XLI. THE RELATION OF CERTAIN BLOOD CONSTITUENTS TO A DEFICIENT DIET.

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THE purpose of this investigation was to determine the variation of certain blood constituents with the development of polyneuritis in chickens, a subject on which, as far as we know, no work has been done.

Mature Plymouth rock hens were used for the experiment. They were given a normal ration for a short time to get them as near as possible to a normal condition. They were then fed on boiled polished rice, with filter paper added to give bulk, and crushed marble for grits.

In addition to the loss of appetite and the decrease in body weight observed by Anderson and Kulp [1922] the hens developed a craving for other foods, and would eat straw and peck at the clothing of the attendants. They were laying at first, but as the experiment progressed, there was a gradual decrease in the number of eggs produced until finally they stopped laying. The eggs had a "puckery" taste and the yolks became light coloured and smaller. Feathers did not develop where they had been plucked, when the blood was drawn. As the rice feeding continued there was a drop in temperature from 1 to 2° varying among the different chickens.

The blood was drawn from the brachial artery under the wing with a hypodermic needle, and was collected in a graduated cylinder. The needle and graduated cylinder were previously rinsed with kerosene, and potassium oxalate sufficient to prevent clotting was added. 10 cc. of blood was drawn at a time, the loss of which apparently did not affect the chickens.

Chicken blood clots more quickly than human or ox blood. There is also a wide variation among individual chickens in the tendency to clot. With some it was always difficult to secure samples; with others it was very easy. Toward the end of the rice feeding period, it became increasingly difficult in every case; and as the polyneuritis symptoms developed, it became impossible to obtain samples. The number of punctures made during the drawing of a single sample increases the tendency to clot very markedly.

Determinations of sugar, uric acid, creatinine and total non-protein nitrogen were made, using the Folin-Wu method [1919] of blood analysis (see Table I). Ogata and associates [1921] found an abnormal amount of sugar in

the blood of pigeons suffering from polyneuritis. An examination of Table I shows that in some cases the final value for sugar was greater than normal. In one individual there was a regular increase in the amount of sugar. The non-protein nitrogen values were somewhat erratic. The uric acid and the creatinine values showed the most regular variation, decreasing at first then suddenly increasing. Soon after this increase occurred, the hen showed signs of polyneuritis. The increased uric acid was apparent from two to five weeks before paralysis set in. Autopsies of the chickens which died showed deterioration of the heart, kidneys, or liver. This disintegration of the solid organs was probably responsible for the increase in the amounts of uric acid and creatinine with the onset of polyneuritis.

Table I. *Results are given in milligrams per 100 cc. of blood.*

Hen number	Days on diet	Non-protein nitrogen	Creatinine	Sugar	Uric acid	Weight lbs. oz.	Remarks
1	0	45.29	1.09	176.56	5.10	5 7	After 87 days paralysis developed. Recovered on yeast-rice diet. In 121 days xerophthalmia ¹ developed. Died 9 days later.
	24	42.38	1.38	269.36	8.65	5 8	
	40	39.58	1.33	174.84	4.47	5 5	
	55	40.93	1.20	228.83	5.31	5 4	
	69	33.38	1.41	217.08	5.53	4 4	
2	0	35.68	1.03	237.68	5.89	—	Paralysis developed in 86 days. Put on yeast-rice diet and recovered.
	10	37.53	1.19	199.67	4.96	7	
	44	51.81	1.08	263.99	5.68	6 12	
	60	41.44	1.22	198.90	7.05	6 5	
3	0	41.80	2.02	176.98	4.75	6	Paralysis appeared in 74 days. Recovered on rice-yeast diet.
	10	37.20	1.38	178.06	3.98	6	
	33	44.58	1.35	180.60	1.99	5 12	
	44	42.60	0.97	254.48	7.61	5 1	
4	0	36.34	1.45	229.30	2.90	7	Had paralysis in 80 days. Died. Autopsy revealed degenerated liver.
	33	40.70	1.35	198.25	2.05	6 5	
	44	25.94	1.03	229.57	7.23	6 6	
5	0	42.48	1.46	214.70	2.24	5 12	Last sample taken 2 days after paralysis occurred. Died. No organic disturbance shown on autopsy.
	moulting 25	40.22	1.66	221.84	13.01	3 14	
6	4	36.43	1.62	248.62	6.50	6 7	Paralysis appeared in 28 days. Died in 37 days. Heart and kidneys degenerated.
	moulting 22	45.99	2.25	241.43	13.98	5 4	
7	0	37.51	1.51	239.34	8.56	6 12	Developed paralysis in 45 days. Recovered on yeast-rice diet.
	moulting 42	32.36	1.36	238.65	9.50	4 11	
8	0	34.44	1.60	218.19	1.98	5 3	Two days after last sample was taken, hen died. Autopsy showed an oedema between leg and body and degenerated liver.
	moulting 22	23.73	2.48	198.64	2.29	5	
	28	59.51	3.10	268.63	7.51	4 9	

¹ [McCollum and Simmonds, 1917.]

When the hens became so paralysed as to be unable to walk about they were fed 30 g. yeast per day and as much boiled rice as they would eat. They showed marked improvement at once although they did not gain much in weight after the first day. The hens which ate the yeast rice mixture voluntarily improved more rapidly than those which were forcibly fed. All of them were able to stand and walk about after a few days. About a week later while still on the rice yeast diet they began to lay again, and continued laying an egg every week or ten days until the end of the experiment.

SUMMARY.

1. A method for drawing blood is given by which the chickens are not injured.
2. The tendency of the blood to clot varies widely in different chickens and increases with the number of punctures during a single blood-letting.
3. There is a marked increase in the uric acid and creatinine content of the blood with the onset of polyneuritis.
4. Autopsy showed degeneration of the solid organs of the chickens upon which the polyneuritis was allowed to run its course.
5. Chickens which were fed on yeast after they developed polyneuritis showed marked increase in vitality, although there was very little increase in weight.
6. The variation of the two groups of chickens with reference to the development of polyneuritis shows that such experiments should be so regulated that the moulting season is avoided. (See appended table.)

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