of human thoracic duct lymph are given. This method has been useful in the study of intestinal absorption of different labelled compounds *via* the lymphatic pathway.

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Tryptophan-Nicotinic Acid Metabolism in Schizophrenia. (23837)

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It is now fairly established that tryptophan is the dietary precursor of 5-hydroxytryptamine(1) which is then oxidatively deaminated by way of 5-hydroxyindolacetaldehyde to yield 5-hydroxyindolylacetic acid(2). The presence of 5-hydroxyindolylacetic acid in normal urine indicates that an appreciable proportion of tryptophan is metabolised *via* 5-hydroxyindole route(3). 5-hydroxytryptamine also occurs in the central nervous system and Woolley and Shaw(4-6) consider it to play a vital part in normal mental processes. They have attributed some naturally occurring psychotic states such as schizophrenia to be the result of an altered metabolism of this compound. Both deficiency as well as excessive formation of serotonin in the brain(4,7) have been held as possible aetiological factors of schizophrenia. 3-indoleacetic acid is also a normal constituent of human urine, but it is not yet settled whether it is a product of metabolism of body tissues or is derived entirely from plant material in diet and bacterial action on tryptophan in the gut(8). In view of these conflicting opinions it was considered worthwhile to study the various metabolic routes of tryptophan in patients suffering from schizophrenia and in normal men.

Material and methods. Twenty adult male patients suffering from schizophrenia admitted in the Lumbini Park Mental Hospital, Calcutta were selected for study. Normal studies were also made on 10 research workers of the laboratory. Their diets did not vary from day to day. The 24-hour urine was collected in bottle containing 10 cc toluene. Urinary excretions of 5-hydroxyindolylacetic acid and 3-indoleacetic acid were determined for 2 consecutive days in 10 subjects of schizophrenia. At end of second day's collection of urine, they were fed 5 g DL-tryptophan and 24-hour urine samples collected daily for 3 subsequent days and analyzed as before. Similar studies were also made on 10 normal subjects. Daily urinary excretions of nicotinic acid, quinolinic acid, N'-methylnicotinamide (NMN), 6-pyridone, tryptophan, kynurenin, anthranilic acid, and 3-hydroxyanthranilic acid before and for 3 days after a similar dose of tryptophan were determined on another 10 patients suffering from schizophrenia. The results of such studies on normal subjects by the authors have already been reported(9). 5-hydroxyindolylacetic acid was estimated chemically by the method of Udenfriend, Titus and Weissbach(3). 3-indoleacetic acid was estimated

TABLE I. Average 24-Hr Urinary Excretions of 3-Indoleacetic Acid and 5-Hydroxyindolylacetic Acid in mg by 10 Patients and 10 Normal Persons.

		Schizophrenia		Normal	
		3-indoleacetic acid	5-hydroxy-indolylacetic acid	3-indoleacetic acid	5-hydroxy-indolylacetic acid
Before feeding tryptophan		17.6 ± 1 *	17.2 ± 1.4	18.5 ± 1.25	7.59 ± .74
Days after feeding 5 g DL-tryptophan	1	48.1 ± 3.46	38.9 ± 3.1	45.3 ± 3.27	9.9 ±1.04
	2	24.7 ± 1.69	20.8 ± 1.3	23.2 ± 1.52	7.8 ± .61
	3	18.2 ± 1.28	17.3 ± 1.2	19.8 ± 1.22	7.54 ± .72

* ± stand. error.

TABLE II. Average 24-Hr Urinary Excretions of Metabolites of Tryptophan and Nicotinic Acid in mg by 10 Patients Suffering from Schizophrenia.

		Nicotinic acid and amide	Quinolinic acid	NMN	6-pyridone	Tryptophan
Before feeding tryptophan		5.8 ± .44*	11.6 ± .77	5.9 ± .56	5.1 ± .9	0
Days after feeding 5 g DL-tryptophan	1	10.4 ± .44	20.4 ±1.21	14.5 ±1.08	20.4 ± 2.24	169.5 ± 6.64
	2	6.4 ± .46	13.3 ± .95	10.4 ± .88	16.5 ± 2.52	16.1 ± .86
	3	5.6 ± .45	12.1 ± .83	6.5 ± .38	8.6 ± 1.44	0

* ± stand. error.

Kynurenin, anthranilic acid and 3-hydroxyanthranilic acid were absent in all urine samples.

by the method of Gordon and Weber(10). Nicotinic acid, quinolinic acid, NMN, 6-pyridone, tryptophan, kynurenin, anthranilic acid and 3-hydroxyanthranilic acid were estimated by methods mentioned before(9). The results are given in Tables I and II.

Results. 3-indoleacetic acid and 5-hydroxyindolylacetic acid were present initially in urine of both normal subjects and patients suffering from schizophrenia. After feeding tryptophan urinary excretion of 3-indoleacetic acid increased equally in both groups and gradually decreased on subsequent days. After tryptophan administration, urinary excretion of 5-hydroxyindolylacetic acid rose significantly in patients suffering from schizophrenia but no discernible increase was observed in normal subjects. Nicotinic acid, quinolinic acid, NMN and 6-pyridone were normal urinary metabolites in patients suffering from schizophrenia and all these substances were excreted in higher quantities after tryptophan intake. Tryptophan, kynurenin, anthranilic acid and 3-hydroxyanthranilic acid were absent in urine initially in schizophrenic subjects. Whereas tryptophan appeared in urine for 2 days after feeding, kynurenin, anthranilic acid and 3-hydroxyanthranilic acid could not be detected in urine even after its administration.

Discussion. The increase in excretion of 3-indoleacetic acid after administration of tryptophan both in normal and schizophrenic groups indicates that dietary tryptophan is the precursor of urinary 3-indoleacetic acid; it also suggests that this route of tryptophan metabolism proceeds normally in schizophrenia. Initial high level and greater increase of 5-hydroxyindolylacetic acid excretion in urine after tryptophan feeding in schizophrenia than in normal subjects points to the possibility that rate of serotonin synthesis in this disease occurs at an accelerated rate. The data at hand do not permit the authors finally to conclude about functional ability of amine oxidase which is normally concerned with disposal of serotonin. It is likely that amine oxidase available is not able to cope with the accelerated rate of serotonin synthesis and the consequent accumulation of serotonin is responsible for the mental aberration.

The initial absence of urinary tryptophan and less recovery after its feeding than in normal subjects may be due to its rapid utilisation in other directions. The absence in urine of kynurenine and 3-hydroxyanthranilic acid, which are intermediates in the synthetic pathway of nicotinic acid, after administration of tryptophan in schizophrenia

in contrast to the findings in normal subjects is possibly because of quicker synthesis of nicotinic acid. The high initial urinary nicotinic acid and its greater output after tryptophan feeding in schizophrenia supports this hypothesis.

Summary. 1. Urinary excretion of 5-hydroxyindolylacetic acid and 3-indoleacetic acid was estimated in 10 patients suffering from schizophrenia both before and for 3 days after feeding of tryptophan. Similar studies were made on 10 normal subjects also. 2. Urinary excretion of 3-indoleacetic acid increased both in normal and schizophrenic subjects after administration of tryptophan. Tryptophan also gave rise to increase in urinary excretion of 5-hydroxyindolylacetic acid in schizophrenia but no significant rise was detected in normal subjects. 3. Urinary excretions of nicotinic acid, quinolinic acid, NMN, 6-pyridone, tryptophan, kynurenin, anthranilic acid and 3-hydroxyanthranilic acid were estimated in 10 schizophrenic subjects before and for 3 days after feeding of tryptophan. 4. Nicotinic acid, quinolinic acid, NMN and 6-pyridone were present in urine initially and they were excreted in greater quantities after tryptophan feeding. Tryptophan which was initially absent also appeared in urine after its administration. Kynurenin, anthranilic acid and 3-hydroxyanthranilic acid could not be detected in urine both before and after administration of tryptophan.

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Purification and Electron Microscopy of Foot-and-Mouth Disease Virus. (23838)

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The present study concerns purification of foot-and-mouth disease virus (FMDV) from infectious tissue culture fluid, as well as identification of the virus particle in the electron microscope by the sensitive method of direct particle counting(1,2) and by aggregation of virus particles by antiviral serum(3). The method of analytical electron microscopy(1) was used to determine the concentration of virus particles in purified virus concentrates and to estimate the number of such particles which constitute one plaque-forming unit (PFU) of infectivity for bovine-kidney monolayer cultures(4).

Materials and methods. Virus was cattle-adapted FMDV, type A, strain 119, obtained from the Research Institute, Pirbright, England. It was subsequently transferred serially 70 or more times in bovine-kidney cultures in Roux flasks, according to procedures previously outlined(5). Twenty to 40 such cultures were used per serial transfer. Each