

# Tropical spices

*Syzygium aromaticum* (Myrtaceae, Eucalyptus family): Native to Spice Islands of Indonesia; cloves are the unopened flower buds picked just before opening and then dried

Valued in ancient China to sweeten the breath of court officials before speaking with the emperor

High content of phenolic compound eugenol (clove oil); clove buds have highest concentration of volatiles of any spice (17%)

Eugenol suppresses microbes so used in mouthwashes

Used to flavor meats and in various desserts; major component of Indonesian cigarettes



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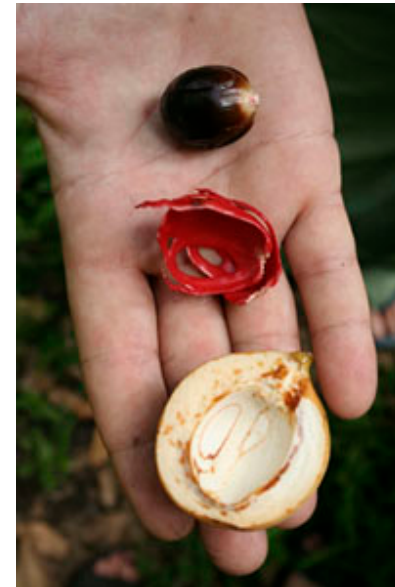
## Nutmeg and mace

*Myristica fragrans* (Myristicaceae): Native to Spice Islands

Dioecious, producing single-seeded drupe fruit. When ripe the mesocarp splits open, exposing the seed covered a red, fleshy aril; color and sugars of aril attract seed dispersers

Mace: dried and ground aril; Nutmeg: dried seed (outer stony endocarp is removed); mainly endosperm

Main flavor due to compound myristicin; nutmeg is toxic in large quantities, hallucinogenic at intermediate doses





*Think Spice, Think Nutmeg*

Note: pepper spray has capsaicin as an active ingredient; MACE is simply the brand name for phenacyl chloride spray



## Ginger family (Zingiberaceae)--close relative of bananas

**Ginger** (*Zingiber officinale*): Native to tropical Asia; spice from rhizome (underground stem).

One of the most important spices in medieval Europe--gingerbread from this period.

Ginger beer and ginger ale created in English taverns during 19th century by sprinkling powdered ginger onto drinks.

Pungency from gingerols (chemical relatives of capsaicin and piperine), less pungent than the other two compounds.

Jamaica considered to produce the world's best ginger.





## Ginger family (Zingiberaceae)

**Turmeric** (*Curcuma longa*): Native to India, spice from rhizome used as yellow colorant for skin, clothing and foods.

Major component of curry powders.

Major pigment is curcumin, an antioxidant that is being tested as an anticancer drug.



## Ginger family (Zingiberaceae)

**Cardamom** (*Elettaria cardamomum*): native to mountains of SW India and grown only there until 1900 when it was brought to Guatemala, now the world's largest producer.

Third most expensive spice.

Seeds of plant harvested from dry capsules before they split open.



**Fun fact: what is the most expensive spice by weight?**



**What is the most expensive spice by weight?**

Saffron (*Crocus sativus*)

## What is the most expensive spice by weight?

Saffron (*Crocus sativus*)

Stigma, sometimes also style

Sterile mutant with long stigmas (wild form is *Crocus carthrichtianus*); originally arose in late Bronze age Crete

Powerful colorant from crocin; flavor from volatile terpene safranal

Iran produces 94% of world's saffron

1 lb dry saffron = 50,000-75,000 flowers!

In US, Pennsylvania Dutch grow saffron



**2nd most expensive is...**



**2nd most expensive is...Vanilla (mainly *Vanilla planifolia*; Orchidaceae)**

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- First cultivated in Mexico ca. 1,000 years ago and used by Aztecs to flavor chocolate



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- Cure pods by exposing to hot temperatures to kill pod, then alternate heat with wrapping in cloth to sweat, freeing vanillin and related compounds; finally dry for several weeks
- Vanilla extracts made by washing chopped pods with alcohol and water, as many of the flavor compounds are more soluble in alcohol
- Demand far exceeds supply: 90% vanilla flavoring consumed in US is artificial; synthetic vanillin is made from products such as wood pulp or clove oil

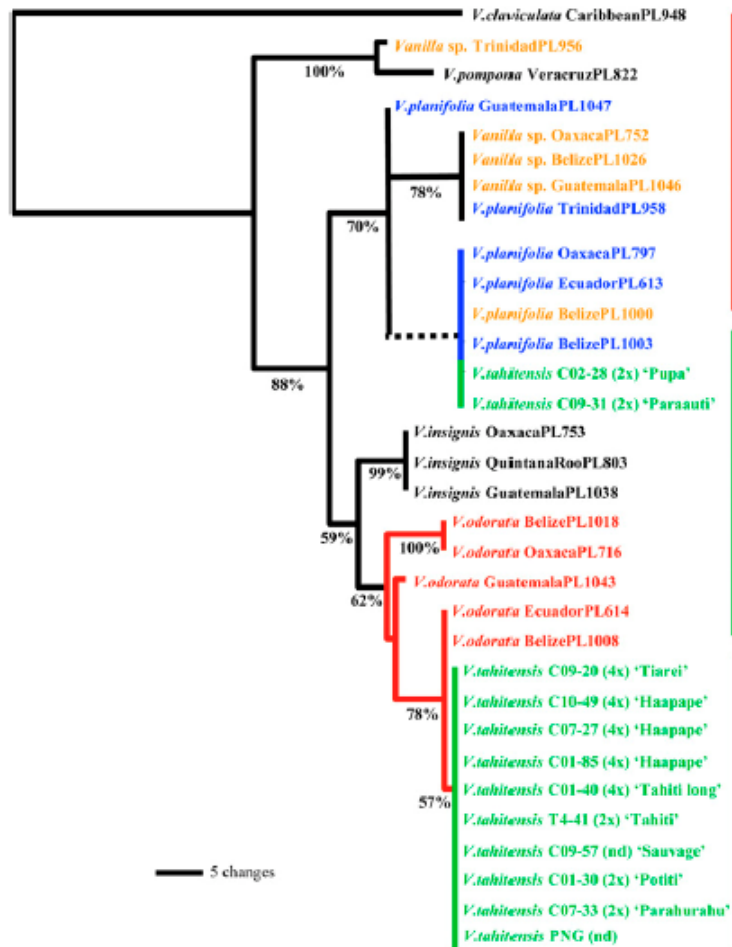
BRIEF COMMUNICATION

**NEOTROPICAL ROOTS OF A POLYNESIAN SPICE: THE HYBRID  
ORIGIN OF TAHITIAN VANILLA, *VANILLA TAHITENSIS*  
(ORCHIDACEAE)<sup>1</sup>**

PESACH LUBINSKY,<sup>2,7</sup> KENNETH M. CAMERON,<sup>3</sup> MARÍA CARMEN MOLINA,<sup>4</sup> MAURICE  
WONG,<sup>5</sup> SANDRA LEPERS-ANDRZEJEWSKI,<sup>5</sup> ARTURO GÓMEZ-POMPA,<sup>6</sup> AND SEUNG-CHUL KIM<sup>2</sup>



**A Nuclear phylogeny  
(ITS of nrDNA)**



**B Organelle phylogeny  
(trnH-psbA of cpDNA)**

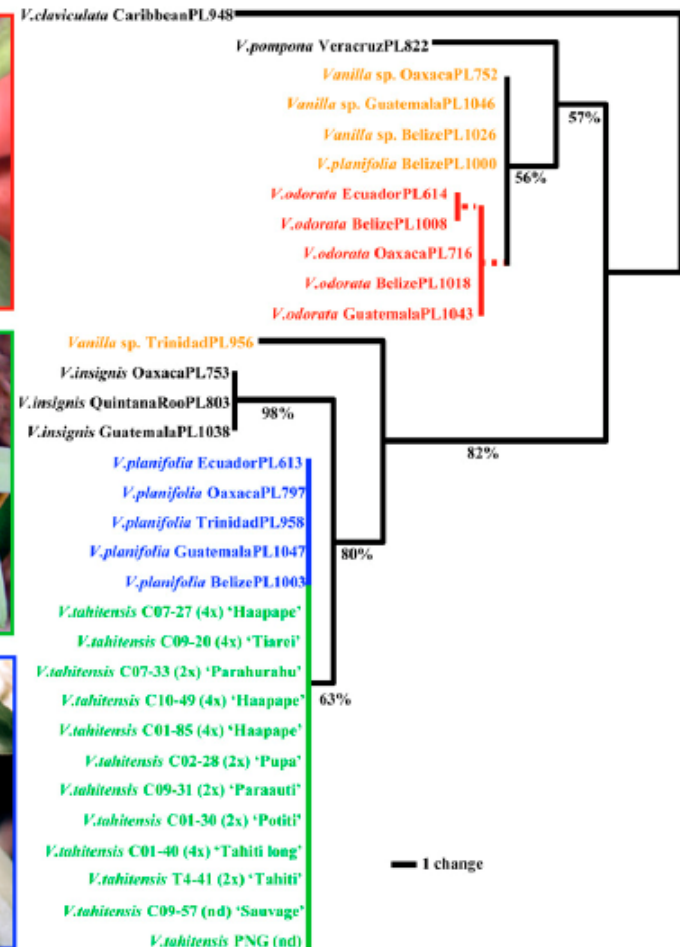
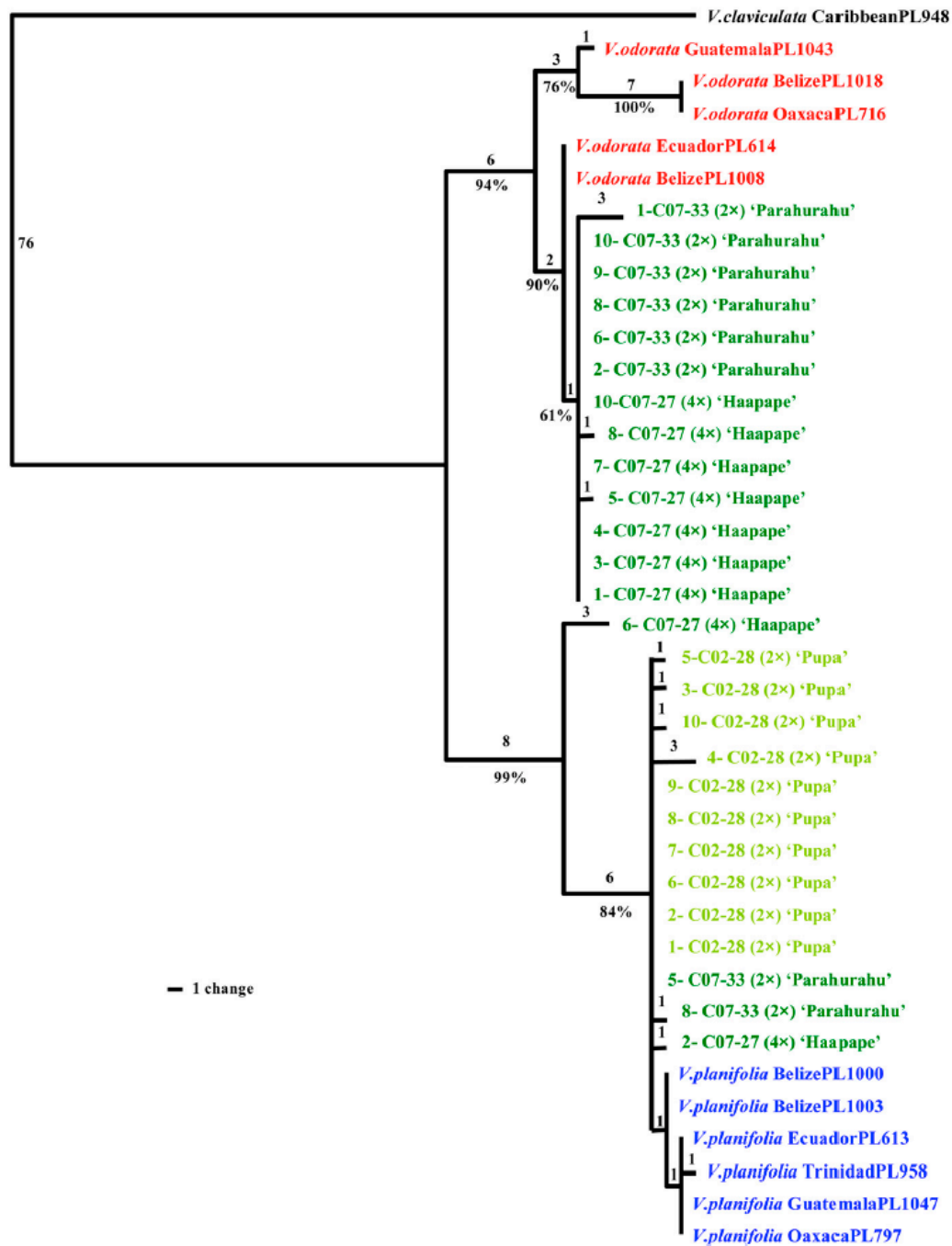


TABLE 2. Additive polymorphic sites (APS) in *Vanilla tahitensis* relative to its parental species, *V. planifolia* and *V. odorata*. Only bp37 (shown in bold) is not additive when compared to its parental alleles. Base calls include all variation found among individuals that were surveyed.

Taxon	1. bp15	2. bp36	3. bp37	4. bp55	5. bp62	6. bp90	7. bp95
<i>V. odorata</i>	T	A	<b>T</b>	C	C	C/T	T/C
<i>V. tahitensis</i> <sup>§</sup>	Y	R	<b>C</b>	Y	Y	Y	Y
<i>V. tahitensis</i> <sup>†</sup>	C	G	<b>C</b>	T	T	C	T
<i>V. planifolia</i>	C	R	<b>Y</b>	Y/T	T	Y/T	T
	8. bp146	9. bp172	10. bp181	11. bp184	12. bp191	13. bp407	14. bp418
<i>V. odorata</i>	T	A	G	A/G	T	T	C
<i>V. tahitensis</i> <sup>a</sup>	Y	R	R	R	Y	Y	Y
<i>V. tahitensis</i> <sup>b</sup>	C	G	A	A	C	C	T
<i>V. planifolia</i>	C	R/A/G	A	A	C	C	T
	15. bp430	16. bp431	17. bp454	18. bp482	19. bp486	20. bp489	21. bp503
<i>V. odorata</i>	T	T	C/T	A	T	T	G
<i>V. tahitensis</i> <sup>a</sup>	Y	K	Y	R	K	Y	K
<i>V. tahitensis</i> <sup>b</sup>	C	G	C	G	G	C	T
<i>V. planifolia</i>	C	G	C	G	G	Y	T/K

<sup>a</sup> *V. tahitensis* accessions C09-20, C10-49, C07-27, C01-85, C01-40, T4-41, C01-30, and C07-33.

<sup>b</sup> *V. tahitensis* accessions C02-28 and C09-31. Y = T+C, R = A+G, K = G+T.



# **Psychoactive drugs and poisons**

Many of the same or similar compounds found in plants used as drugs or poisons as for herbs and spices

Dosage can also differentiate whether same plant product is used as poison or a drug or even for medicinal use.

## All plants produce secondary compounds/metabolites

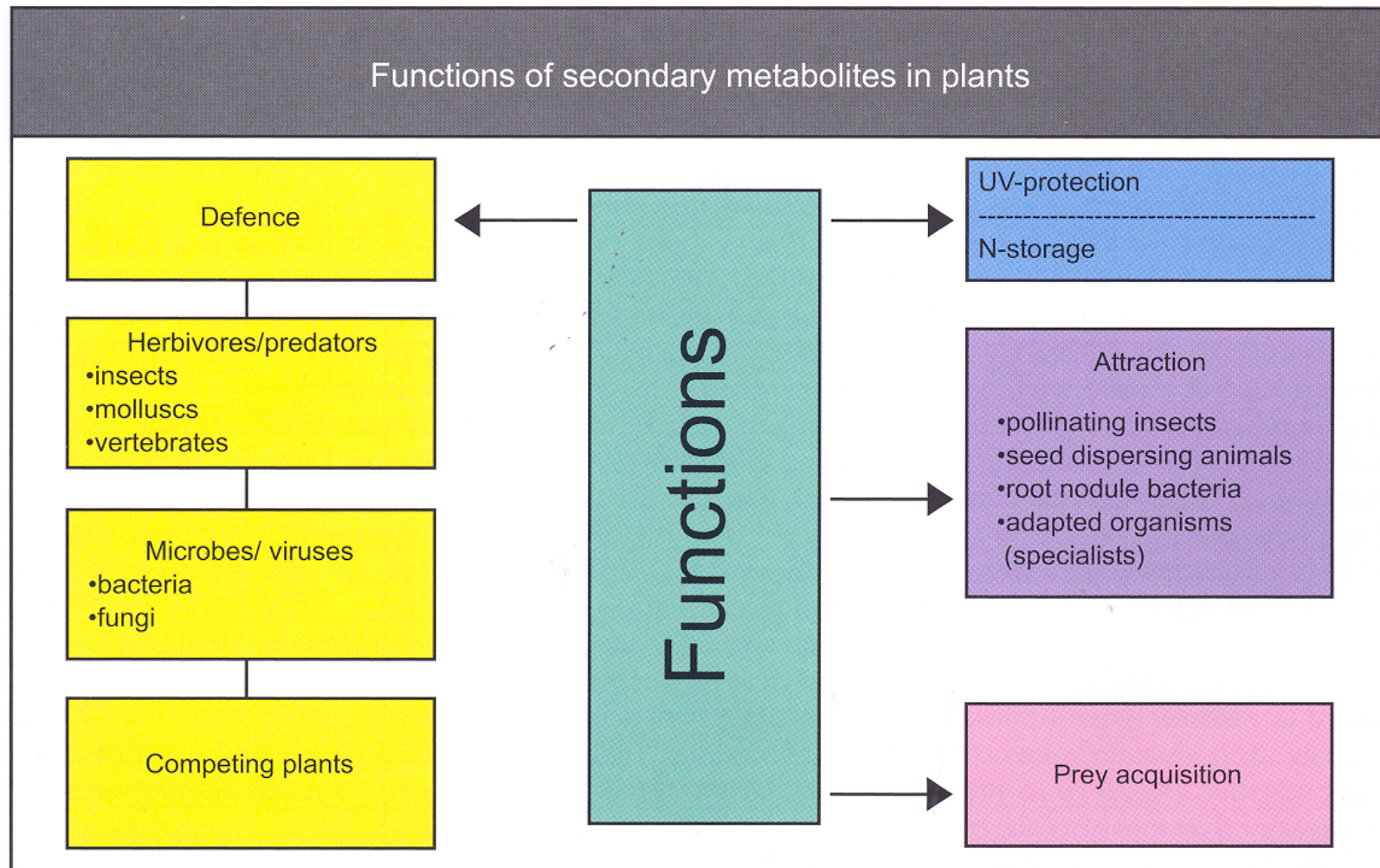


Table reproduced from Wink & van Wyk, 2008. *Mind-altering and poisonous plants of the world*.



## Fewer defense compounds in ripe fruits; seeds usually most toxic

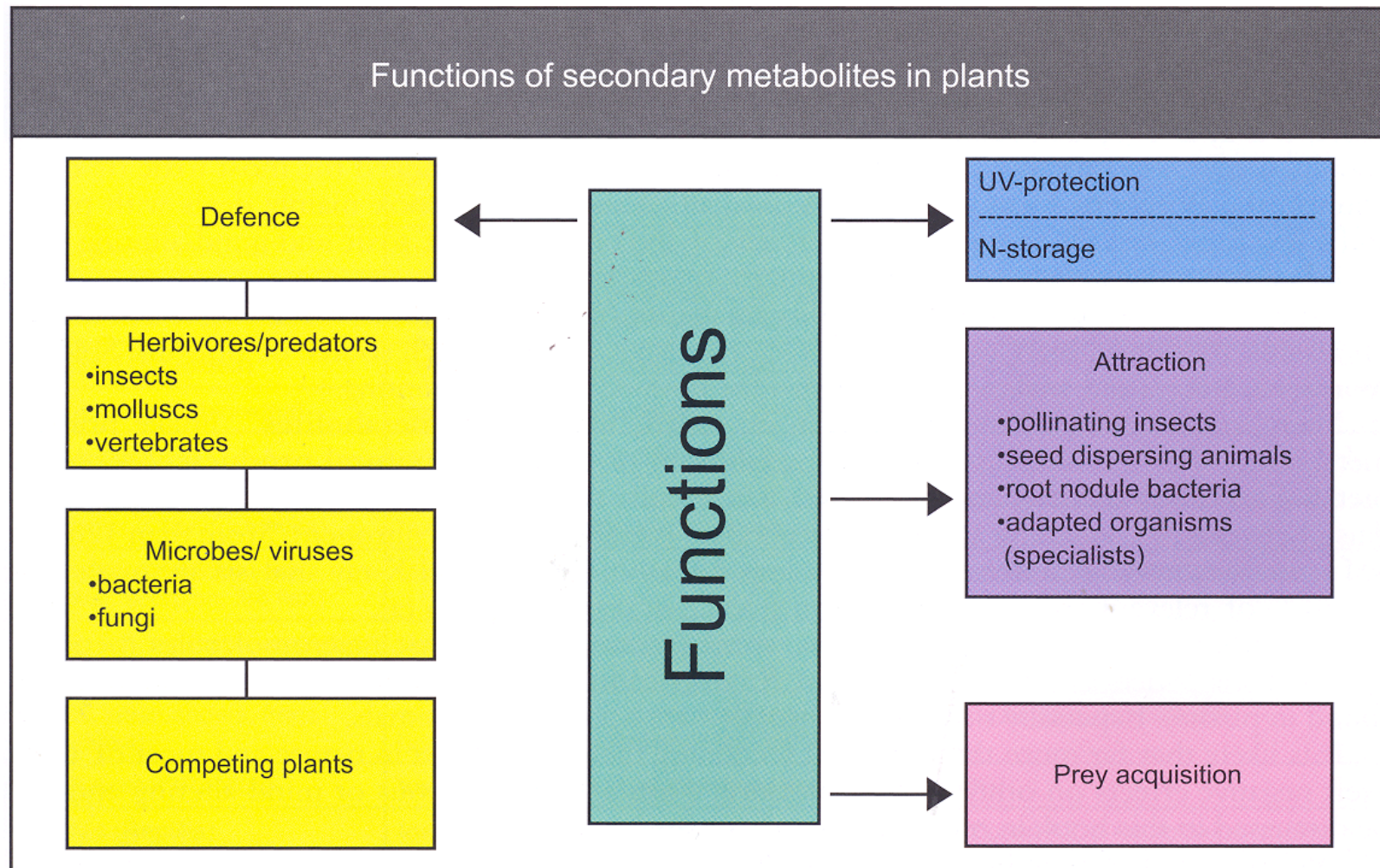


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**Toxins** interfere with central functions of an organism

- Compounds most poisonous to animals are neurotoxins that affect the brain and nervous system
- Also dangerous are cytotoxins and metabolic poisons that affect the liver, kidneys, heart, or respiration

Extremely toxic compounds include: alkaloids, cardiac glycosides (steroids), phorbol esters (diterpenes), lectins, & cyanogenic glucosides

Structural types of plant secondary metabolites and abundance of poisons and psychoactive substances			
Class	Number of structures	Poisons	Psychoactive substances
<b>With nitrogen</b>			
Alkaloids	20000	most	many
Non-protein amino acids (NPAAs)	700	some	few
Amines	100	some	some
Cyanogenic glucosides	60	most	few
Glucosinolates	100	some	none
Alkamides	150	most	none
Lectins, peptides, polypeptides	2000	most	none
<b>Without nitrogen</b>			
Monoterpenes (including iridoids)	2500	some	some
Sesquiterpenes	5000	many	few
Diterpenes	2500	many	few
Triterpenes, steroids, saponins	5000	most	few
Tetraterpenes	500	none	none
Phenylpropanoids, coumarins, lignans	2000	some	few
Flavonoids, tannins	4000	some	none
Polyacetylenes, fatty acids, waxes	1500	some	few
Polyketides (anthraquinones)	750	most	none
Carbohydrates	200	few	none

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Yew (*Taxus baccata*; Taxaceae)

- Poison in antiquity (murder, arrow poison); abortifacient; main compounds diterpenes
- Leaves and seeds are poisonous, *not* red aril
- “Toxin” comes from extracts of this plant referred to as “taxica” or “toxica”



Approximately 750 **very** poisonous substances in >1000 plant species







What plant family??





Apiaceae (Carrot family)

*Conium maculatum* (Poison hemlock)





Apiaceae (Carrot family)

*Conium maculatum* (Poison hemlock)

- Piperidine alkaloids are neurotoxins
- Given to Socrates as death potion

Ordeal trees in Africa used for determining guilt or innocence

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*Erythrophleum* species (Fabaceae)

Tea from pounded bark contains toxic diterpene alkaloids

Used as arrow and fish poison