

attached to the alpha-carbon, did not react with color formation with ascorbic acid unless the acid radical was neutralized. Of the many substances investigated, morpholine and piperazine were the only compounds which gave the color reaction and were not derivatives of pyridine. However, both compounds may be considered as piperidine in which the CH_2 group in the gamma position has been replaced by either O or NH. In both instances the development of color was slow in contrast with the almost immediate formation of color in the case of nicotinamide and other derivatives of pyridine.

Other sugars and related substances substituted for ascorbic acid gave no color reaction with nicotinamide; those tested included glucose, levulose, xylose, mannose, lactose, galactose, sorbitol, arabinose, inositol, glycogen, and gluconic acid.

The reducing property of the ascorbic acid, as determined by titration with dichlor-phenol-endo-phenol, was found to be unchanged by

the color reaction with nicotinamide. Furthermore, the effect of an ingested dose of 25 mg ascorbic acid on the urinary output of the vitamin in a fasting dog was essentially the same whether or not the ascorbic acid had reacted with nicotinamide before its administration to the animal. Whether the biologic activity of nicotinamide is affected by the reaction is not known.

Summary. Ascorbic acid reacts with formation of yellow color with nicotinamide, nicotinic acid, and a number of other derivatives of pyridine. In general, a radical other than the methyl group attached to the alpha-carbon atom interferes with the reaction. Similar conditions were observed in the case of the piperidines, quinolines, and iso-quinolines that were investigated. The effect on the reaction of radicals attached to the nitrogen atom and the influence of neutralization of a carboxyl group in the alpha position are discussed.

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Vitamin E and Length of Life of Rats Fed a Diet with Fatally Low Protein Content.*

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The experiments reported here were originally planned as part of an investigation designed to determine whether a condition simulating exudative diathesis could be induced in rats fed with a vitamin E-deficient diet. The exudative diathesis occurs in chicks when the diet is deficient in vitamin E and contains highly unsaturated fatty acids, such as those provided by cod liver oil, and, within certain limits, can be accelerated by a high carbohydrate-low protein ratio in the diet.¹ Since it is also known from clinical medicine that a tendency to edema is enhanced when the diet is high in carbohydrate and low in

protein, it was thought that a drastic change of the vitamin E-deficient diet in this same direction might precipitate similar symptoms in rats. Although no condition resembling exudative diathesis occurred in these animals it was observed that adequacy of vitamin E enabled the rats to survive longer on the protein-insufficient diet than was the case when the diet was also lacking in vitamin E. Although further study of this problem is not immediately contemplated it seems worthwhile reporting the experimental data since the results may offer some additional suggestions concerning the physiological functions of vitamin E.

Procedure. Groups of 6 newly weaned rats equally distributed according to weight in the

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¹ Dam, H., *J. Nutr.*, in press.

TABLE I.
Data for Groups of 6 Rats Receiving Protein-deficient Diets with or without Vitamin E.

Time, weaning until start of low protein diet, days	Wt at weaning, g		Wt start of low protein diet, g		Wt at death, g		Length of life in days on low protein diet	
	non-E	E	non-E	E	non-E	E	non-E	E groups
7	38	39	57	60	37	36	29	45
7	38	33	58	61	33	35	70	45
7	37	40	55	61	35	34	59	43
7	40	40	61	62	48	38	30	43
7	35	33	58	53	44	34	24	43
7	38	39	59	54	37	39	19	43
	—	—	—	—	—	—	—	—
Avg	37.7	37.3	58.0	58.5	38.8	36.0	38.5	43.7
14	40	43	75	73	51	41	45	80
14	44	44	84	69	50	35	56	55
14	44	44	83	75	56	37	49	90
14	45	37	74	58	50	30	35	75
14	43	44	78	68	50	40	43	65
14	36	40	67	71	38	40	57	52
	—	—	—	—	—	—	—	—
Avg	42.0	42.0	76.8	69.0	49.2	37.2	47.5	69.5
21	41	39	98	85	71	51	45	74
21	40	38	84	100	65	65	34	66
21	38	38	88	92	68	54	33	55
21	38	40	84	80	64	52	32	74
21	37	40	102	99	74	51	45	75
21	42	41	91	85	59	44	45	63
	—	—	—	—	—	—	—	—
Avg	39.4	39.4	91.1	90.3	67.0	52.8	39.0	67.8
42	39	41	140	168	76	82	92	116
42	41	41	151	152	112	72	54	110
42	41	40	165	150	100	72	83	84
42	40	40	144	160	68	77	108	86
42	41	39	148	138	80	88	76	84
42	41	42	168	158	124	70	37	82
	—	—	—	—	—	—	—	—
Avg	40.5	40.5	152.5	154.5	92.3	76.9	75	93.6

non-E and E groups were given the following diet, with or without the addition of 10 mg % d,l-alpha-tocopherol acetate:† alcohol-extracted casein 20 g, ether-extracted yeast‡ 10 g, sucrose 63 g, McCollum's salt mixture No. 185 7 g, diacetate of 2-methyl-1,4-naphthohydroquinone 1 mg, cod liver oil 5 g. After a given number of days the casein was removed from the diet and replaced by a corresponding amount of sucrose. The animals were kept on this diet until they died.

The results, presented in Table I, demonstrate that the animals in all groups receiving the tocopherol supplement survived somewhat longer, on the average, than those deprived of vitamin E and reached a lower weight before

they died. The difference was least pronounced, and perhaps not significant, in the groups which were shifted to the low-protein diet after only one week. It may be noted that the amount of vitamin E given in the E-sufficient diets is moderately high.

No satisfactory explanation can be offered for the difference in length of life depending upon the presence or absence of vitamin E in the diet. It is possible that the deficiency of two factors in the diet, protein and vitamin E, will reduce the resistance of the animals faster than deficiency of only one factor, the protein. The effect may thus not be specific for vitamin E. It is also possible that in the presence of vitamin E the low protein intake is somewhat better utilized, although there is no direct experimental evidence for such a postulation.

† From Hoffmann-La Roche, Inc., Nutley, N.J.

‡ Prepared from Fleischmann Type 2019.