

Adrenalectomy and the Absorption of Different Fats.*

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The effect of removal of the adrenals upon the rate of fat absorption still remains unsettled. Opposing the earlier work of Verzar and Laszt,^{1, 2} Barnes, *et al.*,³ and Barnes, Miller, and Burr⁴ demonstrated that adrenalectomized rats maintained with salt absorbed corn oil (Mazola) and the methyl esters of corn oil fatty acids at the same rate as normal unoperated controls. Recently, Bavetta, *et al.*,⁵ have shown that hydrogenated vegetable oil is absorbed more slowly by adrenalectomized rats and that this lowered absorption rate could be returned to normal by the administration of cortin. One outstanding difference in procedure employed by the 3 groups of investigators mentioned above is in the type of fat used in testing absorption rate. Verzar and his coworkers have used olive oil in most of their studies, Bavetta, *et al.*, employed hydrogenated vegetable oil, and workers from this laboratory have used corn oil. The present investigation was undertaken in order to determine whether or not the type of fat fed had any influence on the differences in experimental results that have been mentioned.

Procedure and Results. Adult albino rats were bilaterally adrenalectomized, and together with a group of unoperated control rats were fed a stock diet and given 0.6% sodium chloride and 0.2% sodium citrate *ad libitum* for 4 days. On the fourth day after operation, food was removed from all cages. Approximately 20 hours after removal of the food the rats were fed by stomach tube 0.5 cc of the test fat per square decimeter body surface. Eight hours following this, the rats were killed by etherization and their entire in-

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¹ Verzar, F., and Laszt, L., *Biochem. Z.*, 1935, **276**, 11.

² Verzar, F., and Laszt, L., *Biochem. Z.*, 1935, **278**, 396.

³ Barnes, R. H., Wick, A. N., Miller, E. S., and MacKay, E. M., *Proc. Soc. Exp. Biol. and Med.*, 1939, **40**, 651.

⁴ Barnes, R. H., Miller, E. S., and Burr, G. O., *J. Biol. Chem.*, 1941, **140**, 241.

⁵ Bavetta, L., Hallman, L., Deuel, H. J., Jr., and Greeley, P. O., *Am. J. Physiol.*, 1941, **134**, 619.

testinal tracts washed out with water and alcohol in the manner previously described.³ The intestinal washings were acidified and extracted with petroleum ether. After weighing the fat extracts, they were dissolved in methyl alcohol and titrated with a 0.1 *N* KOH solution in methyl alcohol, using phenolphthalein as an indicator.

Four different fats were employed in this study. These were corn oil (Mazola), olive oil, hydrogenated vegetable oil (Crisco), and mutton tallow (melting point 43°-45°C). The hydrogenated oil was fed both in its original form and as an emulsion made of 9 cc of the fat with 1 cc of skim milk in the manner apparently used by Bavetta, *et al.*,⁵ in their studies.

The results, which are summarized in Table I, show no significant effect of adrenalectomy upon the rate of fat absorption for 3 of the fats, namely, corn oil, olive oil, and mutton tallow. In view of the variability as indicated by the calculation of standard deviation, it would also appear likely that the rate of absorption of the unaltered hydrogenated oil is not significantly altered by adrenalectomy. The one experiment in which the rate of absorption seems definitely lowered in the adrenalectomized rats is the one in which an emulsion of hydrogenated oil in skim milk was fed. This confirms the observation of Bavetta, *et al.*,⁵ who apparently employed this fat emulsion in their studies, but peculiarly enough it is the only one of the

TABLE I.
Absorption of Different Fats During an 8-hour Period by Adrenalectomized and Unoperated Control Rats.*

Fat Fed	Treatment	No. rats	Avg body surface cm ² †	Avg fat absorbed per cm ² B.S. mg†	Avg free fatty acids in extract mg†
Corn oil " "	Control	6	453	3.39±0.46	205±95
	Adrenalectomized	6	449	2.91±0.33	340±43
Olive " " " "	Control	6	455	3.24±0.33	301±140
	Adrenalectomized	5	453	3.23±0.84	329±264
Hydrogenated oil " "	Control	6	457	3.18±0.26	134±48
	Adrenalectomized	5	458	2.39±0.79	286±78
Emulsified hydro- genated oil " "	Control	6	461	2.73±0.28	187±59
	Adrenalectomized	5	448	1.72±0.35	306±200
Mutton tallow‡ " "	Control	5	445	1.83±0.53	141±45
	Adrenalectomized	5	455	1.98±0.32	214±27

*All rats except those fed mutton tallow were adult females. Rats receiving mutton tallow were adult males.

†Including the standard deviation.

‡Melting point 43°-45°C.

† Carman, G. G., and Mitchell, H. H., *Am. J. Physiol.*, 1926, **76**, 380.

5 different fat preparations shown in Table I, which has a definitely lowered rate of absorption.

The extent of variability in free acids, as indicated by the standard deviation calculations, is a common observation in this type of study. This variation is so large that it would be untenable to conclude from the data presented in Table I that a definite difference in free fatty acid content existed between the normal control and adrenalectomized rats. It is interesting that from the averages alone the free fatty acids of the intestinal contents are higher in all of the adrenalectomized groups than in their controls. The fact that other investigators^{5, 6} have observed an accumulation of free fatty acids in the intestines of adrenalectomized rats after fat feeding lends some support to the significance of the data presented here. However, all observations previously made have referred to fatty acid accumulation in adrenalectomized rats exhibiting a lowered rate of fat absorption, while it would appear from these data that perhaps such an accumulation may take place in adrenalectomized rats that are absorbing fat at a normal rate.

It has been mentioned by other investigators^{5, 6} that the characteristic milky appearance of the mesenteric lacteals in the normal rat after feeding fat is decreased or entirely absent in the adrenalectomized rat which has been fed fat. This has been interpreted as further evidence that fat absorption is impaired in the adrenalectomized animal. In the present study this same phenomenon was observed. However, it was noticed that the lessened milky appearance of the mesenteric lacteals was common to all of the adrenalectomized rats and was not restricted to just those groups in which fat absorption had been decreased.

From the above discussion it is seen that in the adrenalectomized rat the accumulation of free fatty acids in the intestine and the gross appearance of the intestine during fat absorption may differ from the normal even though the actual rate of fat absorption is unchanged. These facts, together with the previously quoted observation⁴ that histochemical examination of the intestinal mucosa of adrenalectomized rats absorbing fat at a normal rate shows a definite alteration from the normal, must be taken as evidence that rate of absorption alone need not indicate changes in the fat absorbing mechanisms that have been brought about by removing the adrenals.

Summary. The rate of absorption of corn oil (Mazola), olive oil, hydrogenated vegetable oil (Crisco) and mutton tallow is not sig-

⁶ Verzar, F., and McDougall, E. J., *Absorption from the Intestine*, Longmans, Green and Co., 1936.

nificantly changed from the normal by adrenalectomy. The absorption of hydrogenated vegetable oil fed as an emulsion with skim milk is significantly decreased following this operative procedure. Evidence for certain changes in fat absorbing mechanisms that are brought about by removal of the adrenals is presented, and it is pointed out that these changes need not result in an altered rate of absorption.

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Effect of Some Sulfonamides on Renal Secretion.*

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In studies concerning the correlation between the molecular configuration of organic compounds and the secretory power of the kidney it has been found that the functional behavior of the isolated frog kidney can be influenced in various ways by sulfanilamide and its derivatives. Among these influences is one, which recently came to our attention and which regards a striking and easily observable pH shift in the secretion from an acid towards an alkaline reaction.

Method. The kidney of frogs (*R. pipiens*) was perfused from the aorta or from both the aorta and the abdominal vein with bicarbonate-Ringer aerated by O_2 - CO_2 in a mixture providing a pH of about 7.5. The perfusion pressures were 20 to 24 cm when the aorta alone was perfused and 24 and 12 cm respectively, when both vessels were perfused. 0.5 to 0.25 mg % phenol red was added. At this time of the year (October, November) the secretion appearing in the ureter cannulas under these conditions is ordinarily canary-yellow or dark orange-yellow. This indicates an acid reaction of the secretion and a marked concentration of the dye, both being due to the activity of the convoluted tubules. The secretion was taken up drop by drop on white paper and the color shade of each drop noted. This

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