

TABLE I.
Effect of Ethanolamine and Betaine on Perosis.

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Supplement to basal diet	Perosis		Avg wt at 6 wk, g	Mortality, %
	Incidence, %	Severity index		
Experiment 1.				
0	87.5	47.5	290 ± 51.8	40
.2% ethanolamine	54.0	28.6	304 ± 58.1	40
.2% betaine hydrochloride	22.2	6.8	396 ± 84.4	10
.2% betaine hydrochloride + 0.2% ethanolamine	10.5	2.6	440 ± 50.3	5
Experiment 2.				
0	87.0	46.0	314 ± 72.9	35
.2% ethanolamine	87.0	41.5	263 ± 33.5	40
.2% betaine hydrochloride	25.0	8.0	383 ± 80.2	0
.2% betaine hydrochloride + 0.2% ethanolamine	15.0	8.6	362 ± 69.2	10

choline in the presence of the added ethanolamine.

The effectiveness of betaine in preventing perosis was nearly as great, if not as great, as choline was found to be in an experiment started 2 weeks earlier than Experiment 1. In the choline experiment the chicks were identical in strain and source with those used in the experiments on betaine and the composition of the basal diet was also identical. The ingredients used in preparing the diet were the same as those used in Experiment 1 on betaine. The incidence of perosis in the choline experiment was 21.0%, the

severity index 6.7, the average weight at 6 weeks of age 421 g and the mortality 5%.

Summary. The occurrence of perosis in chicks was markedly reduced by supplementing the basal diet with betaine hydrochloride. Ethanolamine was slightly effective in one experiment in preventing perosis but not in the other. Supplementing the diet with both ethanolamine and betaine was somewhat more effective in reducing perosis than either one alone. Under the experimental conditions betaine also promoted growth and reduced mortality.

13944

Effect of Hypophysectomy of Growing Chicks upon Their Basal Metabolism.*

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In the course of a study dealing with certain fundamental aspects of physiology of reproduction in domestic chickens, young White and Brown Leghorn chicks were hypophysectomized. No reports of basal metabolic rates of hypophysectomized chickens were found in the literature and this fact, together with the finding of complete post-operative regression of the thyroids and ap-

parent apathy of the birds prompted the study summarized in this report.

Since details of the experiments are to be reported elsewhere only an abridged statement of the experimental approach is given here. Both the operated and the normal birds were hatched on April 26, 1941. They were raised under standard laboratory conditions and were operated upon when weighing about 500 g, at an age ranging between 46 and 51 days.

Following the removal of the pituitary

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TABLE I.
Average Basal Metabolic Rates of Normal, Hypophysectomized and Starved Chickens.

Item	Animal No.	Sex	Treatment	Body wt at		Respiratory quotient	Heat production	
				48 days (g)*	232 days (g)†		Per M ² body surface	Per kg body wt
1	3838	M	Normal	423	2,000	.736	83.65	41.83
	3807	M	"	448	2,040	.667	86.74	42.52
2	3880	M	Castrate	500	2,076	.702	79.84	38.46
	3806	M	"	450	2,367	.693	88.74	37.49
3	3829	M	Incompletely hypophysectomized	475	1,280	.723	57.82	45.17
4	3872	M	Completely hypophys.	513	1,353	.703	45.14	33.36
	3794	M	"	487	1,310	.856	44.69	34.11
5	3825	F	Normal	402	1,252	.694	84.83	67.76
	3826	F	"	452	1,500	.701	90.02	60.01
6	3878	F	Incompletely hypophys.	615	958	.677	56.64	59.12
7	3131	F	Completely hypophys.	405	1,352	.712	56.58	41.85
	3113	F	"	458	1,203	.760	50.42	41.91
8	3838	M	Normal; on restricted feed intake	423	1,630	.726	60.15	36.90
	3807	M	"	448	1,765	.737	59.05	33.44

*Average age at hypophysectomy.

†Average age at BMR tests.

gland most birds recovered rapidly and a few lived for as long as 6-12 months. The voluntary food intake of operated birds was 30-50% lower than that of normal birds but in spite of this most of the hypophysectomized birds continued to gain in weight. This was found to be due to an unusual adiposity of all tissues rather than increase in length of the longbones and the skeletal tissues as a whole. Complete or nearly complete hypophysectomy also resulted in marked apathy of all birds, and pronounced changes in plumage pattern and texture. Upon autopsy the birds were found to have microsplanchnia, greatly enlarged gall-bladders, macro- and microscopic regression of all glands dependent on secretions from the pituitary gland.

Experimental. All determinations of the basal heat production were made at room temperature, care being taken that the temperature did not exceed the thermo-critical range of the birds. Since hypophysectomized animals in general are supposed to be subject to hypoglycemic shock when fasted, and since hypophysectomized chickens in particular were found easily affected by any adverse environmental conditions, it was decided to

fast both operated and normal chickens for only 24 hr prior to the test and compare the results obtained with BMR determinations made on normal birds fasted for 48 hr. The test itself was run over a period of 23 hr and a Haldane type gravimetric respiration apparatus as described and used for chickens by Mitchell and Haines¹ was employed.

Each bird was subjected to 2 tests at intervals of 2 weeks and as the variation in all cases but 2 did not exceed 5%, the two tests were combined.

At the time of the BMR determinations, the completeness of the operation was judged by the condition and the color of the plumage and particularly the size of the head furnishings and the other secondary sex characters. However, all the birds eventually died or were killed and the completeness of the operation verified by sectioning of the hypophyseal region.

Results. Inspection of the tabulated data shows that complete hypophysectomy reduced basal heat production in males to 80% (items 1 and 4, Table I) and in females to

¹ Mitchell, H. H., and Haines, W. T., *J. Agr. Res.*, 1927, **34**, 549.

60% of normal (items 5 and 7, Table I). Riddle, Smith, and Moran² have shown that complete or nearly complete absence of the pituitary gland in pigeons lowered basal metabolism 40-50% when the determinations were made at the animals' own critical temperature. Similar results have been reported for mammals.

Hamilton³ has shown that the basal heat production of rats may be significantly lowered by restricting their food intake. Since removal of the pituitary decreased consumption of food by the birds by 30-50%, it was suggested that the reduction of the BMR of operated birds may be partially or totally due to decreased food consumption rather than hypopituitarism. To test this possibility, 2 normal male hatch mates (Nos. 3807 and 3838) of 2 hypophysectomized males (Nos. 3872 and 3794) which were previously fed *ad libitum* were restricted to the same food intake as was voluntarily consumed by the 2 birds lacking the pituitary. After 25 days of restricted feeding, the normal males had stabilized their body weights at about 400 g lower than their normal previous weights. The "starved weights" of these 2 birds were still 400 g higher than the weights of the hypophysectomized birds. After 30 days' restricted feeding the BMR's of the normal and operated birds were run and repeated 7 days later. Again the variation between the two tests did not exceed 5% and they were combined. It was found that restricted food intake alone had lowered the BMR of nor-

mal birds to about the level of the BMR of completely hypophysectomized males when both are expressed in comparable terms of heat production per kg of body weight. (Items 8, 4, and 1 in Table I). Placed again on full feed, the normal males regained and exceeded their normal level of basal heat production within a few days.

While the cause and effect relationship between hypopituitarism and BMR, and level of food intake and BMR have not been disentangled by the above experimental approach, it appears that the level of food intake is of importance as a regulatory mechanism of basal heat production of both normal and pituitary-less chickens. The postoperative depressions of the BMR may be due to decreased food intake but in normal birds, however, restricted diet is not necessarily the primary cause of depressed BMR because the possibility of a hypopituitary condition caused by starvation has not been ruled out in the above experiment.

Summary. Ablation of the pituitary gland of immature chickens results in a depression of the basal heat production, in males to 80%, in females to 60% of normal. Hypophysectomy results in a voluntary food consumption of one-third to one-half of normal. Restriction of the food intake of normal birds to the level of hypophysectomized birds results in a depression of the BMR of normal birds to about the level of their operated controls. These results suggest that basal heat production may be directly influenced by the level of food intake rather than by hypopituitarism. The possibility of indirect effect of restricted food intake has not been ruled out.

² Riddle, O., Smith, G. C., and Moran, C. S., *PROC. SOC. EXP. BIOL. AND MED.*, 1935, **32**, 1614.

³ Hamilton, T. S., Ph.D. Thesis, U. of Ill., Urbana, 1937.