10.6 Pharmacologically Active Secondary Metabolites from Wood
C. W. W. Beecher, N. R. Farnsworth, and C. Gyllenhaal

10.6.1 Introduction

Plant-derived drugs are of major importance to the health and well-being of mankind. Although many of these useful drugs have been synthesized, very few are produced commercially by synthesis. Thus, the plant source remains extremely important, not only in producing drugs, but in providing novel biologically active model compounds from which potentially more potent and less toxic drugs may be synthesized (171, 575).

In the United States alone, for example, 25% of all prescription drugs dispensed from community pharmacies from 1959–1980 (the latest data available) contained plant extracts or active principles prepared from higher plants. This figure did not vary by more than ± 1.0% in any of the 22 years surveyed (310, 312), and in 1980, consumers in the United States paid more than $8 billion for prescriptions containing active principles extracted from higher plants (313).

On a global basis we have recently compiled data showing that at least 119 drugs are currently in use that are extracted from higher plants. These are obtained from only 91 species of plants (311). These 119 useful drugs are listed in Table 10.6.1, together with their most prominent uses. A large number of these drugs are not used in the United States for a variety of reasons. In some cases, the disease or malady for which they are useful does not exist to any degree in United States — e.g., emetine is useful to treat amoebic dysentery, which is not a condition of concern in most developed countries. Relatively few of these useful drugs accumulate to an appreciable degree in the wood of higher plants.

This review is intended to identify drugs currently in use that are found in woody parts of higher plants and to survey the current literature for additional pharmacologically active secondary metabolites extracted from wood that have interesting and/or potential future application as drugs for humans. The reader is directed to an interesting publication surveying potential useful secondary metabolites from Eastern hardwoods (884).

10.6.2 Sources of Information

Data for this review were obtained by searching the NAPRALERT computer database on natural products, which was housed on an Alpha-Micro minicomputer by the Program for Collaborative Research in the Pharmaceutical Sciences, College of Pharmacy, University of Illinois at Chicago. NAPRALERT contains data from over 75000 literature sources that treat the phytochemistry, biological activities, and medicinal folklore associated with 35000 organisms, both plants and animals. About 70% of the organisms in the database are higher plants. Approximately 195000 results of pharmacological tests and 190000 compounds identified from natural sources are contained in the database (628). Each chemical, pharmacological, or folkloric record is entered independently, and can be
The Utilization of Wood Extractives

cross-correlated with any other record type, so that data from NAPRALET
searches are printed out in the form of a table of results, rather than as a series
of abstracts from which information must be gleaned individually.

The search process used to generate the tables shown in this section took place
in several stages. In the first stage, compounds isolated from plants in predomi­
nantly woody families, or woody genera in predominantly non-woody families of
gymnosperms and angiosperms were requested. This search was conducted only
for information published from 1980—1985. Determinations of which plant fami­
lies and genera were likely to include woody species were made by referring to a
number of standard botanical references, including systematic treatments, floras,
and articles on wood anatomy in predominantly non-woody families. The print­
out that resulted from this search was inspected to determine which compounds
were likely to occur in the wood of the species listed, by noting the part of the
plant from which the compound was isolated. Wood is seldom selected for indi­
vidual analysis by phytochemists, since it is often perceived as being less likely to
contain interesting compounds than other plant parts, such as leaves and bark.
However, many plant organs that are analyzed do contain substantial amounts of
wood, and it is possible that compounds isolated from woody stems, twigs,
branches, or roots are actually contained in the woody, rather than non-woody,
tissue. Therefore, compounds isolated from any plant part that contains a sub­
stantial proportion of wood were selected for further study in this phase of the
search. These plant parts were the following: wood, sapwood, heartwood,
trunkwood, rootwood, roots, stems, trunks, branches, and twigs. Roots of peren­
nial herbs, which may contain woody secondary growth, and roots, stems, and
twigs of woody shrubs were also included. Wood from plants with unusual wood
anatomy, such as woody members of the Compositae, was also included.

The compounds selected in the first stage of the search were then used in the
second stage, which consisted of a listing of all of the experimental results of
pharmacological or biological activity testing of each compound. In this stage,
the entire database was searched. The print-out that resulted from this search con­
tains a brief summary of each experimental test to which the compound has been
submitted. The summaries include information on the test system for in vitro
tests, or the test animal in the case of in vivo tests, the dosage and dosage sched­
ule, the test protocol, the results of the test, and other information such as com­
ments concerning the validity of the testing procedures. For each compound, all
types of pharmacological or biological tests in which the compound was active
were noted. Only those biological tests, however, that are directly and obviously
related to development of new drugs were included in the final table. Thus, tests
for mutagenicity or toxicity, and tests on enzymatic systems that cannot be direct­
ly related to effects at the organism level were omitted from subsequent analysis.

Because compounds that show promise for some type of pharmacologically
significant activity may have been submitted to numerous tests by different inves­
tigators, only one example of each type of pharmacological activity was selected,
in order that the bibliography might remain as compact as possible. An effort was
made to select the best possible experimental protocol for the reference listed in
the table of pharmacological activities (Table 10.6.2). Thus, in vivo tests were se­
lected rather than in vitro tests, when possible, and tests on human subjects were