

## EFFECTS OF SHORT-, MEDIUM-, AND LONG-CHAIN FATTY ACIDS ON AMYLASE RELEASE FROM PANCREATIC SEGMENTS OF RATS

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### Introduction

In ruminants, short-chain fatty acids are known to have many functional activities, including stimulation of pancreatic exocrine as well as endocrine secretion. It has been reported that the stimulating effect of short-chain fatty acids occurs in the exocrine pancreas of sheep, goats and guinea-pigs, and that the mechanism of amylase release from acinar cells stimulated by short-chain fatty acids might be related to Ca ions, which have an activity as a cellular mediator. (Harada and Kato, 1983; Katoh and Tsuda, 1984). However, the effects of short chain fatty acids on the exocrine pancreas have not been examined in rats.

The present experiment was carried out to examine the effects of short-, medium- and long-chain fatty acids on amylase release from rat pancreatic segments, and the possible involvement of extracellular Ca ions therein.

### Materials and Methods

Seventeen rats were used. The method used to obtain dose-response curves was generally similar to that previously described (Katoh and Tsuda, 1984). The pancreas was removed from the animal and cut into small segments in an oxygenated superfusing solution kept at 37°C. These segments were stored in a warmed (37°C) oxygenated superfusing solution for 30 min before use in the experiments. The tissue segments were transferred into a tissue basket. After preincubation for 20 min, the basket was transferred into a test tube containing 2ml of oxygenated superfusing solution and incubated for 10 min, then transferred into another tube. The procedure was successively repeated. The first and second test tubes contained a control solution, while the third to the seventh (last) contained various concentrations of a saturated fatty acid, the concentration of which was increased ten-fold at each step. The experi-

ment was carried out in Ca-supplemented (2.56 mM: control) solution or Ca-free solution containing  $10^{-4}$  M EGTA. The saturated fatty acids used were butyric (C4), caprylic (C8), lauric (C12) and palmitic (C16) acids, at concentrations ranging from  $10^{-6}$  to  $10^{-2}$  M. The amylase concentration in the sample solution in each test tube was determined by the blue starch method. Amylase release was calculated as the percentage increase over the basal level.

### Results

The four fatty acids used in this experiment enhanced amylase release from the rat pancreatic segments. Amylase release increased in a dose-dependent manner. The maximum response was attained at  $10^{-3}$  or  $10^{-2}$  M.

The stimulating effect of the fatty acids increased with increasing carbon number, with the maximal increment in response to C12 or C16 being of similar magnitude to that achieved in response to acetylcholine.

The stimulating effects of fatty acids were

TABLE 1. MAXIMAL AMYLASE INCREMENT EVOKED BY STIMULATION WITH FATTY ACIDS IN SUPERFUSED SEGMENTS OF RAT PANCREAS IN CONTROL SOLUTION (MEAN + SEM)

Fatty acids		C4	C8	C12	C16
Increment (%)	Mean	58.5	58.4	108.8	111.9
	SEM	11.4	11.7	10.3	15.2
		a	a	b	b

\*The amylase increment was represented as the % change in amylase release relative to that evoked by acetylcholine, which was set to 100%. Duncan's test was employed after ANOVA ( $p < 0.01$ ). There was a significant difference between columns bearing different letters ( $p < 0.01$ ).  $n = 7$ .

reduced, but not abolished, in the Ca free solution. The effect was, furthermore, observed even in a solution containing atropine ( $1.4 \times 10^{-6}$  M), phen-tolamine ( $10^{-5}$  M) and propranolol ( $5 \times 10^{-6}$  M).

### Discussion

It is well established in sheep that short-chain fatty acids stimulate amylase release from the acinar cells *in vivo* (Harada and Kato, 1983) and *in vitro* (Katoh and Tsuda, 1984), and that the stimulating effect is dependent on the carbon number.

It was shown in the present experiment that not only the short-chain fatty acids but also medium- and long-chain fatty acids can stimulate amylase release even in the rat pancreas. The effect is a direct one on the acinar cells since amylase release evoked by stimulation with fatty acids was observed in a solution containing both muscarinic and adrenergic antagonists. The reason why the effect of medium- or long-chain fatty acids was

more potent than that of short-chain fatty acids is not clear at present.

It has been reported that the stimulating effects of both short-chain fatty acids and of acetylcholine were decreased in a Ca-free solution in sheep (Katoh and Tsuda, 1984). The present experiment showed similar results, and indicated the importance of Ca ions in the process of stimulation by fatty acids even in the rat.

(Key Words: Exocrine Pancreas, Fatty Acids, Amylase Release)

### Literature Cited

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