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The Activity of Plasma Pseudocholinesterase in the Arabian Camel (*Camelus dromedarius* L.) in Comparison to other Animal Species

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ABSTRACT. The activity of pseudocholinesterase (PCHE) was measured in the plasma of healthy male and female Arabian camels (*Camelus dromedarius*), cattle (*Bos aurus*), sheep (*Ovis aries*), goats (*Capra hircus*), horses (*Equus caballus*), bustards (*Chlamydotis undulata macqueeni*), and rats (*Rattus norvegicus*). The PCHE activity in both male and female Arabian camels increased by about 40% with age. There were no differences in PCHE activity between young and old, or between male and female camels. The enzyme activity was about 90% greater in 6-month old female rats than in male rats of the same age. It was also higher in bustards and horses than in the ruminants studied, including the Arabian camel.

Pseudocholinesterases (PCHE) which hydrolyze acetylcholine, represent an important group of related enzymes found in the serum, plasma, and other animal and human tissues. Moreover, they may act on substrates such as butyl and other acyl thiocoline and choline esters (Kachman and Moss 1976, Zimmerman and Henry 1984). PCHE serum level is of importance in the diagnosis of cholinesterase inhibition disorders, such as organophosphate pesticide exposure, especially in farm animals (Khan 1973, Mosha 1993). However, physiologically low serum cholinesterase levels were observed during pregnancy (Richterich 1961). Serum cholinesterase levels are also lower in hepatic diseases, active infections, muscular dystrophy, renal diseases, pulmonary emboli, and myocardial infarctions (Richterich and Colombo 1981, Zimmerman and Henry 1984).

Running Title: Plasma Cholinesterase in Arabian Camels
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Although data are available on the enzyme activity in many domestic animals (Brankow *et al.* 1972, Halbrook 1992, Kamban *et al.* 1993) there are few reports on the activity of PCHE in animals in tropical regions (Botros *et al.* 1970, Onyeyili *et al.* 1992), especially camels (Ali and Hassan 1986, Shaker *et al.* 1989).

The present study was undertaken to provide reference values regarding the PCHE activity in Arabian camels of both sexes and of various age groups for comparison with other domestic animals, laboratory rats, and humans.

Materials and Methods

Animals

Male and female Arabian camels (3-6 months, and < 4 years old), cattle (< 4 years old), sheep and goats (2-3 years old), and horses (6 years old) were housed at three farms around the Al-Ain area, UAE. They were fed *ad libitum* on dried hay, green *alfa alfa,* and pelleted concentrates. Bustard (Kori) birds (> 6 years old) were obtained from the Al-Ain zoo, and were fed standard poultry feed (Abu Dhabi Flour and Animal Feed Factory) supplemented with green vegetables and fruits. Wistar rats were obtained from the UAE University Animal House, Al-Ain, and were fed a standard pelleted rat food (Abu Dhabi Flour and Animal Feed Factory). Water was provided *ad libitum* to all animals.

Procedures

Blood was collected from the jugular vein (camels, cattle, horses, sheep and goats), from the wing vein (bustard), or from the trunk after swift decapitation (rats). Blood was collected between 8:00 and 9:00 a.m. into test tubes containing EDTA as an anticoagulant. The blood was immediately centrifuged at 900 g (and 5 °C) for 10 min and the plasma was analyzed for PCHE using an Autoanalyzer (Dimension, Du Pont, U.S.A.) and kits supplied by the manufacturer. The substrate used was butyrylthiocholine.

Statistical analysis

Results are expressed as means ± standard error of the mean (s.e.m.) Differences between the means of the various animal species were assessed by a one-way analysis of variance (ANOVA) followed by a multiple comparison test. Differences between males and females of the same species were assessed using Students' t-test. A P value < 0.05 was considered significant.

Results

The activity of plasma PCHE in the animal species studied are listed in Table (1). The differences in enzyme activity between male and female and young and old camels were not statistically significant. However, the PCHE activity in camels increased significantly with age in both sexes ($P < 0.05$). In adult rats however, the enzyme activity in females was about 1.8 times higher than that in males of the same age (Fig. 1).

Table 1. Pseudocholinesterase activity in serum from camels, cattle, sheep, goats, horses, bustards (Kori birds), and rats

Animal	Activity u/L
Camels:	
males, 3-6 months	548.19 ± 6.51 (54)
females, 3-6 months	516.79 ± 5.91 (54)
males, > 4 years	762.19 ± 9.51 (108)
females > 4 years	723.05 ± 11.07 (108)
cattle (males and females, > 4 years)	680.46 ± 11.58 (108)
sheep (males and females, > 4 years)	572.00 ± 14.49 (41)
goats (males and females, > 4 years)	568.27 ± 11.32 (41)
horses (males and females, > 4 years)	9465.10 ± 316.50 (25)
bustards (males and females, > 4 years)	4660.95 ± 247.18 (37)
rats:	
males, 1 months	671.00 16.51 (10)
females, 1 months	669.92 ± 17.81 (10)
males, 6 months	631.11 ± 13.60 (20)
females, 6 months	1198.31 ± 91.20 (30)

Values in the table are mean ± s.e.m. (number of animals)

The PCHE activity was of similar magnitude in both males and females of all domestic animals tested, with the exception of horses and bustards, where it was 12 times and 6 times greater, respectively.

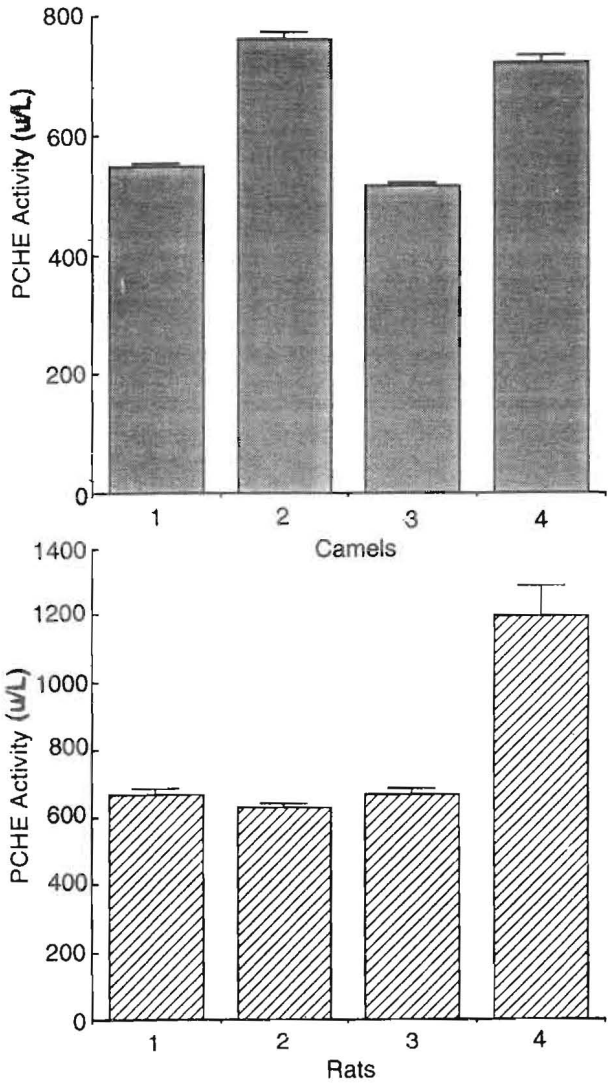

Fig. 1. Pseudocholinesterase activity in plasma of Arabian camels (upper panel) and rats (lower panel). In camels, the enzyme activity in males aged 3-6 months (column 1) is not significantly different from that of females of the same age (Column 3), but was significantly lower than the activity in male (column 2) and female (column 4) aged > 4 years. In rats the enzyme activity in males and females aged 1 month (columns 1 and 3, respectively) is not significantly different from that in male rats aged 6 months (column 2) but is significantly lwoer than that in females aged 6 months (column 4). Each column and vertical bar represent mean ± se.m.

Discussion

Unlike humans, where PCHE activity has been reported to be higher in males than in females (Prellwitz *et al.* 1976). The present results showed a higher PCHE activity in female rats than in males; however, no variations were observed in the enzyme activity between males and females of the ruminants examined. The enzyme activity in horses and bustards was much higher than in the ruminants. However, comparison of the present results with those reported in the literature is not practicable due to the variations in the methods of analysis and in the types of the substrates used by various workers.

The enzyme activities in all the ruminants studied were of the same magnitude and were significantly less than in bustards or horses. However, the enzyme activity in humans can reach values higher than those in the horse. (Anonymous 1990). This may indicate that the ability of ruminants to metabolize choline esters may be less than in humans, horses, or bustard birds. This could also mean that ruminants may be more susceptible to cholinesterase inhibition by organophosphorus pesticides. The present results provide, for the first time, reference values for PCHE activity in Arabian camels.

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نشاط أنزيم أسيتايل كولين أستريز (Pseudocholinesterase) في بلازما الابل العربية : دراسة مقارنة مع ٥ أنواع أخرى

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تُعتبر مجموعة أنزيم أستايل كولين أستريز من الانزيمات الهامة في الدم والأنسجة الأخرى إذ أنها تقوم بالتحليل المائي لمادة أستايل كولين وبعض الكولينات الأخرى وأستيرات الكولين . ويستخدم قياس نشاط هذه المجموعة من الأنزيمات في السيرم والبلازما لتشخيص وعلاج بعض الأمراض (مثل أمراض الكبد والكلى) وحالات التسمم التي تؤثر على الأنزيم عند تعرض الانسان والحيوان للمبيدات الحشرية خاصة من نوع المركبات الفسفورية العضوية . ينخفض معدل نشاط الأنزيم عند الأصابة بامراض أخرى مثل أمراض الكبد والكلى وغيرها .

في هذه التجربة تم قياس معدل نشاط أنزيم استيكل كولين استريز في بلازما الدم في عدد من الحيوانات المختلفة شملت ذكور وإناث الابل والأبقار والأغنام والماعز وطيور الحباري والجرذان .

وُجد في هذه الدراسة بأن معدل نشاط الأنزيم في ذكور وإناث الابل كبيرة السن يفوق معدله في صغارها بنسبة ٤٠٪ . ولم يلاحظ أي فرق في معدل نشاط الأنزيم في بلازما الابل من الجنسين وفي نفس السن ، بينما وُجد أن نشاط الأنزيم في صغار إناث الجرذان (عمر ٦ شهور) يفوق النشاط الموجود

في صغار ذكور الجرذان (من نفس العمر) بنسبة ٩٠٪ . خُلصت هذه الدراسة أيضاً إلى أن نشاط أنزيم أسيتايل كولين أستريز في ذكور الجرذان (عمر شهر واحد) لا يختلف عنه في الإناث من نفس العمر .

أثبتت المقارنة في نشاط الأنزيم المقاس في الحيوانات المذكورة انفاً أن أعلى معدل لنشاط الأنزيم كان في الخيول وطيور الحباري تلتها الابقار ثم الإبل ثم الأغنام والماعز . وكان معدل نشاط الأنزيم في النوعين الأخيرين متقارباً جداً .