

ionine content of the refined, concentrated extracts and the dilute, crude preparations. There is definitely more choline in the crude extracts.

Since we are dealing with the extraction of preformed substances stored in the liver and since nutrition of the animal affects the storage of such substances, it is obvious that the data presented are relative rather than absolute.

Summary. From further quantitative studies of U.S.P. refined, concentrated and from dilute, crude liver extracts, it is evident, using average values per cc, that the amounts of pyridoxine and *l*-methionine are approximately the same in the two types of extract. The crude extracts contain more choline than the refined preparations.

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A Differential Response of the Rodent Adrenal Gland to Acute Starvation.

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It has been shown that the adrenal gland of the female guinea pig progressively enlarges during starvation and that this hypertrophy requires the presence of an intact hypophysis and cannot be appreciably overcome, in the starved animal, with cortical hormone overdosage.¹ The experiments of Cameron and Carmichael² have indicated that enlargement of the adrenals in the rat occurs only in the advanced stages of acute starvation, and that this increase in size is not a true physiological growth but is rather a pathologic change involving increased water content. The present report describes preliminary experiments on rats and guinea pigs which demonstrate differences in adrenal response to acute inanition.

Materials and Methods: Female guinea pigs (290-320 g) and adult rats of both sexes (150-250 g) were subjected to acute starvation over a period of 6-11 days by complete food deprivation (water allowed freely). During starvation some animals were given daily subcutaneous injections of 5-18 mg of desoxycorticosterone acetate (DOCA) in saline or

in sesame oil.* Starved controls received injections of saline or sesame oil alone or remained untreated. Corresponding groups of animals received similar experimental treatment and the complete normal laboratory ration. All animals were exsanguinated 24-36 hours after the last injection, or sooner, if moribund. The adrenals were removed, trimmed, weighed in the fresh state, and dried for 24-36 hours at 100-105° C to constant weight for solid and water content.

Results. The data (tables) indicate that the morphologic response of the adrenals to acute starvation is different in the guinea pig and the rat. In the former, the adrenal gland shows an absolute increase in size and in solid content with advanced starvation. The water content of these hypertrophied glands increases proportionately, and the percentages of solids and water are not appreciably changed from the normal. In contrast, the adrenals of acutely starved rats often fail to enlarge or may diminish in size. Likewise, the solid content of the gland does not increase but either remains unchanged or may

¹ D'Angelo, S. A., Gordon, A. S., and Charipper, H. A., *Endocrinology*, 1948, **42**, 399.

² Cameron, A. T., and Carmichael, J., *Canad. Research*, 1946, **24**, 37.

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TABLE I.
The Effect of Desoxycorticosterone Acetate on the Adrenals of the Normally Fed and Acutely Starved Rat.

Treatment	Sex	No.	Mean body wt, g			Mean adrenal wt, mg	Mean water content, %		Mean solid content, mg		Mean adrenal solids, mg 100 g body wt	
			Initial	Final	% loss						Initial	Final†
Normal fed, saline 1 cc 9 days	♀	9	160 ± 20*	175 ± 19		42.3 ± 5.5	65.5 ± 3.6	15.3 ± 0.9			6.57 ± 0.6	8.25 ± 0.7
Starved, saline 0.5-1.5 cc daily, 8-9 days	♀	9	178 ± 14	101 ± 13	43.2 ± 5.1	42.8 ± 5.0	73.8 ± 1.2	12.4 ± 0.8				12.05 ± 2.2
Normal fed, DOCA, 10 mg daily, 8 inj.	♀	6	166 ± 19	178 ± 20		26.3 ± 5.2	61.6 ± 0.9	11.9 ± 0.1				5.90 ± 0.6
Starved, DOCA, 15 mg daily, 8-9 inj.	♀	6	168 ± 19	102 ± 12	39.2 ± 2.1	30.1 ± 9.0	64.6 ± 9.2	9.6 ± 2.3			5.25 ± 1.6	8.57 ± 2.6
Starved, DOCA, 5 mg daily, 8 inj.	♀	3	183 ± 21	110 ± 20	40.0 ± 5.1	39.7 ± 6.0	68.8 ± 5.8	11.8 ± 0.7			7.12 ± 1.0	12.75 ± 2.8
Normal fed, saline 1 cc 9 days	♂	6	192 ± 21	207 ± 19		26.1 ± 3.0	65.6 ± 2.2	9.3 ± 1.2				4.40 ± 0.5
Starved, saline 0.5-1.5 cc daily, 8-9 days	♂	6	220 ± 15	134 ± 16	39.1 ± 5.2	26.9 ± 6.5	69.7 ± 6.5	8.1 ± 0.9			3.69 ± 0.2	6.18 ± 0.8
Normal fed, DOCA, 10 mg daily, 8 inj.	♂	3	197 ± 16	214 ± 17		17.0 ± 0.7	68.6 ± 0.9	5.5 ± 0.1			1.90 ± 0.4	2.50 ± 0.2
Starved, DOCA, 15 mg daily, 8-9 inj.	♂	4	206 ± 15	133 ± 12	35.4 ± 4.1	13.3 ± 1.8	67.0 ± 5.0	4.1 ± 1.1				2.94 ± 0.5
Starved, DOCA, 5 mg daily, 8 inj.	♂	3	209 ± 24	125 ± 20	40.1 ± 2.8	24.9 ± 4.0	66.5 ± 8.0	7.3 ± 3.3			3.10 ± 0.6	5.04 ± 1.9

* Refers to the mean ± average deviation.

† In all fed animals, the ratio is calculated to final body wt only.

TABLE II.
Comparison of Water and Solid Content of Adrenal Glands in the Normal and Acutely Starved Female Guinea Pig.

Treatment	No. of animals	Days starved	Mean body wt, g			Mean adrenal wt, mg	Mean water content, %		Mean solid content, mg		Mean adrenal solids, mg 100 g body wt	
			Initial	Final	% loss						Initial	Final
Fed, untreated	6	0	311 ± 7*			118 ± 13	66.4 ± 1.2	39.3 ± 4.3			12.6 ± 1.3	
Starved	5	6-8	310 ± 15	191 ± 19	38.4 ± 2.4	187 ± 32	68.6 ± 3.8	57.2 ± 5.9			18.5 ± 1.8	30.3 ± 4.2
Fed, saline 1.5 cc daily, 10 days	7	—	304 ± 9	348 ± 22		157 ± 22	68.4 ± 1.6	49.6 ± 4.0				14.2 ± 0.7
Fed, DOCA, 15 mg in saline, daily, 10 days	3	—	307 ± 8	339 ± 12		154 ± 10	67.0† ± 0.3	49.5 ± 3.7				15.0 ± 1.1
Starved, sesame oil, 0.4 cc daily	6	7-9	301 ± 8	193 ± 10	35.9 ± 3.8	181 ± 24	67.4 ± 2.3	50.2 ± 2.0			16.3 ± 0.3	28.4 ± 1.5
Starved, DOCA, 10-18 mg in sesame oil	6	6-7	306 ± 8	201 ± 14	34.3 ± 2.6	234 ± 45	70.0†	63.0			20.5	31.3

* Mean ± average deviation.

† Determined in 2 animals.

‡ Single determination.

be reduced (females).[†] Occasionally the adrenals of rats in advanced stages of acute starvation do show enlargement. This is especially the case in moribund or dead animals. These glands are usually discolored (grey, maroon) and analysis indicates that the increased size is due largely to increased water content. The adrenals of moribund guinea pigs are heavier than glands of starved pigs with similar body weight loss. This "death hypertrophy" involves an increase in both water and solids with no significant alteration in the normal percentages of these constituents.

The administration of DOCA (10-15 mg daily) decreases the size of the adrenals in acutely starved and fed rats. In either instance, a significant diminution in solid content occurs. The color of these adrenals is usually pale yellow even in terminal stages of starvation. DOCA in the guinea pig is without effect on adrenal size in the fed animal, and fails to prevent adrenal hypertrophy in the

[†] The ratio of adrenal solid content to final body weight, however, is increased over the pre-starvation ratio. In this sense, the starved rat adrenal displays relative rather than absolute hypertrophy.

starved guinea pig. Although only several analyses have been done in this series of animals, it appears that the solid and water content of the adrenals are not affected by DOCA injection.

A detailed histologic study is now being made of the adrenal and pituitary glands of the animals described in this report. These observations together with a more extensive discussion of the problem and consideration of the literature will be published at a future date.

Summary. The response of the adrenal gland to comparable degrees of acute starvation differs markedly in the rat and guinea pig. The guinea pig adrenal displays absolute hypertrophy with significantly increased solid content. In the rat, adrenal enlargement is a variable response and, when it occurs, is characterized by discoloration and percentage increase in water content. The solid content is unchanged or reduced. DOCA in high doses decreases the size and the solid content of the rat adrenal in the fed or acutely starved animal of either sex. DOCA in the guinea pig fails to affect adrenal size in the fed animal, and is ineffective in preventing the adrenal hypertrophy of starvation.

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Effect of Desoxycorticosterone upon Hypophyseal Corticotrophin Production.

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The atrophy of the adrenal cortex produced by chronic administration of cortical extract was shown to be counteracted by the simultaneous administration of adrenocorticotrophic hormone (ACTH);¹ presumably the corticoids merely inhibit hypophyseal corticotrophin production without rendering

the cortex insensitive to the trophic hormone. A similar involution of the adrenal cortex in both the rat and the mouse was obtained with desoxycorticosterone acetate (DCA).² Sayers and Sayers³ showed that the depletion of the adrenal ascorbic acid which follows the exposure of rats to stress can be prevented by the administration of

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¹ Ingle, D. J., Higgins, G. M., Kendall, E. C., *Anat. Rec.*, 1938, **71**, 363.

² Selye, H., *J. Am. Med. Assn.*, 1940, **115**, 2246.

³ Sayers, G., and Sayers, M. A., *Endocrinology*, 1947, **40**, 265.