

Introduction

Plants produce poisons to protect themselves, sometimes at levels toxic enough to kill. Through trial and error, our forebears established which plants were edible and which caused harm. They then avoided the harmful species or in some cases also knowingly used them as weapons to kill rivals, criminals and animals, or as drugs to evoke hallucinations or subject victims to trial by ordeal. While knowledge of poisonous plants may have been lost among the majority of us who now buy our food in shops, scientific understanding of plant toxins and their effects has increased greatly.

SCOPE

This book uses a combination of text, photographs, diagrams and chemical structures to create a fascinating picture of how and why plants – mainly flowering plants – produce poisons (also known as toxins). Taking a global view, it describes a selection of the most historically or culturally significant, interesting and important poisonous plants, the compounds they produce and the mechanisms through which they work on animals – humans in particular. The latest research has been used throughout and is presented in a readily accessible way.

There are, of course, different degrees of toxicity, with some plants just making us a little sick. The plants described in this book, however, are at the more serious end of the spectrum; in fact, they are known to kill – hence the title of this book. Plants

that cause serious effects following contact are also included. While the symptoms resulting from such contact usually fall short of actual death in larger animals, they can be very debilitating, and often these plants are lethal to smaller animals or microorganisms.

Outside the scope of this book are carnivorous and parasitic plants. Most fungi are also excluded, the exception being a few fungi that exert their effects through their close association with plants.

BELOW Stems of oleander (*Nerium oleander*), a widely cultivated shrub from the Mediterranean, may have poisoned soldiers serving under Alexander the Great when used by them as meat skewers.



HOW THIS BOOK WORKS

Title

The type of compound or plant covered on the pages, sometimes also with an indication of the effects.

Chemical structures

The structures of the main toxic compounds found in the featured plant or plants. Provided to show the variety of structures that plants produce and to enable readers to make comparisons between compounds.

Images

Usually photographs to illustrate the plant or particular parts of the plant; botanical drawings or coloured illustrations are used on family spreads, in Chapter 10 (which looks at medicinal applications of poisonous plants) and also occasionally on standard spreads.

Yew and your heart

Taxus was the Latin name used by Romans for the yew tree, so the choice by Carl Linnaeus of the same name for the toxic genus seems pretty obvious. However, the etymology of the word is particularly interesting in a book about poisonous plants. The Romans are believed to have taken the name from the Greeks, who constructed the word *toxikon*, meaning a poison or drug used on arrows, from their word for a bow (*toxon*). As yew wood has a reputation of being the best for making bows, we have, in a way, come full circle.

DEADLY NEEDLES

PLANT: <i>Taxus baccata</i> L.	SYMPTOMS OF POISONING IN HUMANS: CIRCULATORY: abnormal heartbeat
COMMON NAMES: yew, English yew, European yew	NEUROLOGICAL: dilation of the pupils, dizziness, weakness, coma
FAMILY: yew (<i>Taxaceae</i>)	DIGESTIVE: abdominal cramping, vomiting
TYPE OF TOXIN: <i>Taxus</i> alkaloids (<i>Taxine B</i>)	

Taxine B

ABOVE: *Taxine B* is a diterpene alkaloid due to the presence of a nitrogen atom in its sidechain. It is found in many species of yew (*Taxus*) and is structurally similar to the cancer drug paclitaxel.

The yew is one of the few plants in this book that is not a flowering plant, but rather a conifer. As is typical of most other conifers, yews are trees or shrubs with modified leaves that we call 'needles'. Their seed 'cone', however, is very different from a pine cone: it is single-seeded, and by the time each seed is mature it is surrounded by a cup-shaped berry-like aril.

Yews are very slow-growing and long-lived. Probably the oldest living yew tree in Europe can be found in St Cynog's churchyard in Delyfnnog, Wales, and is thought to be around 5,000 years old. There is also evidence that the genus itself is very old in evolutionary terms. *Palaeotaxus redwivia* fossils from the Triassic, dating back some 200 million years, are recognizable as yews, as are those of *Taxus jurassica* from the mid-Jurassic, 140 million years ago.

Today, the *Taxus* genus includes 12 species found around the world, including much of Europe, north Africa, China, the Philippines and Sumatra, Mexico, the United States and Canada.

All parts of the yew, with the exception of the arils, contain *taxane* alkaloids. The toxicity is not decreased on drying, so hedge trimmings are as toxic as the plant itself. Some deer seem able to eat the foliage, and sheep have been

BELOW: Underside of a yew (*Taxus baccata*) branch, showing the pale lower surface of its needle-shaped leaves and both immature green and mature red berry-like arils, each surrounding a single seed.



ABOVE: With an estimated age of 5,000 years, the Delyfnnog yew (*Taxus baccata*) in St Cynog's churchyard in Wales is thought to be the oldest living tree in the United Kingdom and the oldest yew in Europe.

known to browse on it unharmed. However, other animals – including horses, cattle, dogs, and humans – are poisoned if they eat the leaves or branches. Poisoning of livestock is usually prevented by ensuring that they do not have access to these trees.

FOOD FOR BADGERS

The non-toxic arils produced by yews are sweet and of a gelatinous consistency when ripe. Their scarlet or scarlet-orange colour makes them easily seen by birds, which eat them whole, including the seed. The seed then passes through the bird and is deposited elsewhere. Children attracted by the arils usually have the good sense to spit out the seeds, which are larger than the seeds of a grape, and so do not come to any harm.

Scientists at the Royal Botanic Gardens, Kew, observed European badgers (*Meles meles*) eating yew arils off the ground and even standing on their back legs to eat them off the trees. They wondered why the animals were not poisoned. Dung pils found nearby that were full of partially digested arils and apparently intact seeds provided a possible answer. But being scientists, they wanted to test whether the seeds were in fact undamaged by the badgers' digestive system. They used liquid-chromatography mass-spectrometry (LC-MS) analysis (which separates and measures the mass or weight of compounds) to determine the presence and concentrations of alkaloids in arils and seeds taken from the trees, and also in seeds that had passed through the badgers. They found that there was no difference in the concentration of the main

toxins in the seeds before or after they had been eaten. They also confirmed that the arils contained no alkaloids. The appearance of the arils in the dung suggests that they and the seeds pass through the badgers' digestive system very quickly, and the analysis confirmed that the seeds remained undamaged during their passage.

A Pocket Full of Rye

English crime writer Agatha Christie (1890–1976) qualified as an apothecary's assistant in 1917 and worked as a pharmaceutical dispenser in both world wars. She was thus familiar with the drugs and poisons of the early twentieth century, and subsequently wrote them into the plots of some of her 66 detective novels. *A Pocket Full of Rye* (1955) tells of the events at Yewtree Lodge, where the wealthy Rex Fortescue, his latest wife and the maid (who had been trained by the amateur sleuth Miss Marple) are all murdered, the first death being due to rye poisoning. In this twisting story of hidden identities and generational vengeance, the murderer needs to solve the problem of the bitter-tasting yew toxins. To mask this telltale sign, the poison is mixed in English marmalade made of Seville oranges, whose peel already imparts a slightly bitter taste to the spread.

Fact files

Details of the featured plants, including their scientific name and the author (following Kew's Medicinal Plant Names Services; see pages 15 and 219); commonly used scientific names that are no longer current follow in parentheses with the designation 'syn.' for synonym; plant family (following the Angiosperm Phylogeny Group IV; see page 219); most widely used common names; the type(s) of toxin they contain and in parentheses the most important or abundant compounds of each type; and lastly, the symptoms they cause, divided into parts of the body and ordered from least to most serious. Symptoms usually relate to poisoning in humans after a single dose or ingestion, but if they follow other circumstances or affect other animals this will be indicated.

ARRANGEMENT

Although the end result of eating these killer plants is the same, they cause death by targeting a variety of organs and systems in the body. These targets are used to group the plants into chapters within the book, with the first pages of each chapter introducing the diverse mechanisms of action of the compounds it covers. Subsequent pages explore each type of compound, and feature the plant or plants that cause the most serious or numerous poisonings. Other plants are also included if they have an important place in humanity's relationship with these harmful compounds. Chapter 10 is slightly different, as it

looks at some of the numerous plants whose toxic compounds are used by humans as medicines or insecticides.

Some plant families include a large number of poisonous plants, and in an interesting twist many of them are also important sources of plants that are commonly eaten. These families are introduced on coloured feature pages, interspersed throughout the book. They provide an overview of the family, named according to a recent international classification (see page 219), and link together the plants from that family that are covered elsewhere in the book.