

SOME URINARY CHANGES IN NORMAL INDIVIDUALS ON THE PELLAGRA PRODUCING EXPERIMENTAL DIET *

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Many of the pellagra patients admitted to the Pellagra Hospital in 1917 gave a history of using diets which consisted mainly of cereals, fat pork, molasses and greens, with little, if any, animal protein. On such a type of diet, Goldberger and Wheeler¹ experimentally produced pellagra in the human subject at the Rankin Farm, Mississippi State Penitentiary. To test the pellagra producing diet as regards its effect on the main urinary constituents, six normal people were placed on this Rankin Farm experimental diet as given for the week ending Aug. 8, 1915. It was intended to run the experiment for at least several weeks. Unfortunately, on the fifth day of the period of the experimental diet, the water supply of the laboratory froze and the experiment was brought to an end. Accordingly, only the data for four or five days, on the diet mentioned, are available, but these data are of some interest. The diet used was as follows:

BILL OF FARE, WEEK ENDING AUG. 9, 1915

August 2

Breakfast: Biscuits, fried mush, grits and brown gravy, sirup, coffee with sugar.
Dinner: Corn bread, cabbage, sweet potatoes, grits, sirup.
Supper: Fried mush, biscuits, rice, gravy, cane sirup, coffee, sugar.

August 3

Breakfast: Biscuits, mush, rice, gravy, sirup, coffee, sugar.
Dinner: Corn bread, collards, sweet potatoes, grits, sirup.
Supper: Biscuits, mush, grits, gravy, sirup, coffee, sugar.

August 4

Breakfast: Biscuits, mush, grits, gravy, sirup, coffee, sugar.
Dinner: Corn bread, collards, sweet potatoes, rice, sirup.
Supper: Biscuits, mush, grits, gravy, sirup, coffee and sugar.

August 5

Breakfast: Biscuits, mush, grits, gravy, sirup, coffee, sugar.
Dinner: Corn bread, collards, sweet potatoes, grits, sirup.
Supper: Biscuits, mush, rice, gravy, sirup, coffee, sugar.

August 6

Breakfast: Biscuits, mush, rice, gravy, sirup, coffee, sugar.
Dinner: Corn bread, collards, sweet potatoes, grits, sirup.
Supper: Biscuits, mush, grits, gravy, sirup, coffee, sugar.

* From the Pellagra Hospital, U. S. Public Health Service.

1. Public Health Rep. **30**: No. 46, Nov. 13, 1915; Bull. 120, Hyg. Lab., Washington, D. C.

TABLE 1.—URINARY DATA OF NORMAL PEOPLE ON THE PELLAGRA PRODUCING EXPERIMENTAL DIET

Sub- ject	Weight, Kg.	Date	Diet	Volume, C.c.	Specific Gravity	Total Nitrogen, Gm.	Ammonia Nitrogen, Gm.	Urea, Gm.	Urea Nitrogen, Gm.	Creat- inin, Gm.	Creatinin Nitrogen, Gm.	Urea N per Cent of Total Nitrogen	NH ₄ N per Cent of Total Nitrogen
1	...	Dec. 2-3	Normal	770	1.025	8.410	0.316	12.749	6.416	1.947	0.464	76.29	3.76
	...	Dec. 3-4	Mixed...	1.410	1.019	11.822	0.426	21.429	10.000	1.563	0.569	84.59	3.69
	76.2	Dec. 4-5	Diet...	1.600	1.016	9.973	0.432	18.433	8.602	1.379	0.513	86.25	4.33
	...	Dec. 5-6	Diet...										
1	...	Dec. 6-7	Rankin farm pellagra producing diet...	690	1.031	7.403	0.332	11.602	5.414	1.118	0.416	73.13	4.75
	...	Dec. 7-8	Rankin farm pellagra producing diet...	540	1.033	5.972	0.462	8.872	4.140	1.067	0.397	69.32	7.74
	...	Dec. 8-9	Rankin farm pellagra producing diet...	600	1.031	6.196	0.437	9.966	4.324	1.034	0.384	69.78	7.05
	75.6	Dec. 9-10	Rankin farm pellagra producing diet...	690	1.032	6.248	0.419	8.057	3.760	.....	.....	60.18	6.71
2	...	Dec. 10-11	Rankin farm pellagra producing diet...	570	1.034	5.622	0.502	6.585	3.073	.....	.....	54.66	8.93
	52.6	Dec. 2-3	Normal...	1.650	1.018	10.831	0.346	20.148	9.402	1.285	0.478	86.81	3.19
	52.6	Dec. 3-4	Normal...	1.400	1.018	12.433	0.459	20.199	9.426	1.418	0.527	75.81	3.69
	52.7	Dec. 4-5	Normal...	930	1.025	11.414	0.513	20.593	9.610	1.256	0.467	84.19	4.49
2	...	Dec. 5-6	Normal...	1.440	1.022	12.560	0.512	23.510	10.371	1.341	0.498	87.14	4.07
	...	Dec. 6-7	Pellagra producing diet...	1.190	1.020	8.304	0.391	14.497	6.765	1.252	0.465	81.47	4.71
	...	Dec. 7-8	Pellagra producing diet...	1.160	1.020	5.759	0.347	9.056	4.226	1.342	0.499	73.38	6.02
	51.4	Dec. 8-9	Pellagra producing diet...	1.125	1.013	5.447	0.339	8.734	4.076	1.125	0.418	74.83	6.22
3	...	Dec. 9-10	Pellagra producing diet...	700	1.026	5.984	0.356	9.281	4.331	.....	.....	72.38	5.95
	...	Dec. 10-11	Pellagra producing diet...	750	1.023	6.319	0.357	.....	.....	.....	.....	.....	5.65
	...	Dec. 2-3	Normal...	1.080	1.029	11.408	0.521	19.046	8.888	1.286	0.478	77.91	4.57
	...	Dec. 3-4	Normal...	1.160	1.028	11.421	0.499	19.494	9.697	1.305	0.485	79.65	4.37
3	63.7	Dec. 4-5	Normal...	1.670	1.020	12.300	0.569	21.697	10.083	1.470	0.546	81.95	4.87
	...	Dec. 5-6	Normal...	1.560	1.021	12.585	0.581	24.225	11.305	1.487	0.553	89.83	4.62
	...	Dec. 6-7	Pellagra producing diet...	920	1.032	8.805	0.472	15.547	7.255	1.066	0.407	82.40	5.36
	...	Dec. 7-8	Pellagra producing diet...	950	1.028	6.917	0.448	12.337	5.757	1.304	0.485	83.23	6.48
3	63.3	Dec. 8-9	Pellagra producing diet...	1.275	1.017	6.313	0.460	9.587	4.474	.....	.....	70.87	7.29
	...	Dec. 9-10	Pellagra producing diet...	800	1.029	6.302	0.530	8.276	3.862	.....	.....	61.28	8.41
	...	Dec. 10-11	Pellagra producing diet...	875	1.023	7.755	0.436	8.488	3.961	.....	.....	51.08	5.62

4	.... 55.9	Dec. 3-4 Dec. 5-6	Normal..... Normal.....	940 1,360	1.025 1.014	10,292 7,277	0.340 0.225	16,479 13,406	7,690 6,256	1,384 0.918	0.514 0.341	74.71 85.97	3.30 3.09
4	... 54.4	Dec. 6-7 Dec. 7-8 Dec. 8-9 Dec. 9-10	Pellagra producing diet.. Pellagra producing diet.. Pellagra producing diet.. Pellagra producing diet..	1,470 900 1,465 1,040	1.090 1.023 1.016 1.012	6,548 6,280 6,764 5,007	0.284 0.362 0.317 0.302	11,413 11,379 11,465 7,710	5,326 5,310 5,350 3,598	1,417 1,278 1,047 1,002	0.527 0.475 0.372	81.34 84.55 79.10 71.86	4.34 5.76 4.54 6.03
		Dec. 10-11	Pellagra producing diet..	600	1.027	5,433	0.318	6,879	3,210	.....	.....	59.09	5.85
5	.... 49.3	Dec. 3-4 Dec. 4-5 Dec. 5-6	Normal..... Normal..... Normal.....	885 1,210 815	1.023 1.021 1.031	9,959 14,883 13,511	0.464 0.581 0.566	16,900 26,202 20,705	7,564 12,316 9,662	0.885 1,167 1,081	0.329 0.434 0.383	75.95 85.63 71.51	4.66 4.04 4.19
	48.5	Dec. 6-7 Dec. 7-8 Dec. 8-9 Dec. 9-10	Pellagra producing diet.. Pellagra producing diet.. Pellagra producing diet.. Pellagra producing diet..	1,270 1,125 1,675 1,010	1.022 1.024 1.010 1.023	9,355 5,647 4,720 5,037	0.389 0.369 0.348 0.276	17,199 8,539 8,250 7,423	8,926 4,125 3,850 3,464	0.989 0.930 0.969	0.368 0.346 0.360	85.79 73.05 81.57 68.77	4.16 6.53 7.37 5.48
6	.... 56.9	Dec. 2-3 Dec. 3-4 Dec. 4-5 Dec. 5-6	Normal..... Normal..... Normal..... Normal.....	990 700 575 560	1.028 1.034 1.033 1.085	9,434 7,529 8,127 7,908	0.448 0.365 0.394 0.443	15,628 11,490 13,018 13,485	7,293 5,362 6,075 6,293	1,572 1,232 1,109 1,086	0.584 0.458 0.412 0.404	77.31 71.22 74.75 79.58	4.75 4.85 4.85 5.60
6	.... 57.0	Dec. 6-7 Dec. 7-8 Dec. 8-9 Dec. 9-10	Pellagra producing diet.. Pellagra producing diet.. Pellagra producing diet.. Pellagra producing diet..	660 1,190 1,415 1,200	1.034 1.021 1.014 1.016	7,412 6,761 6,039 5,679	0.457 0.522 0.457 0.381	12,885 12,780 7,929 8,237	6,013 5,964 3,700 3,844	1,118 1,220 0.990	0.416 0.453 0.364	81.13 88.21 61.27 67.69	6.17 7.87 7.57 6.71
		Dec. 10-11	Pellagra producing diet..	560	1.028	4,565	0.285	5,803	2,708	.....	.....	59.32	6.24

TABLE 2.—URINE DATA OF NORMAL PEOPLE ON THE RANKIN FARM PELLAGRA PRODUCING EXPERIMENTAL DIET

	Volume, C.c.	Specific Gravity	Total Nitrogen, Gm.	Ammonia Nitrogen, Gm.	Urea Nitrogen, Gm.	Creatinin, Gm.	Creatinin Nitrogen, Gm.	Urea N per Cent. of Total Nitrogen	NH ₃ N per Cent. of Total Nitrogen	Average Weight, Kg.	Creatinin Coeffi- cient
Diet Dec. 2-6											
Normal mixed diet, average of 20 tests.....	1,137	1.024	10,680	0.452	8,616	1.208	0.471	80.35	4.25	59.1	7.88
Pellagra diet, average 24 tests, Dec. 6-10.....	1,042	1.023	6,454	0.395	4,873	1.132	0.421	74.86	6.22		
Pellagra diet, average of last test after 4 days on the diet.....	907	1.023	5,710	0.377	3,810	1.060 (3d day)	0.397 (3d day)	67.03	6.55	58.3	7.05
Average for 26 pellagra patients in active Pel- lagra; severe, moderate, mild cases.....	1,158	1.020	6,214	0.519	4,457	0.751	0.279	71.81	8.453	47.46	5.82
Average of same 26 pa- tients; cured.....	1,420	1.020	10,588	0.605	8,665	0.856	0.318	81.64	5.79	40.397	6.34

August 7

Breakfast: Biscuits, mush, grits, gravy, sirup, coffee, sugar.
Dinner: Corn bread, collards, sweet potatoes, rice, sirup.
Supper: Biscuits, mush, grits, gravy, sirup, coffee, sugar.

August 8

Breakfast: Biscuits, mush, grits, gravy, sirup, coffee, sugar.
Dinner: Corn bread, collards, sweet potatoes, grits, sirup.
Supper: Biscuits, mush, rice, gravy, sirup, coffee, sugar.

Each person was allowed to eat as much of the diet as he or she pleased. With one exception, Subject 1, all the volunteers were males.

The methods of analysis employed were: for total nitrogen, Kjeldahl; for ammonia, Folin's² method as modified by Steel³; creatinin by Folin's method⁴; urea by Folin and Denis' method,⁵ using Jack bean as a source of urease and a reaction temperature of from 50 to 55 C.

The individual records for volume, specific gravity, total nitrogen, ammonia nitrogen, urea and urea nitrogen, creatinin and creatinin nitrogen, the ratio of urea nitrogen and ammonia nitrogen to total nitrogen are given in Table 1, and the average for the fourth day on the pellagra producing experimental diet are given in Table 2. By reference to these tables, it will be noted that on changing from the ordinary mixed diet to the Rankin Farm pellagra producing diet there was a marked change in the urine. The average volume decreased; the total nitrogen and urea nitrogen decreased markedly, the urea nitrogen especially; the ammonia decreased slightly. The ratio of urea nitrogen to total nitrogen was markedly lowered, the ammonia ratio increased.

The findings recorded for the fourth day on the diet are comparable to those which obtain in the urine of pellagra patients in the active stage of the disease,⁶ especially for total nitrogen, urea, and, to a degree, for ammonia and are such as would obtain on a low protein diet as found by Folin.⁷

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2. *Am. J. Physiol.* **13**:45, 1905.

3. *J. Biol. Chem.* **8**:365, 1910.

4. *Ztschr. f. Physiol. Chem.* **41**:223, 1904.

5. *J. Biol. Chem.* **26**:501, 1916.

6. Sullivan, Stanton, and Dawson: *Metabolism in Pellagra: A Study of the Urine.* *Archives Intern. Med.* **27**:387, 1921.

7. Laws Governing the Chemical Composition of Urine, *Am. J. Physiol.* **13**:67, 1905.