mic-pituitary-adrenal axis.

Summary. Brain blood from "stressed" and "unstressed" hypophysectomized rats was injected into rats bearing hypothalamic lesions, and also into hypophysectomized and adrenalectomized rats. When brain blood from stressed hypophysectomized rats was injected into lesioned rats, a marked eosinopenia occurred; this did not occur when unstressed brain blood was injected into those same lesioned rats. This eosinopenia depended upon the presence of an intact pituitary-adrenal axis.

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Received January 13, 1956. P.S.E.B.M., 1956, v91.

Effects of Vitamin E, N,N^1-Diphenyl-Para-Phenylene Diamine, and Fish Liver Oil on Reproduction in Turkeys.*† (22270)

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A deficiency of vit. E has recently been reported in turkey breeder hens fed practical rations(1,2). The lenses of the eyes of embryos from the eggs laid by hens fed diets deficient in vit. E were cloudy in the central portion(3). In vit. E studies with chicks, Singsen *et al.*(4) found that the unsaturated fat level of the diet markedly influenced the development of encephalomalacia and that the antioxidant N, N^1 diphenyl-para-phenylene diamine (DPPD) was about as effective as vit. E in preventing the disease. The effects of DPPD, fish liver oil and alpha tocopheryl acetate on the reproductive performance of turkeys are reported herein.

Procedure. Broad Breasted Bronze turkey hens were distributed into 12 pens of 11 hens each. These birds had been fed a practical diet during the growing period and were reared on range. A basal diet of the following percentage composition was used: 66 ground corn, 18 soybean oil meal, 2.5 dehydrated alfalfa, 3 herring fish meal, 3 dried whey, 3.7 limestone, 3.5 steamed bone meal, 0.3 iodized salt, 0.0125 manganese sulfate and a vitamin mix supplying 680 I.C.U. vit. D, 1135 I.U. vit. A, 1 mg riboflavin, 6.2 mg pantothenic acid and 2.5 mg vit. B_{12} per lb of

* The authors wish to thank Mr. Hugh A. Risley, Distillation Products Industries, Rochester, N. Y., for determining tocopherol content of eggs in this study. The alpha tocopheryl acetate was supplied by Distillation Products Industries. The DPPD was supplied by B. F. Goodrich Chemical Co.

† Scientific Paper No. 1463 Washington Agric. Exper. Stations, Pullman. Project No. 715.

TABLE I. Effect of Vit. E, Fish Liver Oil and DPPD on Reproductive Performance of Broad Breasted Bronze Turkeys and upon Tocopherol Content of the Yolks.

Supplement to basal	Pen No.	% fertility	% embryonic mortality		Pips	% hatch. fertile eggs	Total tocopherol, μg/g yolk
			1-24 days	25-28 days			
None	33	56.9	7.8	14.3	7.4	70.6	32.2
	39	75.7	8.7	12.7	12.7	62.2	31.3
	Avg	66.5	8.3	13.4	10.3	66.0	31.8
Vit. E	36	85.2	4.7	8.0	13.7	74.6	74.2
	41	78.5	5.8	7.9	7.2	79.5	71.2
	Avg	81.8	5.2	7.9	9.9	77.1	72.7
Pollack liver oil (PLO)	35	67.2	15.3	44.5	9.6	30.6	17.1
	37	52.2	7.1	36.3	8.8	47.8	17.8
	Avg	58.6	11.5	41.2	9.2	38.6	17.4
PLO + Vit. E	34	75.8	9.8	7.5	5.6	77.0	27.1
	42	80.8	5.4	9.0	9.7	76.0	16.0
	Avg	77.9	7.7	8.2	7.5	76.5	23.0
PLO + DPPD	31	73.7	7.3	13.7	7.7	71.4	16.5
	38	72.8	3.3	13.3	7.2	76.3	19.7
	Avg	73.2	5.1	13.5	7.4	74.0	18.0
PLO + DPPD + Vit. E	32	68.2	3.9	7.9	6.2	82.0	24.6
	40	70.2	9.3	6.9	5.8	78.0	23.7
	Avg	69.2	7.2	7.2	6.0	79.5	24.3

feed. Duplicate lots were fed the basal diet and the basal diet supplemented with 20 I. U./lb alpha tocopheryl acetate, 2% pollack liver oil, 2% pollack liver oil plus 20 I.U./lb alpha tocopheryl acetate, 2% pollack liver oil plus 0.025% DPPD and 2% pollack liver oil plus 20 I.U./lb alpha tocopheryl acetate. During the first 9 weeks of the experiment, Broad Breasted Bronze toms were maintained in a separate pen. Semen was collected from these toms and pooled for artificial insemination of the hens. During the last 12 weeks of the experiment, one tom was placed in each pen and the toms were rotated weekly. All eggs laid were stored at approximately 55°F and incubated every 2 weeks. The eggs were candled on the 7th and 24th day of incubation to determine infertile eggs and eggs containing dead embryos. The experiment was conducted for a period of 21 weeks. During the latter part of the experiment, a sample of 6 eggs from each pen was analyzed for total tocopherol content.

Results. The results of this experiment are presented in Table I. The data on fertility are based only on eggs laid by the hens after they were naturally mated. These results suggest that natural diets such as used may be deficient in vit. E to the extent of causing reduced fertility of eggs. The addition of alpha tocopherol acetate to both the unsupplemented basal diet and to the basal diet containing 2% fish liver oil increased the percentage of fertile eggs. In results with turkeys reported by other investigators(1,2) fertility was not affected by a vit. E deficiency. Singsen *et al.*(5), however, obtained evidence suggesting an improvement in fertility in chickens by addition of vit. E to the breeder ration. It should be mentioned that fertility in the experiment being reported was determined only by candling. It is possible that some of the eggs classified as infertile may have contained embryos that died at a very early stage.

Addition of vit. E to the basal diet increased hatchability of fertile eggs. When 2% fish oil was added to the basal diet, hatchability of fertile eggs decreased from 66 to 39%. The addition of vit. E or DPPD or a combination of the two in the presence of fish oil markedly improved hatchability. These results show that the presence of an unsaturated oil in the diet greatly accentuated the deficiency of vit. E. The results also show that both vit. E and DPPD act to

counteract the deleterious effect of unsaturated oil on hatchability. An examination of the data on time of embryonic mortality shows that there was very little difference in the percentage of embryos dying from 1 to 24 days among the various treatments. In the case of embryos dying during the 25-to-28-day period, however, there was a marked difference. When fish liver oil was added to the basal diet embryonic mortality during this period greatly increased. In all cases where vit. E was added to the diets embryonic mortality during this period averaged about 8%. In the unsupplemented basal treatment and in the treatment with fish oil and DPPD alone, mortality during this period averaged about 13.5%. In previous reports by Jensen (1) and Atkinson *et al.*(2), the major difference between vit. E deficient and vit. E supplemented lots was in the embryonic mortality from the 25th to the 28th day of incubation. The fact that DPPD alone did not reduce the embryonic mortality during this period to a level equivalent to vit. E supplementation would suggest that the antioxidant was not completely effective in bringing about maximum hatchability. This may have been due to an inadequate level of the antioxidant. It is also possible that the antioxidant was only capable of protecting the vit. E naturally present in the basal diet. If this is the case, one would not expect the results with the antioxidant to be any better than those with the unsupplemented basal diet.

The analysis of egg yolks from the various treatments showed that alpha tocopheryl acetate added to the unsupplemented basal diet gave a marked increase in total tocopherol content of yolks of eggs laid by these hens. The addition of pollack liver oil to the basal diet caused a marked reduction in tocopherol content of the yolks. The addition of vit. E, DPPD, or a combination of the two with fish liver oil slightly increased the tocopherol content of the yolks, but did not bring it back to the level of the unsupplemented basal diet. This was surprising, since the hatchability of these eggs from hens supplemented with vit. E was as high as eggs from hens fed the basal diet plus vit. E without fish oil and was higher than eggs from hens fed the unsupplemented basal diet. The results suggest that vit. E and DPPD may be protecting some other unknown nutrient or metabolite which is essential for reproduction in the turkey. Bunnell *et al.*(6) proposed that the protective action of DPPD against encephalomalacia in chicks might be due to a stimulating effect on the metabolism of the unsaturated fats rather than a purely vit. E protective action.

Summary. Fish liver oil added to the diet greatly accentuated a deficiency of vit. E in turkey breeders. A reduction in fertility due to a vit. E deficiency was suggested. Both alpha tocopheryl acetate and DPPD counteracted the deleterious effect of fish oil on hatchability. With fish oil in the diet, tocopherol levels of the yolks of eggs were not appreciably increased by either vit. E or DPPD even though hatchability was near maximum.

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Received January 16, 1956. P.S.E.B.M., 1956, v91.