INTRODUCTION

Before discussing carbohydrate metabolism, it may be appropriate to consider why this metabolism is of primary importance and needs to be tightly regulated.

Glucose occupies a unique position in intermediary metabolism for two reasons: (1) It is the substrate of glycolysis which is the only pathway to produce ATP in anaerobic life. Although anaerobiosis is an exceptional condition in mammals, it is important to recall that erythrocytes, because they are deprived of mitochondria, are entirely dependent upon glycolysis for their supply of adenosine triphosphate (ATP). (2) Glucose is the major substrate of brain metabolism; indeed, fatty acids are bound to albumin and cannot penetrate the blood–brain barrier. Ketone bodies are easily utilized by the brain but their concentration in the blood is normally very low and increases only upon fasting. A significant decrease in the level of glycaemia could therefore cause major damage to the brain. This in itself is a justification for the rather elaborate and sometimes expensive mechanisms of control that the liver has developed to maintain a constant level of glycaemia.

A SUMMARY OF CARBOHYDRATE METABOLISM

Figure 1.1 shows a brief summary of carbohydrate metabolism. The main
dIetary carbohydrates are starch, sucrose and lactose which are hydrolytically degraded into the free sugars, glucose, fructose and galactose. Hydrolysis of the oligosaccharides occurs through the action of oligosaccharidases located in the intestinal wall. This specific location prevents the accumulation of free sugars in the intestinal lumen and their utilization by microorganisms.

Fructose is very rapidly utilized by the liver and converted to glucose and lactate. When fructose is given intravenously, its utilization may be so intense that lactic acidosis may occur. Furthermore, fructose-1-phosphate accumulates in the liver causing depletion of P, and ATP, followed by conversion of adenine nucleotides to uric acid and resulting in hyperuricaemia.

Galactose is also rapidly utilized by the liver and its metabolism normally causes no problem. It is only in congenital galactosaemia that the galactose concentration in the blood increases. Under these conditions, galactose can be converted to galactitol by aldose reductase, the activity of which is approximately proportional to substrate concentration; this enzyme is present in several tissues, including lens and nerve, in which the accumulation of galactitol may cause various types of damage, particularly cataract. The metabolism of fructose and of galactose is not subject to regulation.

Glucose is utilized by all tissues in the body and its penetration into muscle and adipose tissue is controlled by insulin. One important function of the liver is to control the level of glycaemia. When this level is elevated, as is