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Serine Dehydratase Activity in the Liver and Extrahepatic Organs of Fed and 24-Hour Fasted Rats

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The serine dehydratase activity in crude homogenates of rat liver, intestine, adipose tissue, kidney, brain, leg striated muscle, skin and stomach, both in fed and 24-hour fasted rats have been estimated. The liver enzyme activity increased twofold with fasting, while it did not affect the serine dehydratase activity in any other organ studied. The highest serine dehydratase activity is found in the liver, with only fractional activity in all other tissues studied.

Serine dehydratase (EC 4.2.1.13), a key enzyme for the gluconeogenetic utilization of serine in the adult mammal liver (5, 16), produces pyruvate and ammonia. Its function seems to be practically confined to the liver, as most other tissues, including kidneys, have very low or nil serine dehydratase activity (6, 7, 18). Liver serine dehydratase is considerably adaptative under conditions of gluconeogenesis increase; glucose depresses the enzyme (11, 13). During prolonged fasting, the rat liver enzyme increases considerably its activity (9), but litle is known of the effects of less extreme conditions, or the effect of relatively short term fasting upon serine dehydratase activity in other extrahepatic tissues. Our purpose has been to study the effect of 24 hour fasting upon the extrahepatic serine dehydratase activity as compared with that of the liver.

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Materials and Methods

Female adult Wistar rats were used. The fasted rats had all food removed

exactly 24 hours prior to sacrifice. The conditions of housing and feeding have been previously described, together with the killing, dissecting and homogenization procedures (3). Samples of liver, hind leg striated muscle, lumbar adipose tissue, back skin, kidneys, small intestine, stomach and brain were extracted and homogenized. Crude homogenates were coarsely filtered and used for the estimation of serine dehydratase activity with the method of FRIEDMAN and HAUGEN (8) modified by SUDA and NAKAGAWA (18) for its use with crude homogenates. The incubations were carried at 37° C and were stopped at 0, 8 and 16 minutes of incubation for osazone formation and pyruvate colorimetric estimation (8) at 520 nm. Under the conditions used, liver serine dehydratase activity was found to remain constant up to more than 20 minutes of incubation. Initial velocities were plotted and used for the calculation of specific activities. Aliquots of the crude homogenates were used for the estimation of protein (19) and DNA (15). The results have been expressed in four different complementary expressions: μkat/100 g of tissue weight, μkat/g of protein or DNA, and μkat/100 g of animal weight (3). For the calculation of relative enzyme activity in the extrahepatic organs, muscle mass was calculated with the method of AROLA *et al.* (2). The adipose tissue mass has been estimated to be 20 % of body weight, value calculated from the data of SCHEMMEL (17).

Results and Discussion

Table I shows the serine dehydratase activity found in the liver of fed and fasted rats. The serine dehydratase found in intestine, adipose tissue, skin, kidney, brain, striated muscle and stomach, both in the fed and 24-hour fasted states shows a level of activity between 0.27 and 0.61 μkat/100 g of tissue weight.

The effects of fasting are only apparent in the case of the liver enzyme, being about twice the fed state activity in all expressions except that of μkat/g of DNA. In all extrahepatic tissues studied there are no changes in the serine dehydratase activity induced by 24 hour fasting The maximal serine dehydratase activity is found in the liver as indicated in the literature (7, 18), with values close to those found by other authors (9). Kidneys had an activity fully comparable to that of other extrahepatic tissues, such as muscle, in dissagreement with CHARGAFF and SPRINSON (6). The practically negligible activity of this enzyme in the kidney is in agreement with the known role of kidney as net serine synthesizer (1, 14) from other amino acids.

A 24 hour fast is enough to induce a significant increase in the liver enzyme, practically doubling the serine handling capability of this organ, regardless of its decrease in relative size (10). Most serine released from peripheral organs and kidneys (14) during fasting is handled through this pathway (4, 16). Changes in liver serine dehydratase parallel those of the

Table I. *Serine dehydratase activity in the liver of fed and 24-hours fasted rats.* All values are the mean ± s.e.m. of six to eight different animals. Statistical significance of the differences versus fed controls: * = $p < 0.05$.

Feeding status	μkat/100 g of tissue	μkat/g of protein	nkat/g of DNA	μkat/100 g of rat weight
Fed	15.3 ± 2.2	0.887 ± 0.128	23.7 ± 3.4	0.502 ± 0.086
Fasted	33.5 ± 6.2 *	1.661 ± 0.301 *	32.8 ± 6.0	1.103 ± 0.187 *

key gluconeogenic enzymes (12); the increase observed with fasting is in agreement with the gluconeogenic activity of the liver under these conditions (11, 13). The extent of the increase observed after the 24 hour fast is fully comparable to that described for 48 hours of fasting (9).

All other organs and tissue activities studied did not change with fasting; nevertheless the estimated combined ability to deaminate serine of muscle, skin and adipose tissue is about one half that of the liver; in the fasted state, this figure is reduced to about one third.

The liver thus contains most of the dehydratase activity of the mammal, being induced by fasting. Such activity was not observed in all the extrahepatic tissues studied.

Resumen

Se ha determinado la actividad serina deshidratasa de homogenados de hígado, intestino, tejido adiposo, riñón, cerebro, músculo estriado de miembro, piel y estómago en ratas control y en ratas sometidas a 24 horas de ayuno. Tras el ayuno se observa un aumento de casi el doble en la actividad hepática, mientras que el ayuno no induce cambios en la actividad serina deshidratasa en ningún otro órgano estudiado. La gran mayoría de la actividad se encuentra en el hígado, siendo la de los restantes tejidos estudiados sólo una fracción de la actividad hepática.

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