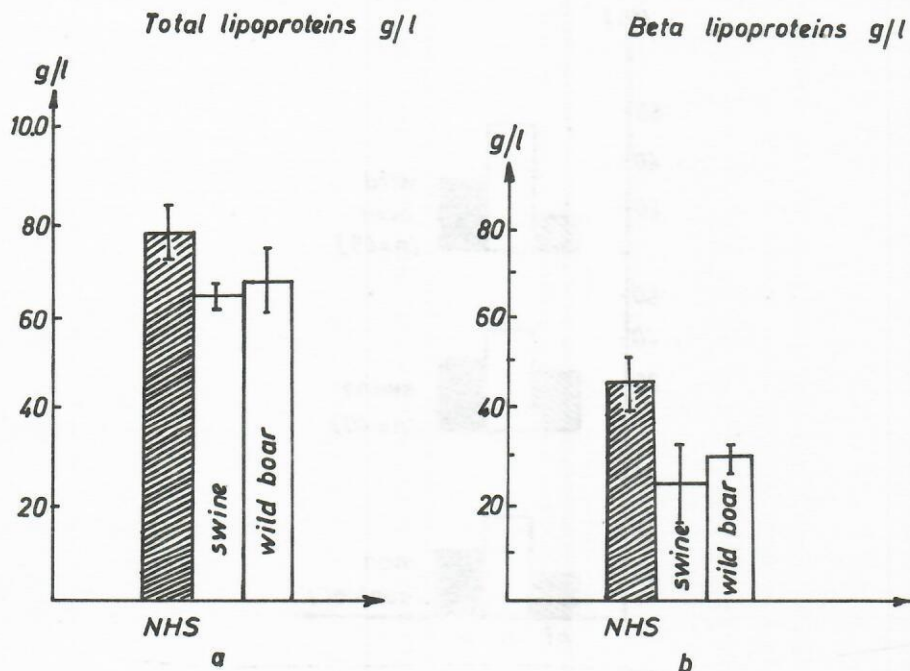


Figure 1. The concentrations of total serum lipoproteins (a) and beta lipoproteins (b) of domestic swine and wild boars. For comparison, the concentrations of total serum lipoproteins and beta lipoproteins in normal human serum is also presented.

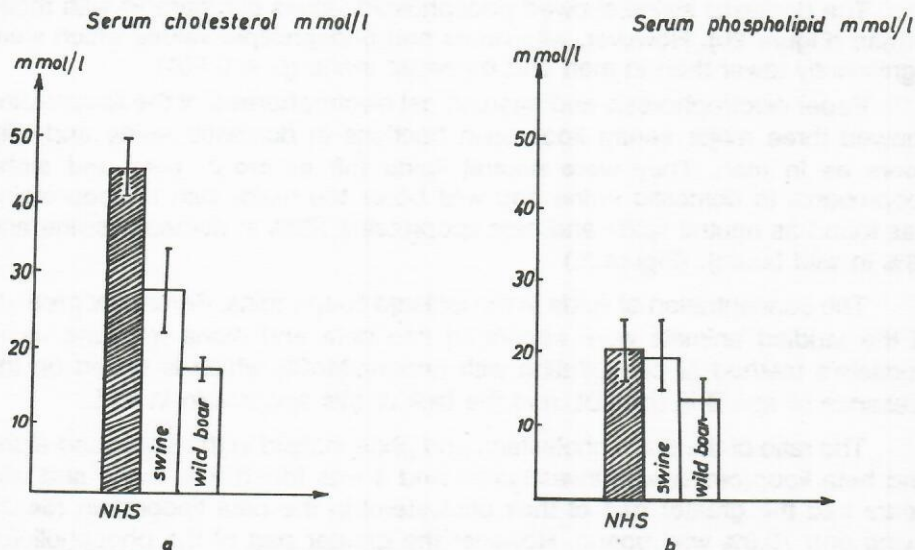


Figure 2. The concentrations of cholesterol (a) and phospholipid (b) in normal human sera and in sera of domestic swine and wild boars.

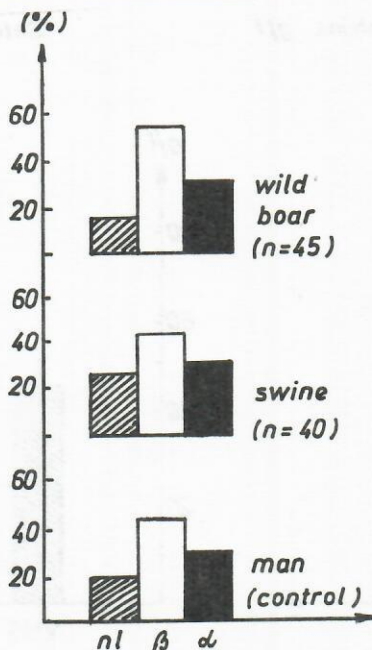


Figure 3. Relative contribution of the lipoprotein fractions separated by paper electrophoresis nl-neutral lipids, beta lipoproteins and alpha lipoproteins.

The domestic swine showed phospholipid values comparable with those in man (Figure 2b). However, wild boars had phospholipid values which were significantly lower than in man and domestic swine ($p < 0.001$).

Paper electrophoresis and agarose gel electrophoresis of the lipoproteins showed three major serum lipoprotein fractions in domestic swine and wild boars as in man. They were neutral lipids (nl) or pre- β , beta and alpha lipoproteins. In domestic swine and wild boars the major part of lipoproteins was found as neutral lipids and beta lipoproteins (69% in domestic swine and 68% in wild boars). (Figure 3.)

The concentration of lipids in the isolated lipoproteins. Serum lipoproteins of the studied animals were separated into beta and alpha fractions using Burstein's method of precipitation with heparin/MnCl₂ which is based on the presence of apo-B in the LDL and the lack of this apoprotein in HDL.

The ratio of the lipids cholesterol and phospholipid in the separated alpha and beta lipoproteins was investigated and it was found that swine and wild boars had the greater part of their cholesterol in the beta lipoprotein (64.0% swine and 70.0% wild boars). However the greater part of the phospholipids was found in alpha lipoproteins, namely, 60% in swine and 71% in wild boars (Table 1).

Table 1. The concentration of cholesterol and phospholipids in isolated beta and alpha lipoprotein and the relative amount of cholesterol in the isolated beta and phospholipids in the isolated alpha lipoprotein fraction

	C h o l e s t e r o l		in beta lipoprotein %	P h o s p h o l i p i d		
	in beta lipoprotein m mol/l	in alpha lipoprotein m mol/l		in beta lipoprotein m mol/l	in alpha lipoprotein m mol/l	in alpha lipoprotein %
man (control)	3.36±0.97*	1.11±0.07**	50—70	0.76±0.23	1.30±0.15	60
swine n=40	1.80±0.30*	0.97±0.25	64	0.82±0.30	1.20±0.30	60
wild boar n=45	1.20±0.15*	0.55±0.12**	70	0.50±0.20	0.98±0.16	71

*s.s. $p < 0.001$ **s.s. $p < 0.001$

DISCUSSION

The major part of the lipoproteins in swine and wild boars consisted of beta lipoproteins (43–54%) and alpha lipoproteins (about 30%), as in man. These results are in good agreement with data reported by other authors (Marcet et al. 1978, Chapman 1980, Jacobbsson 1986, Vitić et al. 1988) and demonstrate that swine have a lipoprotein distribution and composition similar to that of man and that the pig is a suitable animal model for studies of experimentally induced dyslipidaemia.

The values obtained for the components of the lipid and lipoprotein systems tested in domestic swine and wild boar sera are within normal limits for lipid and lipoprotein concentrations in animals (Alexander and Day 1973, Chapman 1980, Vitić 1984).

Swine have concentrations of total lipoproteins, beta lipoproteins, serum cholesterol and serum phospholipids significantly lower than man (Vitić et al. 1988). However, wild boars have, concentrations of serum cholesterol and serum phospholipids significantly lower than domestic swine.

The distribution of cholesterol and phospholipids between the various lipoprotein fractions of the sera of domestic swine and wild boars is similar from that found in humans. Most of the serum cholesterol (64,0% in swine and 70,0% wild boars) is transported in the low density lipoprotein fraction, most of the serum phospholipids (60,0% in swine and 71,0% in wild boars) are carried in the high density lipoprotein fraction.

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KOMPARATIVNO ISPITIVANJE LIPOPROTEINA I LIPIDA U SERUMU DOMAĆIH SVINJA I DIVLJIH SVINJA

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SADRŽAJ

Ispitivane su razlike između serumskih lipoproteina i lipida domaćih i divljih svinja pod fiziološkim uslovima. Dobijeni rezultati pokazuju da se najveći deo serumskih lipoproteina domaćih svinja i divljih svinja nalazi u obliku beta lipoproteina (43–54%) i alfa lipoproteina (oko 30%), kao kod čoveka.

Koncentracija ukupnih serumskih lipoproteina i beta lipoproteina se ne razlikuju kod domaćih i divljih svinja. Međutim, divlje svinje imaju koncentraciju serumskog holesterola i fosfolipida statistički značajno niže nego domaće svinje ($p < 0,001$).

Odnos holesterola i fosfolipida u lipoproteinskim frakcijama seruma domaćih i divljih svinja je sličan kao kod ljudi. Veći deo holesterola (64,0% kod domaćih i 70,0% kod divljih svinja) se nalazi u beta lipoproteinima dok se veći deo fosfolipida (60,0% kod domaćih i 71,0% kod divljih svinja) nalazi u alfa lipoproteinskoj frakciji.

