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Cyanide-Metabolizing Enzymes in Camels (*Camelus dromdarius*)

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Abstract: Hydrogen cyanide is a commonly occurring and highly toxic material. Detoxication of cyanide is catalysed by two enzymes, Rhodanase (Thiosuphate: cyanide sulphur transferase, (E.C 2.8.1.1) and 3-mercaptopyruvate sulphurtransferase (3-MST, EC. 2.8.1.2). Analysis of the two enzymes in the tissues of camels resulted in high activity of rhodanese in liver, almost three times that in the kidney, followed by kidney, spleen and muscles. The activity of mercaptopyruvate was also higher in the liver.

Key words: Camel, cyanide, enzymes, sulfer, thiosulfate, mercaptopyruvate

INTRODUCTION

Cyanide is known to be one of the most toxic substances present in a wide variety of food materials that are consumed by man and animals. Animals may be exposed in their food to cyanogenic glycosides that can cause cyanide toxicity.

Small quantities of cyanide are physiologically detoxified in the animal body to the less toxic thiocyanate. This conversion is considered to be the main pathway for cyanide detoxication (Mintel and Westly, 1966) and is catalysed by two enzymes, Rhodanase (Thiosuphate: cyanide sulphur transferase, E.C 2.8.1.1) and 3-mercaptopyruvate sulphurtrandferase (3-MST, EC. 2.8.1.2). The two enzymes differ in their substrates (Aminlari *et al*., 1996) and pattern of distribution in different tissues of domestic mammals (Aminlari and Gilanpour, 1991). The activity of the enzyme in a particular tissue may reflect the ability of that tissue to detoxify cyanide. The present study was conducted to measure the activities of the two enzymes in different tissues of the camel.

MATERIALS AND METHODS

Animals: Tissue samples of liver, kidney, spleen and thigh muscle of camel were obtained from freshly killed animals al local abattoir. Tissue samples obtained were rinsed in ice-cold normal saline (0.9% Nacl) and frozen at 20°C for 3 days before being analyzed.

Tissue preparation: Tissues were thawed and homogenized in 19 volume of ice cold 0.2 M phosphate buffer PH 7.4 for the rhodanese assay or in 19 volume of ice cold tris-Hcl buffer, pH 7.4 for 3-MST assay. Homogenization was carried out in the Virtis homgeniser. The homogenates were diluted further with 0.125 M thiosulphate.

Rhodanese assay: Rhodanese was assayed according to the method of Sorbo (1951, 1953) in which rhodanese activity is conveniently followed by the production of thiocyanate from thiosulphat and cyanide which is read at 460 nm on spectrophotometer $CN^- + S_2O_3$ $CNS^- + SO_3^{2-}$.

Protein in the homogenate was determined by the microbiuret method described by ltzaki and Gill (1964).

MST assay: This enzyme was assayed according to the spectrophotometric method of Taniguchi and Kimura (1974), where the absorbance is measured at 460 nm.

Protein assay: This was measured by the method of Lowry *et al*. (1951), using bovine serum albumin as the standard.

RESULTS

Distribution of rhodanese activity in the camel are shown in Table 1.

The highest activity of the enzyme was found in the liver, approximately 3 times that in the kidney. The activity is lower in the spleen followed by the muscles rhodanese activity in the liver was significantly higher ($p<0.01$) than in other tissues.

Table 2 shows the distribution of 3 MST activity in camel tissues. The highest activity of the enzyme was

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Table 1: Activity of rhodanese in different tissues of camel

Tissue	No. of observations	Rhodanese activity
Liver	15	15.86±1.12
Kidney	12	5.45±0.65
Spleen	12	2.24±0.32
Muscle	6	0.68±0.08

Table 2: Activity of 3-mercaptoyruvate sulphurfransferase

Tissue	No. of observations	3-merceptoyruvate activity
Liver	15	0.26±0.07
Kidney	12	0.18±0.04

Values are means±SD

found in the liver followed by the kidney but unlike the activity of rhodancse the higher activity of 3-MST in the liver was not significant compared to the kidney.

DISCUSSION

Distribution of rhodanese activity in camel tissues of animals was studied by several workers (Himwich and Saunders, 1948; Reinwein, 1961; Oh *et al*., 1977). Because of the intramitochondrial localization (Koj *et al*., 1975) of rhodanese, different procedures for the enzyme assay were used by workers. The enzyme will be released when the mitochondrial memberane is disrupted by freezing, action of detergent, hypotonicity or sonication (Sorbo, 1975; Mousa, 1982).

The results in camel tissues agreed with original research of Lang (1933), who indicated that rhodanese activity exists in all mammalian tissues except the blood. Rhodanese activity in the liver of different species was not found to be the same. The highest activity was in the liver of rat, rabbit, quiuea pigs, horse, pig, man, sheep, cow, foul and dog (Himwich and Saunders, 1948; Drawbaugh and Marrs, 1987).

The activity 3-MST was lower than that of rhodanese in all the tissues examined in this study. The highest activity of the 3-MST in the liver followed by the kidney was found to be the same as that obtained by Al-Qarawi *et al*. (2001), when studied the specific activity of 3-MST in camel, cattle, sheep tissues and found that the highest activity was found in the liver.

The highest activity of the two enzymes was found in the liver. This reflects the importance of the liver in cyanide detoxication.

In addition to their role in the conversion of cyanide to thiocyanate, rhodanese and 3-MST also catalyse other biologically important reactions such as the formation of an iron sulphur chromophore of ferrodoxin, an impotant component of the respiratory chain and overall metabolism of sulphur (Taniguchi and Kimura, 1974). One biological function of 3-MST nay be to contribute to the endogenous sulphaur sulphur pool by forming persulphides (Westley, 1973). As it is known that the level of rhodanese in any particular organ reflects the ability of that organ to detoxify cyanide (Aminlari and Shahbazi, 1994; Lewis *et al*., 1992).

CONCLUSION

In this study, cyanide detexi cation depends on the bioavailability of suitable sulphur donors rather than on the mere presence of the detexication enzymes and/or their intra cellular distribution.

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