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DISTRIBUTION OF ARGINASE IN TISSUES OF CAMEL (*Camelus dromedarius*)

N. Razmi, S. Nazifi and Gh. Motaalleh
Department of Basic Sciences, School of Veterinary Medicine,
Shiraz University, P.O.Box 1731, Shiraz 71345, IRAN

Arginase (*L - arginine amidinohydrolase*), which catalyses the hydrolysis of L - arginine into L - ornithine and urea, was first detected in mammalian livers as the terminal enzyme of the urea cycle (Greenberg, 1960). Arginase activity occurs also in other tissues, which are devoid of a complete urea cycle (Pohjanpelto and Holtta, 1983; Skoy *et al*, 1981; Schneider and Dy, 1985). In the later instance, the importance of arginase may be in the production of ornithine for the synthesis of the polyamines putrescine, spermidine and spermine, which are required for normal cellular proliferation (Pegy and McCann, 1982; Tobor and Tobor, 1981) and differentiation (Pegg, 1986). Arginase activity at the site of wounds plays a role in the recovery of host tissues from inflammation and infection (Guoyao *et al*, 1998). The distribution of arginase between the organs of normal human (Reyero and Doner, 1975; Spector *et al*, 1982, 1983; Zamecka and Porembska, 1988) and domestic animals (Aminlari and Vaseghi, 1992) has been studied. There is little recent further information on the distribution of arginase activity in the tissues of the camel, apart from the report on arginase distribution in tissues of domestic animals by Aminlari and Vaseghi (1992) that the number of camels and tissues was limited. The purpose of this investigation was to examine and compare the tissue distribution of arginase in camel. The results of these studies will help to assess the role and significance of arginase in different tissues of camel. Serum enzymes are monitored routinely in camels to detect and assess damage to various organs. This study would assist the rational interpretation of serum arginase data in camel.

Materials and Methods

Ten apparently healthy camels (*Camelus dromedarius*), 3 to 6 years old, were slaughtered at the slaughter house located at Fars province in the south of Iran. Immediately after slaughter, 200 tissue samples were obtained from liver, kidney, lung, heart (atrium and ventricle), skeletal muscle, spleen, brain, lymph node (prescapular and mesenteric), rumen, reticulum, abomasum (fundus and pylore), duodenum, jejunum, ileum, caecum, colon and rectum. All samples, kept on ice, were transferred to the laboratory within 45 minutes; tissues were separated, stripped from fat and extraneous materials, washed a few times with physiological saline and then blotted.Tissue extracts were prepared by freezing 1 gram of the sample in liquid nitrogen, homogenising with a hand - homogeniser and suspending the homogenate in 4 milliliters of 0.025 M sodium phosphate buffer, pH 7.2. The suspensions were centrifuged for 15 minutes at 4000 x g in an MSE high-speed refrigerated centrifuge. The super- natants were used as the source of enzyme. The activity of arginase was measured by modified p-nitrophenyl glyoxal (PNPG) method. Arginine reacted with PNPG in 0.1 mol/lit sodium pyrophosphate / 0.25 mol/lit sodium ascorbate, at pH 9.0 and 37°C to produce a coloured compound which absorbed maximally at 480 nm with a molar extinction coefficient of 2.6×10^3 M/cm. The maximum absorbance was obtained after 30 minutes. The reaction described above was used to determine arginase activity in tissue extracts. Protein concentration in the crude extracts of different tissues was measured by the method of Lowry *et al* (1953). The data were analysed statistically by analysis of variance (ANOVA). The differences between the means were statistically estimated by the Duncan's test. All values were expressed in mean (± SEM) using a significant level of $p < 0.05$ (Norusis, 1993).

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Results

The specific activity of arginase in different tissues of dromedary camel is shown in table 1. All tissues contained different amounts of arginase activity. The highest activity of arginase was observed in liver. The specific activity of arginase in liver was significantly different ($P < 0.01$) from the other tissues.

Table 1. Mean (± SEM) of the specific activity of arginase in the crude extracts from different tissues of camel (n = 10).

Tissues	Specific activity of enzyme (IU/mg protein)
Liver	0.567 (0.012)
Kidney	0.024 (0.010)
Lung	0.022 (0.009)
Heart atrium	0.016 (0.005)
Heart ventricle	0.014 (0.008)
Skeletal muscle	0.008 (0.004)
Spleen	0.009 (0.002)
Brain	0.043 (0.009)
Lymph node, prescapular	0.015 (0.006)
Lymph node, mesenteric	0.005 (0.002)
Rumen	0.023 (0.005)
Reticulum	0.018 (0.006)
Abomasal fundus	0.011 (0.004)
Abomasal pylore	0.014 (0.004)
Duodenum	0.008 (0.002)
Jejunum	0.011 (0.005)
Ileum	0.007 (0.004)
Caecum	0.023 (0.003)
Colon	0.014 (0.003)
Rectum	0.015 (0.001)

*Value of this tissue is significantly different from all other tissues ($P < 0.01$).

Discussion

Liver was the richest source of arginase in adult dromedary camels. The role of arginase in the metabolic life of cells has generally been considered in terms of its function in the urea cycle In mammals, the liver is the organ in which a full urea cycle is functional (Greenberg, 1960). The highest rates of arginine synthesis occur within the hepatic urea cycle, which is localised within periportal hepatocytes. Net arginine synthesis by the liver is only possible if the urea cycle is replenished by necessary intermediates, such as ornithine. The urea cycle enzymes are also organised in a metabolon, whereby the product of each enzymic reaction is efficiently channelled to the next enzyme in the pathway. Thus the tight channelling of metabolites and the very high level of arginase in hepatocytes result in little or no net production of arginine by the liver (Guoyao *et al*, 1998). Our data show that besides liver, some other tissues of camels (kidney, lung, brain) show low activity of arginase. The presence of arginase in extrahepatic tissues might indicate that these tissues use arginase for purposes other than urea synthesis. Approximately 60% of net arginine synthesis in adult mammals occurs in the kidney (Guoyao *et al*, 1998). Arginine serves as the sole source of ornithine which, in turn, can be metabolised to either proline or glutamate. Arginase can therefore function physiologically in the metabolism of arginine to proline and/or glutamate. Ornithine is also important as a precursor for polyamine biosynthesis which is necessary for cell division and differentiation (Pegg, 1986). Such functions might be significant in the brain (Vanella *et al*, 1979). A high arginase level in brains of domestic animals might be due to its role in this regard (Aminlari and Vaseghi, 1992). Our data show the presence of arginase in different parts of the the digestive system of camels, albeit at very low levels. Although the rumen of camel contains some arginase, it probably does not play a significant role in ammonia detoxification as compared with liver. As liver is the richest source of arginase, it would be expected that arginase renders a suitable candidate for liver function tests in camels.

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