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Site of Fatty Acid Absorption.*† (24738)

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It has been recently reported from this laboratory(1) that segments of the hamster intestine are capable of absorbing fatty acids from the mucosal side of an *in vitro* preparation. The fatty acids appeared in the serosal solution predominantly in the form of esterified fatty acids. The serosal esterified fatty acids were 90% or more as triglyceride.‡ During the investigation, it was recognized that sacs, prepared from the same animal, exhibited a variation in absorptive activity depending upon the portion of the small intestine employed. Location of fat absorption in the small intestine of different species has been reported in a number of investigations as reviewed by Turner(2). These investigations were primarily concerned with determination of the fat content of sections of intestine following ingestion of triglycerides. Because of the lipolysis which occurs in the intestine, it is difficult to interpret these results with regard to absorption of the specific products of the hydrolysis of ingested triglycerides. In an attempt to determine whether fatty acids, as the sole lipid placed on the mucosal side, are absorbed and transported to a greater degree in certain areas of the isolated small intestine, the present investigation was undertaken.

Materials and methods. A solution of C^{14}-palmitic acid-albumin complex containing 200 mg % glucose was prepared as previously described(1). Small everted sacs were made from successive segments of the hamster intestine from upper jejunum to iliocecal junction according to a modified procedure(1) of Wilson and Wiseman(3). The sacs were filled with approximately 0.5 ml of bicarbonate buffer, pH 7.4, containing 200 mg % glucose. Intestinal segments were incubated for 2½ hours at 37°C in 4 ml of the fatty acid-albumin complex in an atmosphere of 95% O_2 and 5% CO_2. Aliquots of the serosal and mucosal solutions as well as from the homogenized intestinal wall were plated for counting(1). The lipids were fractionated into free and esterified fatty acids according to the procedure of Borgström(4).

Results. The results from successive segments of intestine from upper jejunum (sac 1) to iliocecal junction (sac 5) are given in Table I. Averages of similar segments of 3 animals are shown as the total activity recovered from mucosal and serosal solutions and intestinal wall. Although there was variation in ability to absorb fatty acid from animal to animal, each of the individual experiments exhibited decreasing serosal and intestinal wall activities in the lower portions of the small intestine. The lowered activity was confirmed by similar decrease in fatty acid uptake from the mucosal solution. The combined lipids from the mucosal solutions and intestinal walls of similar sacs were fractionated into glycerides and fatty acids. The corresponding serosal solutions from sacs 1 and 2 in the 3 experi-

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TABLE I. Total Activity and Distribution of Activity between EFA* and FFA* Recovered from Mucosal and Serosal Solutions and Intestinal Wall of Successive Intestinal Sacs from Upper Jejunum (Sac 1) to Iliocecal Junction (Sac 5) following Incubation with C^{14}-Palmitic Acid-Albumin Complex (70,500 cpm) on the Mucosal Side.

	Mucosal solution†			Intestinal wall			Serosal solution			
Sac No.‡	Total activity	% activity in EFA*	FFA*	Total activity	% activity in EFA	FFA	Total activity	% activity in EFA	FFA	ml recovered
Sac 1	51,080	18	82	10,597	73	27	3,051	90	10	.47
2	56,793	16	84	10,680	84	16	1,570	94	6	.46
3	58,713	22	78	9,267	83	17	838			.61
4	61,903	6	94	6,396	80	20	508			.56
5	65,500	2	98	3,492	74	26	275			.51

* EFA and FFA denote esterified fatty acids and free fatty acids, respectively.
† Mucosal volume 4 ml.
‡ Sacs were approximately same length and weight.

ments were separated (Table I). Activity per unit volume of the serosal solution from the first sac was approximately 50% of that found in the mucosal solution. Progressively down the intestine, the percentage decreased to a value of 3% in sac 5. Ratios of resulting serosal to mucosal glycerides in sacs 1 and 2 were 2.6 and 1.5, respectively.

Discussion. Employing an *in vitro* procedure for study of fatty acid absorption, it has been demonstrated that absorption and transformation of fatty acids takes place primarily in the upper portion of the hamster intestine. The upper segments demonstrate approximately 12 times the ability of the lower segments to carry out absorption and conversion into esterified fatty acids. This finding must be taken into consideration when making comparisons of absorptive rates of different test materials. The results indicate a greater penetration of fatty acids in the upper portion of the intestine and suggest an existing mechanism other than that of simple diffusion for the passage of fatty acids into the mucosal cell.

If the resulting mucosal glycerides are compared with the serosal glycerides on the basis of glyceride activity per unit volume, there is approximately a 2-fold concentration gradient across the intestinal wall in favor of the serosal glycerides.

Summary. In an *in vitro* sac preparation from the hamster intestine, fatty acid absorption, resulting in serosal triglyceride, takes place predominantly in the upper jejunum of the small intestine. A concentration gradient between the resulting glycerides of the mucosal and serosal solutions has been demonstrated.

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