16226

Lipids of the Fasting Mouse. IV. Liver Total Lipid Content.

HAROLD C. HODGE, P. L. MACLACHLAN, W. R. BLOOR, EILEEN WELCH, S. L. KORNBERG, AND M. FALKENHEIM.

From the Departments of Biochemistry and Pharmacology, University of Rochester, School of Medicine and Dentistry, Rochester, N.Y.

The inter-relation of liver and muscle in the complex mechanisms of fat utilization have often been considered; the fasting mouse has proved to be a valuable object of study in this connection.[1,2] Despite the rapid mobilization of available carcass fat and its prompt metabolism in the first days of fasting, the liver weight decreases in a regular fashion so that approximately half its initial weight is lost during a four day fast. The liver total lipid in this period exhibits a striking fatty accumulation followed by a reduction to below normal values.

In earlier studies, considerable variation had been observed in mortality, in liver weight loss and in accumulation of total lipid in the liver. Thus, a mortality of 66% was reached in 4 fasting days when the room temperature was occasionally permitted to fall even from 25° to 20° C, whereas only 22% mortality had occurred by the same day when the room temperature was held at 25° C. In the case of liver weight, the losses had been sufficiently irregular so that no simple tendency could be described. As to the liver total lipid, in one study the amount present had approximately doubled after 1 day of fasting but thereafter decreased to less than normal amounts; however, with more careful room temperature control and longer survival, the liver total lipid content had remained elevated on both the second and third fasting days. Finally, it was desired to extend the period of observation from 4 to 5 fasting days. With these several problems in mind, the following experiment was undertaken.

Experimental. The fasting procedure in general was as described before.[1] Three months old, male, albino mice previously maintained on a diet of oats and Purina dog chow were fasted in individual cages. Water was supplied *ad lib.* and the room temperature was kept at 25°C. The mice were lightly anesthetized with ether and sacrificed by bleeding from the axillary artery.[3] The livers were removed quickly and analyzed by standard procedures for total lipid.[4]

Mortality. No mice died during the first 2 fasting days; thereafter the mortality rapidly increased to about 50% on the fifth fasting day (see Table I). The temperature was maintained at 25°C in the animal room; at this temperature, the results reflected a mortality rate similar to that previously seen. A lower room temperature is known to be less favorable to survival.

Body Weight Loss. The average initial body weight varied from 20 to 22 g; the extreme variation among individual mice was 19 to 24 g. The body weight when recorded at the time of sacrifice was calculated as the sum of the carcass weight, the liver weight, and the weight of the blood sample. An almost linear decrease in body weight was observed with fasting. The average percentage body weight losses for the 2 preceding series[1,2] and for the current experiments were almost identical. The average mouse lost about a third of its original weight

TABLE I.
Percentage Mortality: The Relation to Room Temperature Control.

Room temperature °C	Days of fasting 1	2	3	4	5	
20-25	0	13	39	66	—	(1)
25	0	0	0	22	—	(2)
25	0	0	10	55	50	(current)

1 Hodge, H. C., MacLachlan, P. L., Bloor, W. R., Stoneburg, C. S., Oleson, M. C., and Whitehead, R., *J. Biol. Chem.*, 1941, **139**, 897.

2 MacLachlan, P. L., Hodge, H. C., Bloor, W. R., Welch, E. A., Truax, F. L., and Taylor, J. D., *J. Biol. Chem.*, 1942, **143**, 473.

3 Kuhn, L. R., *Science*, 1941, **93**, 504.

4 Bloor, W. R., *J. Biol. Chem.*, 1928, **77**, 53.

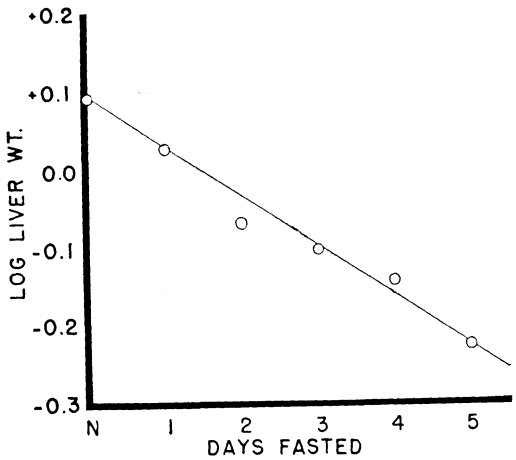

FIG. 1.

Logarithm (base 10) of moist liver weight in g plotted against the days fasted. The linear tendency is evident.

by the fifth day. The calculated equation for the average percentage body weight loss based on nearly 300 fasting mice is as follows: % weight loss = 1.10 + 7.48 × days fasted.

Liver Weight Loss. A logarithmic decrease in liver weight was found (Fig. 1); the liver weight dropped from about 5.5% of the body weight in the normal mouse to 2.9% of the initial body weight in the mouse fasted 5 days. This corresponds to a loss of about 52% of the initial liver weight. The fact that the liver loses weight more rapidly than the carcass has been repeatedly observed (Table II).

Liver Total Lipid. The milligrams of total lipid for whole liver increased 2- or 3-fold during the first 2 fasting days (Table III); thereafter, it dropped to an amount significantly less than normally present. Expressed as percentage of *moist* liver weight the total lipid values are as follows: normal—7%, fasted one day—12%, two days—17%, three days—7%, four and five days—6%. One mouse after one day's fast had 17% fat in its liver; 2 mice on the second fasting day had 28 and 29%, respectively, of liver fat. The increase in liver total lipid has been shown to be due to an increase in the neutral fat fraction and to occur despite a decrease in the phospholipid content. It can be reasonably assumed that the fat which appeared in the fasting liver had its origin in a mobilization of depot fat.

Summary. Young adult male albino mice

TABLE II.
Data on Body and Liver Weights of the Normal and Fasting Mice.

		Body weight				
		Initial		Carcass		Liver weight
	No. mice	Mean (g)	S.D.	Mean (g)	S.D.	Mean (g)	S.D.
Normal	15	20	1.3	18.7	1.5	1.099	0.16
Fasted 1 day	18	21	1.2	—	—	0.920	0.08
" 2 "	15	21	0.8	—	—	0.836	0.21
" 3 "	15	20	0.8	14.6	1.3	0.865	0.20
" 4 "	22	22	0.9	15.6	1.3	0.696	0.10
" 5 "	11	20	1.0	12.2	1.0	0.578	0.08

TABLE III.
Combined Summary Data on Liver Moist Weight and Total Lipid of Normal and Fasting Mice.

	Liver moist weight*			Liver total lipid†		
Condition	No.	Avg, g	S.D.	No.	Avg, mg	S.D.
Normal	55	1.24	0.26	34	70	17
Fasted 1 day	58	1.06	0.15	37	108	30
" 2 "	55	0.85	0.18	35	123	56
" 3 "	55	0.79	0.17	34	51	24
" 4 "	62	0.71	0.13	39	32	16
" 5 "	11	0.58	0.08	10	38	5

* Data from references 1 and 2 plus current data.
† Data from reference 2 plus current data.

lose about one-third of the initial body weight during a 5 day fast. The liver weight decreases logarithmically. In the first 2 days of fasting a marked increase was observed in total liver lipid of young, male mice. Thereafter a decrease to less than normal values followed on the third to fifth fasting days.

16227

Studies on Q Fever: Complement-Fixing Antibodies in Meat Packers at Fort Worth, Texas.*

ELIAS STRAUSS AND S. EDWARD SULKIN.

From the Department of Bacteriology and Immunology and the Department of Medicine, Southwestern Medical College, Dallas, Texas.

Previous studies[1,2] have suggested that risk of infection with Q fever is greater among stockyard and packinghouse workers than among the general population. The recovery of *Rickettsia burneti* from ticks in Liberty County, Texas,[3] and the more recent demonstration of the same organism as the causative agent of a natural outbreak of Q fever among stock handlers and slaughterhouse workers at Amarillo, Texas,[4] stimulated interest in the possibility of unrecognized human infections in this area. Accordingly, a serologic survey was undertaken to determine the frequency of complement-fixing antibodies to *R. burneti* in a group of packing plant employees at Fort Worth, Texas.

Serum specimens were obtained from the laboratory of the Fort Worth Health Department. The blood samples were collected during May and June, 1947, for the performance of routine serological tests for syphilis, from employees of meat packing plants. The sera used in this study were obtained only from workers who handled meat or meat products in raw or prepared states. Of the 1,433 specimens examined, approximately ¾ were secured from employees of one large packing house, the remainder being obtained from workers at a number of smaller establishments. When the routine tests for syphilis were completed, the sera were transported to this laboratory and stored in the deep freeze cabinet until tested for antibodies against *R. burneti.*

The Q fever antigen† was prepared from yolk sacs of embryonated eggs infected with a strain of *R. burneti* (American Nine Mile) isolated in Montana in 1935.[5] The antigen consisted of a washed rickettsial suspension prepared by a combination of ether extractions to remove the fats and repeated centrifugation cycles to free the rickettsial bodies from extraneous proteins and fats. All tests

* These studies are being aided by grants from the Lederle Laboratories Division, American Cyanamid Company, Pearl River, N.Y., and the Rose Lampert Graff Foundation, Los Angeles, Calif.

1 a.Derrick, E. H., *Med. J. Australia,* 1937, **2,** 281; b. Freeman, M., Derrick, E. H., Brown, H. E., Smith, D. J. W., and Johnson, D. W., *Australian J. Exp. Biol. and Med. Sc.,* 1940, **18,** 193; c. Derrick, E. H., *J. Hyg.,* 1944, **43,** 357.

2 Shepard, C. C., *Am. J. Hyg.,* 1947, **46,** 185.

3 Parker, R. R., and Kohls, G. M., *Pub. Health Rep.,* 1943, **58,** 1510.

4 a. Topping, N. H., Shepard, C. C., and Irons, J. V., *J. A. M. A.,* 1947, **133,** 813; b. Irons, J. V., and Hooper, J. M., *J. A. M. A.,* 1947, **133,** 815; c. Irons, J. V., Murphy, J. N., and Wolfe, D. M., *J. A. M. A.,* 1947, **133,** 819; d. Cox, H. R., Tesar, W. C., and Irons, J. V., *J. A. M. A.,* 1947, **133,** 820.

† The authors are indebted to Dr. Herald R. Cox, Virus and Rickettsial Section, Lederle Laboratories Division, American Cyanamid Company, for generously supplying the yolk sac antigen (lot No. Q 9M-5-16) used in these studies.

5 Davis, G. E., and Cox, H. R., *Pub. Health Rep.,* 1938, **53,** 2259.