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Changes in Liver and Kidney Arginase Activities of Geese After Experimental Tissue Damage

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Summary

The changes in arginase activity in the liver and kidney of geese were investigated through long-term treatment with carbon tetrachloride (CCl_4) and ethanol (C_2H_5OH). Compared to the control group, arginase activity in the kidneys and liver of the CCl_4 treatment groups was found to be significantly decreased. Arginase activity in the kidney of the ethanol treated group was found to be significantly increased, whereas no significant differences were found in the hepatic arginase activity.

These results show that arginase activity in the liver and kidney of geese is affected by cell damage. The kidney arginase is more sensitive than the liver arginase to cell damage.

Keywords: Arginase, carbon tetrachloride, alcohol, geese

Deneysel Olarak Doku Dejenerasyonu Oluşturulmuş Kazlarda Karaciğer ve Böbrek Arginaz Aktivitesi Değişimleri

Özet

Uzun süre karbon tetraklorür (CCl_4) ve etanol (C_2H_5OH) verilen kazlarda karaciğer ve böbrek arginaz aktiviteleri incelendi. CCl_4 verilen gruptaki böbrek ve karaciğer arginaz aktiviteleri kontrol grubu ile karşılaştırıldığında önemli derecede düşük bulundu. Etanol verilen grupta ise böbrek arginaz aktivitesi önemli derecede yüksek bulunurken karaciğerde önemli derecede değişiklik gözlenmemiştir. Sonuçta, karaciğer ve böbrek hücrelerinin zarar gördüğü, arginaz aktivitesinde de değişim olduğu ve bu değişimde böbreklerin karaciğere göre daha fazla etkilendiği görülmüştür.

Anahtar sözcükler: Arginaz, karbon tetraklorür, alkol, kaz

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INTRODUCTION

Carbon tetrachloride and ethanol causes hepatotoxicity by interacting with several important cell molecules and by inhibiting crucial metabolic processes[1-4]. The reactive oxygen species are among the substances produced by the administration of carbon tetrachloride and ethanol that directly or indirectly participate in the damage caused on hepatic tissue and kidney[2-5].

Chickens, and birds in general, are said to be uricotelic. In the liver of the ureotelic animal, the enzymes of the urea-ornithine cycles are directly regulated by alterations in the dietary intake of protein[6,7]. The terminal enzyme of this cycle, arginase (EC 3.5.3.1), which catalyzes the formation of ornitine and urea from arginine, is present in the cytosol of the hepatic cell[8,9]. Tamir and Ratner[10] have reported that chicks (gallus gallus) have a limited capacity to convert citrulline to arginine by means of argininosuccinate formation in the kidney, but not in liver and have an incomplete ure-ornithine cycle in kidney. Arginase activity in chickens is found primarily in the kidney, with very low activity of this enzyme present in liver[6].

As the liver is the main site of ethanol and carbon tetrachloride biotransformation and a target organ of the xenobiotic[11,12], and the kidney is the main site of toxic mater accumulation And a target organ of the metal[12-14], in the present study we have investigated the arginase activity of both organs in geese simultaneously exposed to CCl_4 and ethanol.

MATERIALS and METHODS

Forty geese (3 weeks old and weighing 200-250 g) were divided randomly into four groups. The animals were fed with standard pellet diet NRC[15]. All of the geese had free access to pellets of control diet and water ad libitum. The first group was used as control, the second was fed with CCl_4 (1 ml/kg bw) third was fed with (1.5 ml/kg bw) CCl_4 and fourth group was given ethanol 1:1 w/w (5 ml/kg bw) tree times a week for 12 weeks.

After 12 weeks of exposure, all of the geese were slaughtered under chloroform anaesthesia and their livers and kidneys were immediately excised. Thiosemicarbazide diacetylmonoxime urea (TDMU) method[16] for arginase and Lowry method[17] for tissue protein were used. One unit of arginase activity was defined as the amount of enzyme catalysing the formation of one μmole of urea h^{-1} at 37°C. The results are given as units/mg of protein.

Results of the experiment were evaluated statistically by the Student's t- test. The data were analysed by one-way ANOVA technique and means were considered different at $P<0.05$, $P<0.01$.

RESULTS and DISCUSSION

Table I clearly shows that arginase activity in liver and kidney was decreased significantly by the administration of CCl_4. It was decreased 2.1 to 2.6 fold in kidney, 1.3 to 1.8 fold in liver. Arginase activity in the liver was not affected by the administration of ethanol, but arginase activity in the kidney was significantly higher than it was in the control group. The activity of the enzyme in the CCl_4 group started to decrease compared to the ethanol group and control group.

Table I. Liver and kidney arginase activity (units/mg of protein) levels of geese in control and treatment groups.
Tablo 1. Deneme ve kontrol grubu kazların karaciğer ve böbrek arginaz aktiviteleri(ünite/mg protein).

Tissue	Control	Treatment		
		(CCl4) 1 ml/kg bw	(CCl4) 1.5 ml/kg bw	(Ethanol) 5 ml/kg bw
Liver	3.72±0.29	1.97±0.32**	2.81±0.52*	3.54±0.24
Kidney	140.6±9.74	65.78±5.60**	54.53±6.86**	160.84±9.06**

$P<0.05$*, $P<0.01$**

Although chickens are uricotelic and do not have significant urea-ornithine cycle in any tissue, the kidneys contain a high concentration of arginase which apparently function to regulate degradation of dietary arginine[18]. We also determined that the kidney arginase activity in geese was clearly higher than that of the liver.

Carbon tetrachloride is a well-known hepatotoxin and hepatocarcinogen. It causes fatty degeneration and necrosis in hepatic cells within a short time after administration, and causes cirrhosis after repeated administrations. Liver damage resulting from CCl_4 poisoning leads to a number of metabolic changes, one of them being a profound disturbance in nitrogen metabolism[19].

Arginase activities in cirrhotic human liver biopsies have been reported to decrease below those of control groups[20]. The activity of arginase in rat liver treated by CCl_4 was found to decrease in cirrhosis CCl_4[21]. Similarly, the present study shows that arginase activity in the liver and kidney of geese decreased after the oral administration of CCl_4. Furthermore, renal arginase was much more sensitive than liver arginase to CCl_4 treatment and its activity decreased about 50-60% after the oral administration of CCl_4.

Ethanol are known to disturb the oxidative balance of the organism and the free radical processes have been recognized to be involved in the mechanisms of health effects of intoxication with these substances[11, 22]. Investigations of the effects of acute and chronic alcohol intoxication on arginase activity in rats showed that the arginase activity in liver increased so a result of chronic alcohol intoxication, whereas it decreased in acute alcohol intoxication[23]. On the contrary, the long-term oral administration of ethanol unchanged the hepatic activity of arginase in rat[24]. We also determined that the hepatic arginase activity did not change after the ethanol treatment.

Rout et al[25] observed the up-regulation of arginase mRNA (3.5-fold after 2 h) and a 2.5-fold increase in arginase activity in the mouse blastocyst after ethanol exposure. Similar studies were performed on geese and the activity of kidney arginase was found to increase after ethanol[26].

These results revealed that arginase activity of liver and kidney tissues decreased in damage cell due to CCl_4 exposeure. As a result it can be said that the degeneration in connection with oxidative stress may lead to peroxidation and affect the enzyme activities in liver and kidney.

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