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Lactate Dehydrogenase Isoenzymes in Prostate and Testis of Wild Animals and Some Histological Remarks

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Summary. The lactate dehydrogenase (LDH) isoenzyme pattern of prostate and of testis of 27 wild animals showed that in several species more than 5 isoenzymes are detected, with electrophoretic mobilities different to those found in humans. The LDH-X band, found in testis from mature humans is also observed in the testis of wild animals. However, in several species more than one LDH-X is found. The results obtained demonstrate their usefulness in phylogeny. The prostate gland and testis of the chimpanzee show the greatest resemblance to man. Histological examination of the prostate glands seems to correlate with the phylogenetical classification of the mammals studied.

Key words: LDH isoenzymes – Prostate – Testis – Wild Animals – Histology

Introduction

The lactate dehydrogenase (LDH) isoenzyme pattern in human prostate and testis is well known and fully documented. We report results obtained from the tissues of 27 wild animals and comment on the histological appearances of the prostate glands. Incidental findings of prostatic pathology in the animals were recorded. The results obtained may contribute to the comparative histology and biochemistry and demonstrate their use in phylogeny.

Material and Methods

Prostate and testis were obtained from wild animals of the Zoological Garden of Antwerp, Belgium. The animals died from natural causes, and mostly from artheriosclerotic complications. Autopsy was carried out as soon as possible and the tissues stored at −20 °C. The animals from which we could study the LDH-zymogram in prostate and testis tissue are recorded in Table 1.

Homogenates were made following Van Camp's technique [2]. After centrifugation at 50,000 x g, during 60 min at 4 °C, the clear supernatant was submitted to electrophoresis in agar gel (pH: 8.4; μ: 0.05) on microscopic slides as described by Wieme [4]. A reference mixture, composed of human albumin (A), siderophilin (S) and Macrodex (M), a depolymerized dextran, was run with each sample. The LDH-isoenzymes were visualized on the slide with a nitroblue tetrazolium salt using lactate as substrate, following the method of Van der Helm [3]. The LDH-isoenzymes patterns were evaluated with a Beckman (Fullertown, California, USA) scanner for paper electrophoresis, adapted by us for microscopic slides.

Histological examination was carried out with standard techniques.

Results

The results of the LDH-zymograms obtained are schematically represented in Fig. 1. The prostatic homogenates showed that for several wild animals more than five LDH-isoenzymes are obtained. This was probably not due to the formation of isoforms of one (or more) of the classical five isoenzymes. Furthermore, the electrophoretic mobilities of the isoenzymes were different from those observed in humans. As might be expected, the LDH-isoenzymes of the testis of a given mammalian species have the same number of isoenzymes with the same mobility as the isoenzymes of the prostate. In mature animals, the LDH-X, first described in humans by Blanco and Zinkham [1], was present, but in several species more than one LDH-X band was observed.

The quantitative patterns of the LDH-isoenzymes, obtained after scanning, of prostate and testis tissue were different. Some examples are represented in Fig. 2.

On histological examination of prostatic, tissue comparison of the wild animals studied showed great histological differences in the ratio of glandular, connective and muscular tissue.

In the order of the marsupiala the prostate is composed of tubular glands in a parallel arrangement and of hard interstitial and muscular tissue.

Table 1. Wild animals, from which the LDH-isoenzymes have been studied in prostate and testis

Species studied	
Subclass:	
Metatheria or Marsupialia	*Macropus ruficollis benneti Waterhouse*
Subclass:	
Eutheria or Placentalia	
Edentata	*Manis gigantea Illiger*
Rodentia	
Suborder: Simplicidentata	
fam.: Hystricidae	*Hystrix cristata Linnaeus*
Carnivora	
a) Fissipedia	
fam.: Ursidae	*Thalarctos maritimus (Phipps)*
Felidae	*Felis tigris Linnaeus*
b) Pinnipedia	*Phoca vitulina Linnaeus*
Suborder: Ungalata	
Proboscidea	*Elephas maximus Linnaeus*
Perissodactyla	
fam.: Tapiridae	*Tapirus terrestris (Linnaeus)*
Artiodactyla	
a) Suborder: Neobunodontia	
fam.: Suidae	*Sus scrofa Linnaeus*
b) Suborder: Selenodontia	
fam.: Cervidae	*Rangifer tarandus (Linnaeus)*
	Sika nippon (Temminck)
	Dama dama (Linnaeus)
	Elepharus davidianus Milne-Edwards
Bovidae	*Cephalorus dorsalis (Gray)*
	Bison bonasus Linnaeus
	Tragelaphus spekii Sclater
	Capra hircus Linnaeus
	Ovis musimon (Pallas)
	Bos indicus Linnaeus
	Ovis aries Linnaeus
	Boocercus urycerus (Ogilby)
	Ammotragus lervia (Pallas)
	Bos taurus Linnaeus
Primates	
Suborder: Anthropoidea	
Superfam.: Platyrrhina	*Lagothirx humboldti Geoffroy*
fam.: Cercopithecidae	*Macaca maurus Cuvier*
Anthropomorphidae	*Piliocolobus Kirki (Gray)*
	Pan satyrus schweinfurthii (Giglioli)
Hominidae	*Homo sapiens*

In the prostate of *Euphractus sexcintus (Linnaeus)* and *Manis gigantea Illiger* (Edendata) the glands were of the acinic type but connective and muscular tissue was absent.

With *Hystrix cristate (Linnaeus)* (Rodentia) branching of the glands and muscular tissue arrising from the capsule and forming downgrowths into the underlying glandular tissue, were evident.

With the Fissipedia, a tissue pattern appeared which resembled human prostate, except that the muscular component predominated. *Phoco vitualina Linnaeus* on the contrary showed a predominance of connective tissue.

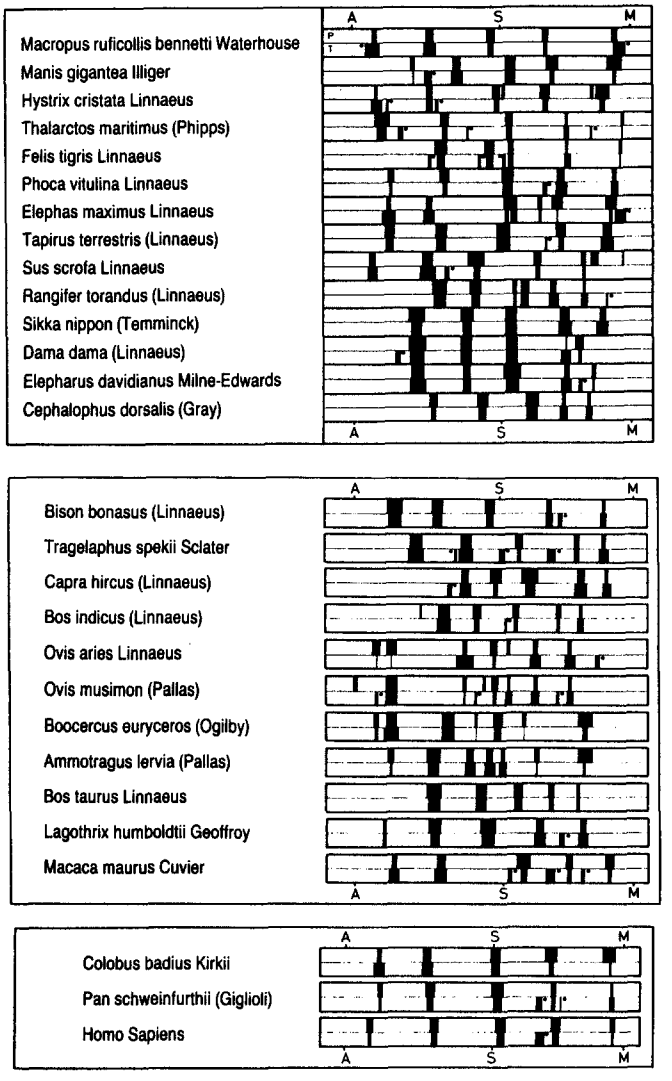

Fig. 1. Schematic representation of the LDH-isoenzymes found in prostate (P) and testis (T) of wild animals. A is standing for human albumin, S for siderophilin and M for Macrodex (electrophoretic mobility zero). The LDH-X fractions in testis are indicated with •

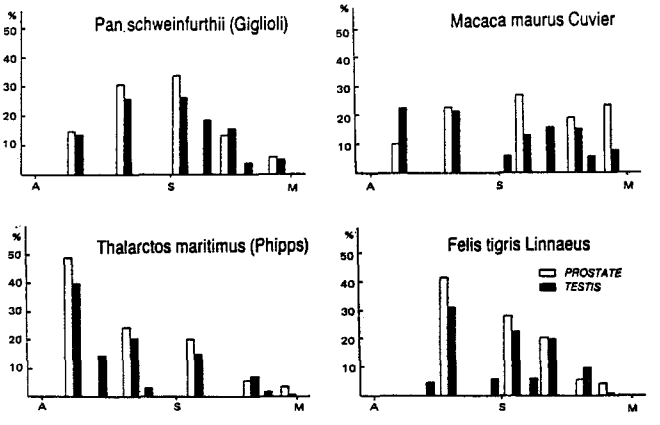

Fig. 2. Diagrams comparing the relative values of the LDH-isoenzymes from prostate and testis tissue of four wild animals. A is standing for human albumin, S for siderophilin and M for Macrodex. Results are obtained after scanning of the nitroblue tetrazolium stained isoenzymes

The prostate of a four month old elephant showed very clearly the simultaneous differentiation of glandular acini and surrounding connective tissue. An analogous phenomenon arose in the prostate of *Tapirus terrestris (Linnaeus)*: here each acinus was surrounded by a larger mass of muscular fibres.

With the artiodactyla a new feature appeared: the glandular acini were grouped into lobuli by septa of connective tissue. Glandular tissue was predominant and showed – especially with the cervidae – a very important secretory activity similar to the histological picture of adenoma in man.

The prostate gland of the Anthropoidae finally showed a distinctive microscopic appearance, very similar to the human prostate: division in lobes and lobules, a more or less extensive branching of the draining ducts into tubelo-secretory units – for instance *Lagothrix humboldti Geoffroy* and *Macaca maurus Cuvier* (little branching); *Piliocolobus Kirkii* (Gray) and *Pan schweinfurthii (Giglioli)* (much branching) – and a disposition of the fibromuscular stroma, both between and within the lobules and acini. The prostate of the chimpanzee showed the greatest ressemblance to the prostate of man.

Discussion

Notwithstanding the fact that the number of wild animals we were able to study for their LDH-pattern in prostate and testis is rather limited, we believe that the results obtained may contribute to comparative biochemistry and are useful in phylogeny. The most striking facts are: a) that in several species more than five LDH-isoenzymes could be detected. We do not have any evidence that any of these fractions are isoforms of one of the classical five isoenzymes; b) that although in humans only one LDH-X is found in testis, in most sexually mature animals more than one "testicular" fraction is observed. Even in testicular tissue of the cimpanzee, a supplementary LDH-X is found, although in this species the prostatic LDH-isoenzyme was very similar to that found in the human. The reason for the heterogeneity of LDH-X in animal testis was not clear.

The same parallels were valid for our histological observations. Although we did not have at our disposal a prostate of each family (fam.) of the mammalian class, we were able to recognize in our series from histological sections a development line, which, to a certain extent, seemed to correlate with the phylogenetical classification of the mammals.

It should be stated also that prostatic pathology occurred within the class of the mammalia. In the suborder Selenodentia, we found cases of prostate infections: subacute prostatitis, tuberculous prostatitis, prostate adenoma and prostate atrophy.

In summary, the results of our study seem very promising, and examination of more prostate and testis of wild animals may contribute to the comparative histology and biochemistry and may be of use in phylogeny.

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