

THE ROLE OF L-AROMATIC AMINO ACID DECARBOXYLASE IN
SEROTONIN-STIMULATED ALDOSTERONE SECRETION IN
RESPONSE TO SALT INTAKE

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ABSTRACT

In this study we tested a new hypothesis namely that serotonin (5-hydroxytryptamine, 5-HT) could be synthesised within the zona glomerulosa of the rat adrenal gland from exogenous 5-hydroxytryptophan (5-HTP) by the enzyme L-aromatic amino acid decarboxylase (L-AAAD). A specific monoclonal antibody against L-AAAD showed that the enzyme was present predominantly in the adrenal medulla but also in the zona glomerulosa and zona fasciculata. Wistar rats, maintained on a normal (NS), low (LS) or high (HS) salt diet for one week, were sacrificed by decapitation, blood samples taken and the adrenal glands removed. Plasma aldosterone concentrations were significantly higher in the LS diet group ($2.91 \pm 0.35 \text{ nM}$) and significantly lower in the HS diet group ($0.261 \pm 0.55 \text{ nM}$) compared with the NS diet group ($1.025 \pm 0.133 \text{ nM}$) ($p < 0.001$). Capsules from the LS diet group synthesised significantly higher maximal levels of 5-HT ($2615.463 \pm 480.88 \text{ nM/mg protein}$) than capsules from the NS ($1219.117 \pm 150.259 \text{ nM/mg protein}$) and the HS ($968.477 \pm 214.485 \text{ nM/mg protein}$) salt diet groups ($p < 0.05$). Maximal aldosterone secretion in adrenal capsules obtained from rats on the LS diet ($73.428 \pm 4.053 \text{ nM/mg protein}$) was significantly higher than in those obtained

from rats on the NS diet (41.658 ± 1.87 nM/mg protein) ($p < 0.05$). Maximal aldosterone secretion in adrenal capsules from the HS diet group (30.624 ± 2.114 nM/mg protein) was significantly lower than in the capsules from both the LS and NS groups ($p < 0.05$). Carbidopa (10^{-4} M), a specific inhibitor of L-AAAD, markedly attenuated the secretion of aldosterone when adrenal capsules from all three salt diet groups were incubated with 10^{-4} M 5-HTP ($p < 0.05$), but had no significant effect on basal aldosterone secretion. These results clearly demonstrate that L-AAAD is not only present in the medulla, but also in the zona glomerulosa and zona fasciculata of the rat adrenal gland. In addition, 5-HT can be synthesised in the zona glomerulosa/capsular region of the rat adrenal gland and both its biosynthesis and its ability to stimulate aldosterone secretion is increased by sodium depletion and attenuated by sodium loading. This raises the interesting possibility that L-AAAD could play a role in the regulation of aldosterone secretion during sodium deficiency in the rat by converting circulating 5-HTP (which is present in blood at concentrations exceeding 1 micromolar) into 5-HT within the adrenal cortex.

SELECTED REFERENCES

1. Osim EE, Wyllie JH. 1983 J Physiol 340:77-90.
2. Hinson JP, Vinson GP, Pudney JM, Whitehouse BJ. 1989 J Endocr 121:253-260.
3. Rahman MK, Nagatsu T, Kato T. 1981 Bio Pharm 30:645-649.
4. Verhofstad AAJ, Jonsson G. 1983 Neuroscience 10:1443-1453.
5. Delarue C, Becquet D, Idres S, Hevy F, Vaudry H. 1992 Neuroscience 46:495-500.
6. Coge F, Krieger-Poullet M, Gros F, Thibault J. 1990 Biochem Biophys Res Commun 170:1006-1012.
7. Beltramo M, Krieger M, Calas A, Franzoni MF, Thibault J. 1993 Brain Res Bull 32:123-132.
8. Nishigaki I, Ichinose H, Tamai K, Nagatsu T. 1988 J Biochem 252:331-335
9. Haning R, Tait SAS, Tait JF. 1970 Endocrinology 87:1147-1167.