CARBOHYDRATES

Introduction

* This is a practical, but inaccurate, generalization: 2-deoxy and 6-deoxy-sugars only have n-2 alcohol functions: 2,6-dideoxy-sugars are also known (for example in foxgloves)

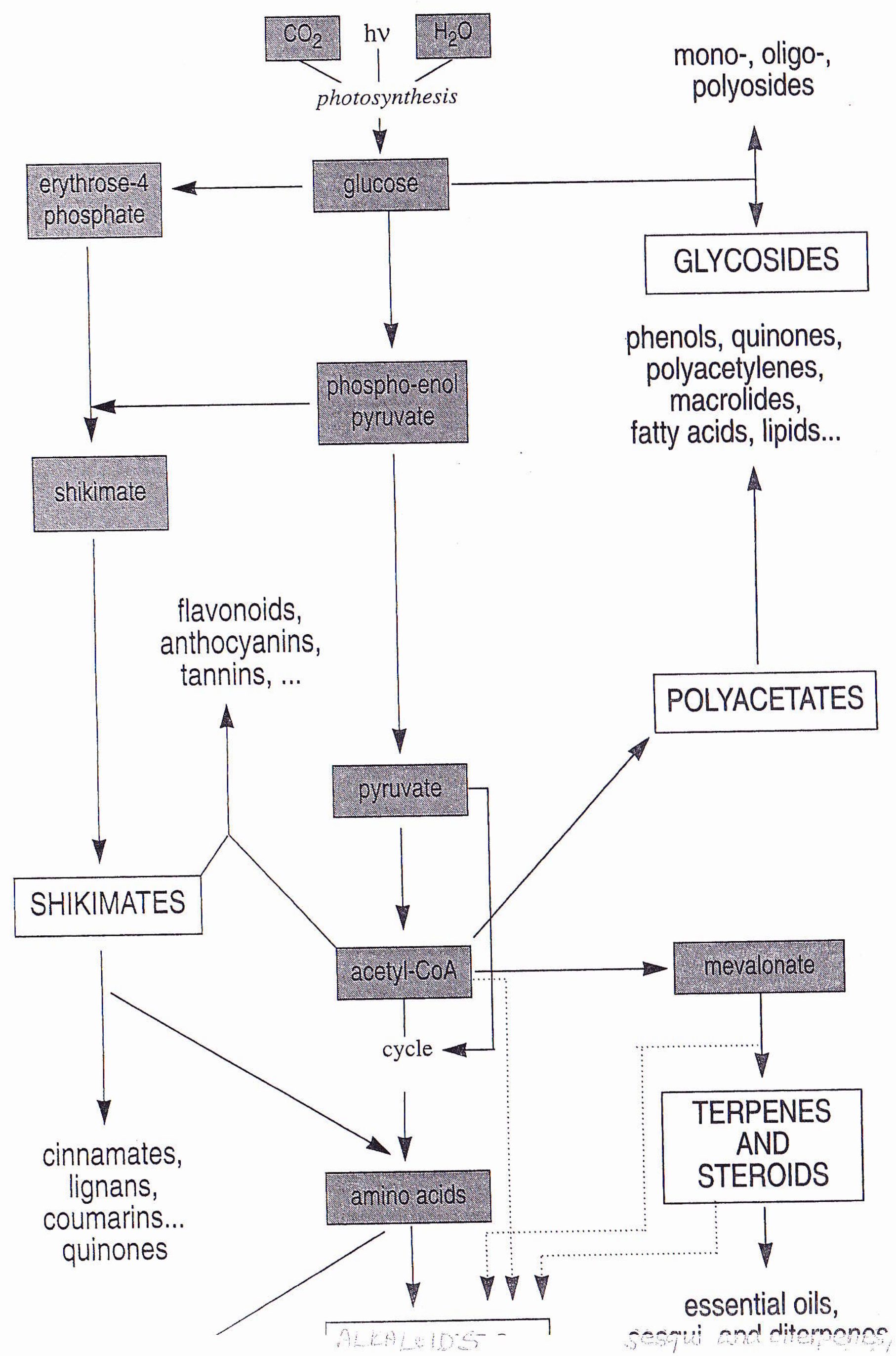
Carbohydrates are universal constituents of living organisms. They are, at first approximation, organic compounds with carbonyl (aldehyde or ketone) and multiple hydroxyl functions. The carbohydrate group also encompasses oxidized or reduced derivatives (uronic acids, polyalcohols), their esters and ethers, and their amine derivatives (amino sugars).

In plants, they are found:

- as support elements; participating in the structure of the organism (cellulose and other parietal polysaccharides);
- as energy reserves; in the form of polymers (for example starch) which store solar energy captured by the photosynthetic process;
- as constituents of various metabolites; nucleic acids and coenzymes, but also multiple glycosides, the role of which is only rarely known;
- as required precursors for all other metabolites; first formed during photosynthesis from carbon dioxide and water, they are the basis of all organic compounds of the living world (see Table on page 4).

Classically, they are distinguished as:

• monosaccharides, of the general formula $C_n(H_2O)_n$, characterized by the presence of an aldehyde (aldoses) or ketone (ketoses) carbonyl function and (n-1) hydroxyl functions *. The number of carbon atoms is most often five or six (pentose, hexose), and ranges from three to nine;



• ***oligomeric and polymeric saccharides***, resulting from the combination, through a glycosidic bond, of several monosaccharide molecules (simple or true saccharides), or of monosaccharides with non-saccharide compounds (conjugate saccharides or glycosides):

• ***simple or true saccharides***: they result from the combination of monosaccharides. The number of consecutive units distinguishes oligosaccharides (less than 10) and polysaccharides (more than 10);

• ***glycosides or conjugate saccharides***: they result from the establishment of a bond between a sugar (monosaccharide or oligosaccharide) and a non-sugar molecule (the *aglycone* or *genin*). If the bond involves a nitrogen-containing function in the aglycone, an *N*-glycoside results: such is the case of nucleosides. If this bond involves an alcoholic or phenolic hydroxyl group of the aglycone, an *O*-glycoside results: such is the case of the vast majority of glycosides that are specific to the vegetable kingdom (saponins, flavonoids, glycoalkaloids, among others). *C*-glycosides, in which the saccharide-aglycone bond is established directly between two carbon atoms, are less common (see, for example p. 435, aloin of aloe, and p. 333, flavonoids of the passion flower). Finally, *S*-glycosides, the sulfur-containing analogues of *O*-glycosides and known as glucosinolates, are characteristic of certain plant families, particularly the Brassicaceae and Capparidaceae.

Quite classically, we will not study glycosides as a group, but rather in various chapters of this text, under the heading of their aglycones, which form the basis of their pharmacological activity.

Monosaccharides, oligosaccharides, and drugs that contain them will only be discussed briefly: their importance in the pharmaceutical context—at least in terms of therapeutic applications—is indeed very limited.

In contrast, the multiplicity of pharmaceutical and industrial applications of polysaccharides will lead us to devote to them, as well as to the drugs that contain them, an important place, even if it is often their auxiliary function in manufacturing or their dietary and nutritional impact or both, rather than their pharmacological properties, that command the pharmacist's attention.