ON CERTAIN PECULIARITIES IN THE URINE OF VEGETARIANS.

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I HAVE recently presented the results of analyses of a number of normal urines[1] in which the relation of the copper oxide reducing power to the amounts of creatinin and uric acid present, was especially noted. In this paper I shall give briefly the corresponding data found by examining the urine of individuals living wholly on a vegetable diet. As the methods of examination were the same as formerly employed, it will not be necessary to refer to them again. The seven men who furnished the urine for the tests are students of the American Medical Missionary College of Battle Creek and Chicago, and for a year or longer had lived on a diet of bread, fruits, vegetables, and prepared cereal and nut foods exclusively. Eggs were not eaten, and only as much milk as was taken with the "cereal coffee" used. The whole day's excretion was furnished me in each case. The table following gives the important data secured as explained in the heading over each column.

No. of sample.	Excretion in twenty-four hours.	Specific gravity at 20°.	Urine required to reduce 50 cc. of copper solution.	Ammonia from 1000 cc. of urine.	Urea from 1000 cc. of urine by Liebig process.	Uric acid from 1000 cc. of urine.	Creatinin from 1000 cc. of urine.	Chlorine from 1000 cc. of urine.	P_2O_5 from 1000 cc. of urine.
	cc.		cc.	Mg.	Gms.	Mg.	Mg.	Gms.	Gms.
1	800	1.029	16.2	745.0	28.9	668.5	1551.6	6.65	1.89
2	805	1.030	16.3	522.0	28.8	645.0	1288.7	9.66	1.77
3	850	1.030	18.1	431.7	30.6	693.7	556.0	8.44	2.07
4	610	1.031	18.2	607.3	28.5	622.5	87.4	9.15	2.09
5	975	1.032	17.3	944.2	40.7	930.0	958.8	6.60	2.41
6	920	1.031	18.5	854.1	34.7	817.5	1123.7	7.88	2.38
7	494	1.030	16.7	507.7	32.4	765.0	362.8	6.10	1.40
8	1040	1.023	25.7	483.9	27.5	626.2	170.7	6.24	1.81
9	685	1.032	16.5	896.8	36.6	753.7	795.9	6.17	2.40
10	1025	1.029	19.6	982.2	33.8	588.7	847.6	5.75	2.50
11	1065	1.029	21.1	640.5	29.2	746.2	1337.3	....	....
12	850	1.030	19.1	716.5	31.9	810.0	1157.8	....	....

[1] This Journal, **22**, 309.

No. of sample.	Excretion in twenty-four hours.	Specific gravity at 20°.	Urine required to reduce 50 cc. of copper solution.	Ammonia from 1000 cc. of urine.	Urea from 1000 cc. of urine by Liebig process.	Uric acid from 1000 cc. of urine.	Creatinin from 1000 cc. of urine.	Chlorine from 1000 cc. of urine.	P_2O_5 from 1000 cc. of urine.
	cc.		cc.	Mg.	Gm.	Mg.	Mg.	Gm.	Gm.
13	800	1.031	17.1	626.3	34.8	843.7	790.1	....	....
14	1020	1.028	19.2	498.2	28.8	705.0	889.6	....	....
15	850	1.030	20.2	711.7	32.2	952.5	1082.7	9.77	....
16	800	1.030	17.9	1043.9	38.8	731.2	1137.2	....	....
17	950	1.027	22.8	616.8	28.6	656.2	1017.4	8.17	....
18	1020	1.027	22.7	607.3	26.8	645.0	1003.0	10.19	....
19	800	1.031	16.1	683.2	33.2	1166.2	1558.8	7.68	....
20	950	1.031	19.2	1062.8	35.8	843.7	805.7	9.02	....
21	925	1.030	17.3	1262.1	37.1	978.7	1157.8	9.06	....
22	905	1.030	18.4	1072.3	34.2	746.2	1547.0	9.38	....
23	860	1.030	17.2	920.5	41.6	780.0	361.1	....	....
24	970	1.028	21.6	664.3	32.4	705.0	247.5	8.35	1.85
Mean	874	1.030	18.9	754.2	32.8	767.6	909.8	8.01	2.05

At first sight we notice the rather marked reducing powers of these urines which in the mean appears to be about 20 per cent. greater than in the cases described before. But at the same time it will be observed that these urines in general are highly concentrated, the average daily excretion being only 874 cc. as against 1167 cc. for the former series. If weakened then to the same dilution the total copper oxide reducing power, expressed in these terms, would be brought down even lower. In other words, for the daily excretion the reduction is not large. The probable reason for this will be evident from what follows.

Making due allowance for differences in concentration there is nothing noteworthy in the excretion of urea, uric acid, and ammonia, or for chlorine and phosphoric acid found in part of the cases, but for the excretion of creatinin we have remarkably low figures in general. The former investigation gave as the normal relation of uric acid to creatinin about 1 : 2, but here we have about 1 : 1.2. The value for the uric acid excretion is based on a volume of 1000 cc. but if calculated for the volume voided in twenty-four hours, is brought down to 671 milligrams, which is a fair average.

The correspondingly low creatinin points apparently to low metabolism, and is a fact of considerable importance. Creatinin is supposed to reach the urine in one of two ways. Many physiologists (for illustration see Schaefer's "Text-book of Physiology," p. 599) attribute it mainly or wholly to the creatin found in the lean meat consumed as food, and changed by dehydration in the liver, while on the other hand, it may be a product of body muscle metabolism. That it is not necessarily dependent on the creatin of meat has long been recognized by numerous writers since its appearance in urine during starvation has been abundantly demonstrated. The above tests fully confirm this view. The food of the persons furnishing the urines for experiment was certainly free from anything more than traces possibly of either creatin or creatinin, and had been for a period of months or years. Yet we find a creatinin excretion which is within the limits given as normal in many of our text-books. This must be traced to muscular creatin, formed in turn by metabolism of the food proteids. This view is rendered more probable by the discovery pointed out by several recent writers of the close relation of creatin and similar bodies to the derivatives of proteids formed by various hydrolytic cleavages. Although the simple relation suggested by Drechsel[1] in which the resemblance of creatin to lysatin was shown, no longer appears to hold since Hedin and others have made it evident that lysatin is probably a mixture of arginin and lysin,[2] we still have the creatin-like nature of arginin itself as a very interesting fact[3] pointing to the same general relation. The fact that the hexone bases are produced in trypsin digestion as well as by acid hydrolysis[4] has probably no bearing in the case in suggesting another possible source of the creatinin found, besides that of muscle katabolism, as the amounts which may be so formed are usually very small.

That the creatinin was relatively low in all the urines was probably due to low food consumption and metabolism. The men furnishing the urine performed little muscular work and took but little exercise. In a few cases the results were very

[1] *Ber. d. chem. Ges.*, 23, 3096.

[2] *Ztschr. physiol. Chem.*, 21, 297.

[3] Schulze and Winterstein: *Ztschr. physiol. Chem.*, 26, 1.

[4] See papers by Kossel and Mathews and by Kutscher: *Ztschr. physiol. Chem.*, 25, 190 and 195, in illustration.

low; this can not be explained by accidental error in the experimental methods, concentration of the urine with alkaline reaction, for example, but must depend on some relation not at present discernible. The tests were all carefully made in the same manner and precautions were taken to secure a final concentrated filtrate in which zinc chloride would certainly precipitate any creatinin present.

The distribution of the reducing power in these urines is also interesting. It will not be necessary to make the calculation for each case as was done in the former paper, but the average results may be taken. The table above gives 18.9 cc. of urine in the mean as the volume required to reduce 50 cc. of the standard copper solution containing 2.604 grams of cupric oxide to the liter. From this it may be calculated that 1000 cc. of the urine would reduce 6.888 grams of cupric oxide. This is a high figure because of the marked concentration of most of the urines. Making a similar calculation from the data of the last paper we find that the creatinin of 1000 cc. of the average urine would reduce 1.282 grams of cupric oxide, while the uric acid would reduce 1.091 grams. The sum of these reductions is 2.373 grams, or a trifle over one-third of the total reduction. We have remaining 4.515 grams of cupric oxide per liter as the amount corresponding to the carbohydrates or similar bodies present. In view of the character of the food consumed this is an interesting but not unexpected result. Allowing for the concentration the reduction due to carbohydrates is still large. It is evident, therefore, that a diet wholly vegetable, in which carbohydrates and fats predominate, favors the increase in the non-nitrogenous (probably carbohydrate) factors in the urine. My thanks are due to Mr. Frank Wright and Mr. Charles Erickson for the experimental work.

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