of copper into the cytoplasm and cell death. At present, we have no evidence that such a release takes place.

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BIOCHEMISTRY

Dietary Starch, Dietary Sucrose and Hepatic Pyruvate Kinase in Rat

IT has been pointed out[1] that a low activity of hepatic pyruvate kinase (ATP-phosphotransferase *EC*.2.7.1.40) favours gluconeogenesis, and a high activity favours lipogenesis from oxidizable substances. These experiments with rats showed that the activity of the enzyme was rapidly affected by alterations in the amount of carbohydrate in the diet, being highest when the diet contained 80 per cent carbohydrate (as sucrose), less when it contained 55 per cent carbohydrate (mostly as starch) and least when it contained no carbohydrate.

In view of recent findings that levels of blood lipids and amounts of adipose tissue in rats are changed when the dietary carbohydrate is changed from starch to sucrose[2], we have measured the activity of hepatic pyruvate kinase in rats given diets with the one or the other carbohydrate at the same levels.

Male hooded rats of the Lister strain were used for the experiments. The composition of the diets is shown in Table 1. The enzyme activity was estimated by the method of Bücher and Pfleiderer[3], except that the concentration of adenosine diphosphate was increased to $1{\cdot}3 \times 10^{-3}$ molar. Preliminary experiments with weanling rats showed that purified diets with 60 per cent sucrose gave an enzyme activity three or four times higher than that given by diets with 60 per cent starch. The effect was seen after 3 days on the diet, and there was only a slight increase in the enzyme activity on either diet after another seven days.

Table 1. COMPOSITION OF DIETS

Male hooded rats were given these diets, and water, *ad libitum*. Quantities are in g/km

	Carbohydrate-free, I	Carbohydrate-free, II	Sucrose 60 per cent	Starch 60 per cent	Sucrose 72 per cent	Starch 72 per cent
Sucrose	0	0	600	0	720	0
Starch	0	0	0	600	0	720
Casein	700	500	240	240	180	180
Maize oil	0	0	0	0	20	20
Butter	0	0	0	0	30	30
Arachis oil	0	0	80	80	0	0
Margarine	220	420	0	0	0	0
Salt mixture	50	50	50	50	50	50
Vitamin mixture	0·058	0·058	0·058	0·058	0·058	0·058
Choline chloride	1	1	1	1	1	1
Solka floc	30	30	30	30	0	0

The results of two further experiments are shown in Table 2. In each instance, the difference in activity of pyruvate kinase between the dietary treatments is highly significant ($p < 0{\cdot}001$). The highest level of activity was found in rats that were put on the experiment when they were 39 days old, and fed the purified diet with 60 per cent sucrose for 10 days. The results of this experiment parallel closely those[1] in which the diet with 80 per cent sucrose gave an enzyme activity about ten times that given by carbohydrate-free diets. Our results with the starch-containing diet suggest, however, that the intermediate level found by these authors with diets containing 55 per cent carbohydrate as starch was due more to the type of carbohydrate than to its quantity.

The difference in pyruvate kinase activity in rats fed sucrose or starch for 98 days, though still highly significant, was less than in rats fed for only 10 days. It is possible that this was caused by the differences in the type of dietary fat, but it may be that the animals gradually adapt to the differences in carbohydrate.

Differences in enzyme activity produced by the different levels of fat in the two diets free of carbohydrates were not significant at a level of $P = 0{\cdot}05$. We might expect significant differences with greater differences in fat content; as it is, the differences are in the expected direction in view of the higher ketogenic potential of the diet higher in fat.

Table 2. PYRUVATE KINASE ACTIVITY OF RAT LIVER

Activity as μmoles/min/g fresh weight (± *S.E.*)

Diet	No. of rats	Days on diet	Age at start (days)	Weight at start (g)	Weight at end (g)	Pyruvate kinase activity
60 per cent sucrose	6	10	39	93	134	102·7 ± 15·4
60 per cent starch	6	10	39	95	134	20·2 ± 2·1
Carbohydrate-free, I	5	10	39	96	142	10·4 ± 1·3
Carbohydrate-free, II	4	10	39	97	149	7·6 ± 0·9
Total carbohydrate-free	9	10	39	97	145	9·2 ± 0·9
72 per cent sucrose	5	98	28	42	283	63·0 ± 5·8
72 per cent starch	5	98	28	41	281	28·1 ± 3·8

The observation[1] was confirmed that a diet with carbohydrate produces a higher activity of hepatic pyruvate kinase in rats than a diet free from carbohydrate. We must add, however, that the activity of the enzyme also depends on the type of dietary carbohydrate, as sucrose produces a considerably higher activity than does starch.

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