may be related to the above-mentioned elevation of the intra-mitochondrial ATP-level, ultimately responsible for the respiratory inhibition.

Since, as previously reported, hexokinase in the resting liver has a low affinity for glucose, it may be suggested, as a working hypothesis, that a temporary increase of such an affinity during regeneration may both stimulate the ærobic glycolysis rate and favour the appearance of a Crabtree effect.

E. Clerici
P. Ciccarone

Istituto di Patologia Generale,
Università di Milano, Italy.

[1] Ibsen, K. H., *Cancer Res.*, **21**, 829 (1961).
[2] Di Pietro, D. L., Sharma, C., and Weinhouse, S., *Biochem.*, **1**, 455 (1962).
[3] Guidotti, G., Clerici, E., and Bazzano, E., *Min. Nucleare*, **2**, 14 (1958).
[4] Higgins, G. M., and Anderson, R. M., *Arch. Path.*, **12**, 186 (1931).
[5] Clerici, E., Guidotti, G., Sambo, G., and Bazzano, E., *Proc. Soc. Exp. Biol. Med.*, **105**, 377 (1960).
[6] Packer, L., and Golder, R. H., *J. Biol. Chem.*, **235**, 1234 (1960).
[7] Arcos, J. C., Gosch, H. H., and Zickafoose, D., *J. Biophys. Biochem. Cytol.*, **10**, 23 (1961).

β-D-Glucosiduronic Acid Conjugation by the Mucosa of Various Organs

β-D-Glucosiduronic acid synthesis carried out by the mucosal membrane of the stomach and intestine has been previously demonstrated[1–4]. This function is strongest in the duodenum. The mechanism of this β-D-glucosiduronic acid conjugation is the same as in the liver; uridine-diphosphoglucosiduronic acid acts as a glucuronic acid donator; this is oxidated by a specific dehydrogenase enzyme system and the final transfer of glucuronic acid is carried out by specific glucuronyl transferase enzymes[5].

The glucosiduronic conjugation of *o*-aminophenol has been tested also with mucosa of other organs in the rabbit, rat and guinea pig with negative results. Only a trace reaction occurs with the bladder mucosa[2,3]. The cat has been an exception to the usual findings: no organ in the cat reveals a positive glucosiduronic acid conjugation capacity[3,6].

It was expected that the β-D-glucosiduronic acid conjugation might occur also at the higher parts of the gastrointestinal tract. Therefore, experiments were performed in which the conjugation capacity of the oral mucosa slices in the rabbit, guinea pig, rat and dog were determined. Control analyses were also made using liver and skeletal muscle samples. Also the gall bladder, conjunctiva and vaginal mucosa were tested in guinea pig. The results are presented in Table 1. It can be seen that, with the exception of dog, all animals showed a glucosiduronic acid conjugation capacity in the upper part of the gastrointestinal tract. This capacity was highest in the guinea pig and lowest in the rabbit. In the rat (Wistar) the conjugation capacity increased beyond the œsophagus up to the duodenum, whereafter it decreased again. Different parts of the stomach showed no difference in this capacity. It is interesting to note that the gall bladder, and to some extent also the vagina, possess a conjugation capacity.

In addition to these observations, trials were made in order to establish a comparison of the conjugation capacity of the gastric and intestinal wall with the liver. Altogether 80 male and female rats were used. The conjugation capacity of the liver, lesser and major curvature of the stomach, pylorus, duodenum, jejunum, ileum and colon were analysed using whole tissue slices and *o*-aminophenol as the substrate. The method has been previously described[3]. The results are listed in Table 2. They also reveal the activity of the renal cortex and medulla without any difference between these two organs.

These results indicate that the β-D-glucosiduronic acid conjugation is really carried out by the whole gastrointestinal tract. Sex differences demonstrated by other workers[7] could not be detected in the Wistar rats used here, which agrees with our other study. This might be explained by strain specificity. On the other hand, a great difference is noted between conjugation-level in series I and II. It happens that the former was performed in the winter and the latter in the spring. Whether the seasonal factors really account for the results needs further investigation.

Table 1. Formation of *o*-Aminophenolglucuronide by Various Organs. Incubation Time of Tissue Slices 90 min, 37° C, μg/100 mg Dry Weight. Number of Determinations (in brackets)

Organ	Guinea pig male	Guinea pig female	Dog	Rabbit male	Rabbit female	Rat male	Rat female
Anterior part of the tongue	136 ± 43 (6)	79 ± 57 (2)	trace	21 ± 9·4 (5)	26 ± 13 (4)	48 ± 22 (3)	79 ± 43 (4)
Posterior part of the tongue	133 ± 51 (6)	71 ± 51 (2)	trace	21 ± 9·6 (5)	21 ± 7·0 (4)	44 ± 27 (4)	27 ± 11 (4)
Bottom of the tongue	70 ± 22 (6)		trace		39 ± 20 (4)	81 ± 39 (4)	65 ± 29 (4)
Tongue muscle	23 ± 15 (6)	38 ± 26 (2)	negative	16 ± 6·3 (7)	trace	14 ± 8·8 (4)	16 ± 10 (4)
Cheek mucosa	216 ± 82 (6)	66 ± 53 (2)	trace	28 ± 9·4 (12)	30 ± 15 (4)	67 ± 31 (4)	91 ± 50 (4)
Œsophagus mucosa, upper part	284 ± 101 (6)	43 ± 37 (2)	trace	14 ± 8·4 (5)	27 ± 14 (4)	14 ± 6·9 (2)	76 ± 37 (4)
lower part						91 ± 41 (4)	167 ± 69 (4)
Skeletal muscle	negative	negative	negative	negative	negative	negative	
Gall bladder mucosa		59 ± 19 (5)					
Vaginal mucosa		trace					
Eye conjunctiva		trace					
Liver	278 ± 71 (12)	156 ± 115 (2)	177 ± 121 (2)	216 ± 64 (12)	31 ± 6·1 (4)	241 ± 120 (4)	322 ± 111 (4)
Duodenum				390 ± 179 (7)			

Table 2. Formation of *o*-Aminophenolglucuronide by Various Rat Organs. Incubation Time of Tissue Slices 90 min, 37° C

Organ	Series I	Series II	
Male	μg/100 mg dry weight	μg/100 mg dry weight	μg/mg nitrogen
Stomach			
Liver	153 ± 32	64 ± 6	180 ± 34
Lesser curvature	60 ± 5	25 ± 3	129 ± 19
Major curvature	44 ± 6	24 ± 5	106 ± 15
Pylorus	103 ± 29	41 ± 4	288 ± 35
Duodenum	249 ± 23	125 ± 11	860 ± 52
Jejunum	172 ± 17	76 ± 11	565 + 36
Ileum	52 ± 7	21 ± 3	206 ± 30
Colon	55 ± 5	27 ± 2	305 ± 165
Renal cortex	58 ± 8	34 ± 2	124 ± 38
Renal medulla	41 ± 8	7 ± 1	77 ± 24
Female			
Stomach			
Liver	90 ± 9	58 ± 6	135 ± 16
Lesser curvature	54 ± 9	27 ± 3	127 ± 13
Major curvature	41 ± 5	23 ± 2	88 ± 9
Pylorus	75 ± 9	36 ± 3	231 ± 17
Duodenum	221 ± 25	115 ± 11	561 ± 73
Jejunum	181 ± 25	64 ± 6	367 ± 36
Ileum	50 ± 8	25 ± 4	171 ± 22
Colon	41 ± 5	29 ± 3	158 ± 16
Renal cortex	50 ± 5	30 ± 3	82 ± 8
Renal medulla	57 ± 10	15 ± 2	(273 ± 86)

This work was supported by a grant from the Sigrid Juselius Foundation.

K. J. W. Hartiala
M. O. Pulkkinen
P. Savola

Department of Physiology,
University of Turku,
Finland.

[1] Zini, F., *Sperimentale*, **102**, 40 (1952).
[2] Hartiala, K. J. W., *Acta physiol. Scand.*, **31**, Suppl. 114, 20 (1954).
[3] Hartiala, K. J. W., *Ann. Exp. Med. Fenniae*, **33**, 239 (1955).
[4] Shiray, Y., and Ohkubo, T., *J. Biochem.* (Tokyo), **41**, 341 (1954).
[5] Stevenson, I. H., and Dutton, G. J., *Biochem. J.*, **82**, 330 (1962).
[6] Hartiala, K. J. W., *Biochem. Pharm.*, **6**, 82 (1961).
[7] Inscoe, J. K., and Axelrod, J., *Fed. Proc.*, **18**, 406 (1959).