Table 2 *Values of force constants* (10^5 *dynes/cm*), *mean amplitudes* (10^{-2} *A*) *at* 298.16 *K, Coriolis coupling constants and rotational distortion constants* (*kHz*)

Force constants		Mean amplitudes		Coriolis coupling constants			
f_d (Mo – O)	7.0961	l_d (Mo–O)	3 6800	ζ^x_{3a3b}	0.1604	ζ^y_{1a4a}	−0 0872
f_{dd}	−0.7209	l_q (O...O)	7.9603	ζ^z_{4a4b}	−0.4353	ζ^x_{2a3a}	0.7514
		Rotational distortion constants		ζ^x_{3a4b}	0.8095	ζ^y_{2a4a}	0.5242
f_a	0 1017						
f_{aa}	−0 0071	D_J	5.0940	ζ^y_{3a4a}	0.3707		
f_{da}	−0.0141	D_{JK}	−7.8870	ζ^y_{1a3a}	−0.1250		
f'_{da}	0.0273	D_K	4 8931				

and ν_1 (A_1) of MoO_3 = 814 cm^{-1}. The present set of force constants has been utilized in evaluating compliance constants, vibrational mean square amplitudes, Coriolis coupling constants and centrifugal distortion constants. The mean amplitudes for the bonded as well as non-bonded distances obtained in the present investigation are in the characteristic range for Mo–O vibration. As expected $l_{O\ldots O}$ is greater than l_{Mo-O}, which is contrary to the corresponding force constants. Thus, it is clear that in metal oxides, mean vibrational amplitudes are characteristic to some extent. The present set of values will be useful to interpret the electron-diffraction data relating to this molecule. The present set of values for the vibrational mean amplitudes once again confirms the correctness of our assignment. The values of ζ^y_{13}, ζ^y_{14} and ζ^z_{44} are negative. Further, the magnitude of ζ^y_{23} and ζ^z_{34} is of the same order. The high values of the constants ζ^y_{23} and ζ^z_{34} show that the coupling concerned is much stronger. As expected, the value of the rotational distortion constants D_{JK} is negative for this molecule. The thermodynamic functions for MoO_3 molecule are presented in table 3.

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Table 3 *Heat content, free energy, entropy and heat capacity* (*in cal.* deg^{-1}, mol^{-1}) *of* MoO_3 *for the ideal gaseous state at* 1 *atmospheric pressure*

T(K)	$(H_0-E_0)/T$	$-(F_0-E_0)/T$	C_p^0	S^0
298.16	10.7853	51.5772	14.2582	62.3621
400	11.8813	54 9041	15.8249	66.7858
500	12.7918	57.6721	16.8920	70.4639
600	13.5380	60.0636	17.6215	73.6016
700	14.1564	62.1895	18.1263	76.3470
800	14.6763	64.1121	18.4834	78.7984
900	15.1063	65.8506	18.7445	80.9569
1000	15.4874	67.4816	18.9436	82.9691

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AGE RELATED CHANGES IN CATECHOLAMINE BIOSYNTHETIC ENZYMES OF RAT TISSUES

MADHULIKA SRIVASTAVA and NARINDER K. KAPOOR
Division of Biophysics, Central Drug Research Institute, Lucknow 226 001, India.

IT was reported earlier that the biogenic monoamines increase progressively in different tissues of rat during postnatal development[1]. Many neurophysiological processes, such as motor activity, thermoregulation, sleep and hormonal secretion do in fact deteriorate during ageing[2–5]. Since catecholamines are known to be involved in these processes it seems important to understand the ageing effects on regulation of

catecholamine biosynthesis. In continuation to the previous work, the biosynthetic enzymes, tyrosine hydroxylase (TH) and dopamine β-hydroxylase (DBH) of rat brain and heart were studied during postnatal development and ageing.

Male Charles Foster rats of 1 day, 15 days, one month, 3 months, one year and two years were taken from the Institute animal colony, sacrificed by cervical dislocation, and the tissues were quickly removed within 30 sec kept in ice and immediately homogenized for enzymes and catecholamines estimations.

TH assay: TH activity was assayed according to a procedure described by Nagatsu and Yamamoto[6]. Tissue homogenate (10%, w/v) was prepared in 0.25 M sucrose solution and centrifuged at 105,000 g for 1 hr at 4°C using Beckman L-ultracentrifuge. The supernatant rich in TH enzyme was used for enzyme assay. In the reaction mixture 0.01 ml of 0.1 μM p-bromo-m-hydroxybenzyloxyamine (DOPA decarboxylase inhibitor) was also added to prevent the conversion of formed DOPA into dopamine. DOPA was estimated spectrophotofluorometrically by trihydroxyindole procedure.

DBH assay: DBH enzyme was assayed spectrophotometrically using tyramine as substrate according to the method of Nagatsu and Udenfriend[7], details of which are given in our previous report[8,9].

Catecholamine estimation: The estimation of catecholamines was carried out by alumina adsorption method and their oxidation was done by iodine as reported earlier[1,9].

TH and DBH activities of brain were increased upto three months showing maximum activity at this period. In ageing rats of one and two years, the activities of these enzymes were found to be decreased (table 1). TH activity of rat brain was reduced by 38.4 and 44.5% at one and two years of age respectively as compared with the maximum activity at 3 months. Brain DBH activity increased progressively during development, however a two fold and three fold rise was obtained in the enzyme activity at 15 days and one month respectively as compared with initial activity at one day and this increase continued upto three months showing maximum activity at this period (table 1). The enzyme activity was markedly reduced in ageing rats showing 47 and 61 % decline in one and two years old rats respectively.

Alternations of heart TH and DBH activities during development and ageing are represented in table 2. There was a slight increase in TH activity from 1 day to 15 days followed by a marked two fold rise in the activity from 15 days to one month and this increase continued upto 3 months. A regular increase was also observed in the DBH activity of heart upto 3 months. There was found significant reductions in the activities of these enzymes during ageing. TH activity declined by 49.7 and 61.6% at one and two years of age respectively while DBH activity was found to be decreased by 30.2% at one year and by 39.2% at two years.

Earlier, a progressive increase in the levels of catecholamines of rat tissues during postnatal development was reported[1]. In continuation to this, the levels of rat brain and heart catecholamines were estimated during ageing and compared with adult level at 3 months of age. In both the tissues the levels were found to be decreased during ageing. In brain, epinephrine (E), norepinephrine (NE) and dopamine (DA) levels were reduced by 52.6, 44.1 and 27.3% at one year, and by 68.1, 64.9 and 50.9% at two years respectively. Heart E, NE and DA showed a decline of 33.3, 35.2 and 28.5% at one year, and 56.5, 71.5 and 60.5% at two years respectively.

It has been shown in the present study that catecholamine levels and their biosynthesis vary with

Table 1 *Tyrosine hydroxylase and dopamine β-hydroxylase activities of rat brain during postnatal development and ageing.*

Age	No. of rats	TH specific activity (n mol DOPA/mg protein/15 min.)	DBH specific activity (n mol octopamine/ mg protein/30 min)
1 day	12	0.520 ±0.03	29.75 ±1.3
15 days	8	0.663 ±0.02	59.23 ±4.1
30 days	8	0.881 ±0.05	95.40 ±7.8
3 months	8	0.965 ±0.05	109.37 ±5.5
1 year	6	0.594 ±0.04	58.27 ±2.1
2 years	6	0.532 ±0.06	42.71 ±5.3

Values are mean ±S. E., $P < 0.01$.

Table 2 *Tyrosine hydroxylase and dopamine β-hydroxylase activities of rat heart during postnatal development and ageing.*

Age	No. of rats	TH specific activity (n mol DOPA/mg protein/15 min.)	DBH specific activity (n mol octopamine/ mg protein/30 min.)
1 day	12	0.625 ±0.04	30.75 ±2.2
15 days	8	0.792 ±0 05	37.21 ±2.7
30 days	8	1.562 ±0.08	41.70 ±5.2
3 months	8	1.729 ±0.11	54.93 ±2.9
1 year	6	0.868 ±0.09	38.33 ±1.3
2 years	6	0.663 ±0.09	33.35 ±4.5

Values are mean ± S E., $P < 0.01$.

respect to age. Changes in biogenic amine levels of rat brain during development and ageing has been reported by several workers[10,11]. Catecholamine biosynthesis is regulated by the activity of TH, and possibly in the case of NE, also by the activity of DBH. It is likely that the effect of development and ageing on catecholamine biosynthesis may be due to a change in the catalytic property or in the concentrations of these enzymes. The activity in human serum was reported to increase markedly for the first 2–3 years attaining maximum constant level during adulthood[12]. A decrease in TH activity in aged rats were reported by few workers[13,14]. Implication of metabolizing enzymes monoamineoxidase[15] and catechol-o-methyltransferase[16] in the regulation of catecholamine levels can not be ruled out since the activities of these enzymes has been reported to increase in the brain of senescent rats. The findings suggest that biosynthetic enzyme activities and catecholamine levels are impaired in ageing rats. The biosynthetic enzymes play an important role in regulation and control of catecholamine levels during development and ageing.

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SPECTRAL INTERPRETATION OF SELF-POTENTIAL ANOMALY DUE TO AN INCLINED SHEET

S. V. SESHAGIRI RAO and N. L. MOHAN
Centre of Exploration Geophysics, Osmania University, Hyderabad 500 007, India.

THE self-potential method is one of the simplest techniques of prospecting geophysics for the exploration of metallic sulphides and some other conductive