Saponins: Part-2

Course Code: 0521511
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Learning Outcomes

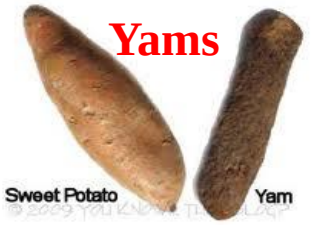
At the end of the lecture students will be able to

- **Outline botanical name, family name, chemical constituents, medicinal uses, side effects of**
  - **Dioscorea species**
  - **Ginseng Saponins**
  - **Siberian ginseng**

Dioscorea species
(> 600 species)
Family: **Dioscoreaceae**

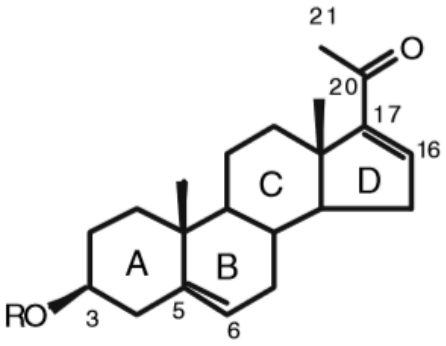
- **Important species:** *D. alata*, *D. panthaica*, *D. parviflora*, *D. villosa*, *D. collettii*, ver. *Hypoglauca*, *D. spongiosa*, *D. pseudojaponica*
- Dioscorea sp. are creeping and climbing vines, typically herbacious
- May reach up to **5 m in hight**, given support from trees and shrubs
- **Part of the plant used: Roots or Tubers,** also known as **Yam**
- **Tubers** of this species **reach maturity in 3-5 years**.
- **Yam** contributes to the **basis of food** for the millions of population of Asia, Africa and Tropical America.
- ***D. alata*** is one of the **dioecious** and **major cultivated species** with wide geographical distribution

Dioscorea species

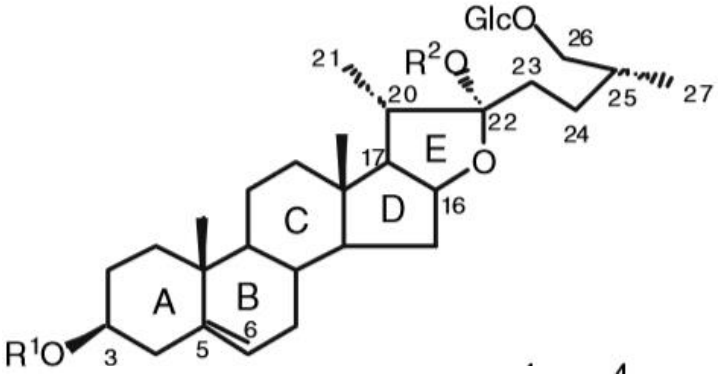


Chemical Constituents:

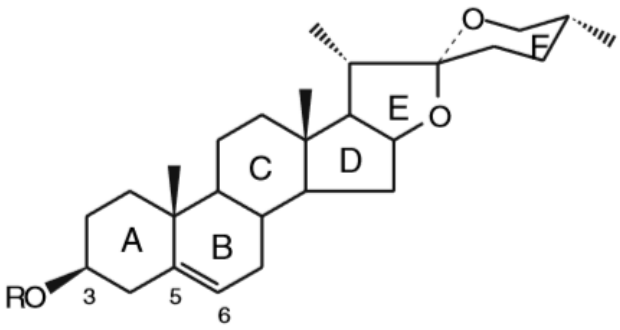
- More than **50 steroid saponins** discovered from 13 D. species
- On average **yams yield >2%** of saponins and **sapogenins**
- The structures of the aglycones belonged to three skeleton types:
  - **Pregnane**, a **tetracyclic** ABCD-ring system
  - **Furostane**, a **pentacyclic** ABCDE-ring system with a sixth open F ring
  - **Spirostane**, a **hexacyclic** ABCDEF-ring system (eg. **disogenin**)
    - All spirostane saponins are derivatives of **disogenin.**



Spongipregnoloside A
(R=Rha-Glc)



Protodioscin
(R^1=Rha-Glc-Rha, R^2=H)



Disogenin (R=H)
Dioscin (R = Rha-Glc-Rha)

Dioscorea species

Medicinal Uses:

- **Disogenin** is used as the **starting material in the synthesis of many steroids** (cortisone, pregnenolone, progesterone) which are on the market as **anti-inflammatory, androgenic, estrogenic**, and **contraceptive** drugs.
- This class of **compounds/saponins** are reported to possess cytotoxic, antitumor, antifungal, immunoregulatory, hypoglycemic, and cardiovascular properties.
- **Traditional Chinese Medicine** shows many therapeutic uses of D. species
  - **Anticancer agents** (*D. colletii* var. *hypoglauca*),
  - **Cardioprotective, cerebrovascular, gastroprotective agents** (D. panthaica)
  - **Anti-rheumatism agents** (*D. nipponica*, *D. futschauensis*)

Ginseng Saponins

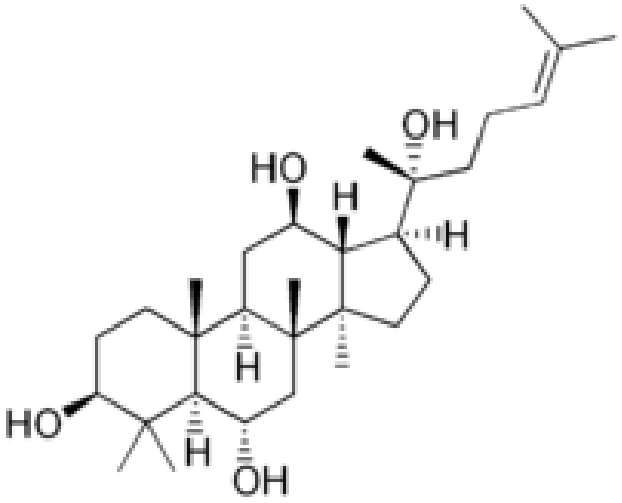
- Ginseng is a **perennial herb** species of genus **Panax**
- Family: **Araliaceae**
- The name "**ginseng**" originates from the Chinese words "**Jen Sheng**" means "**man herb**" because of **human-like shape of the root or rhizome** of plant
- The word **Panax** means "**cure all**"
  - Traditional belief that ginseng has properties that heal all body diseases.

Ginseng Saponins

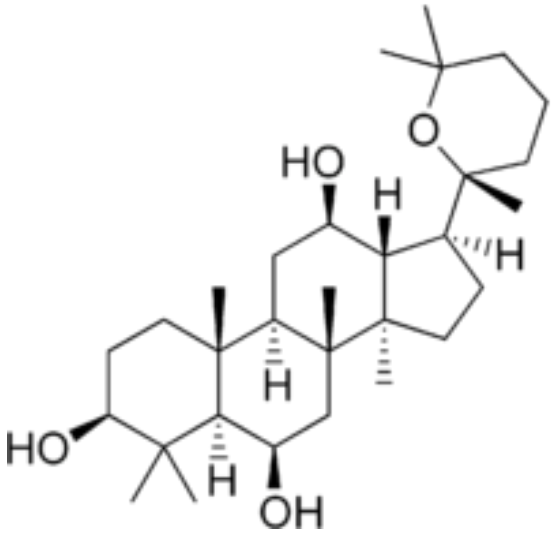
- To date, **12 species** have been classified under the genus ***Panax***
- Three species are mainly used as herbal medicines worldwide:
  - *Panax ginseng* M. (Korean ginseng)
  - *Panax notoginseng* (Chinese ginseng)
  - *Panax quinquefolius* (American ginseng)
- Other plants that have some properties in common with *Panax ginseng* have been allegedly called "**ginseng**"
- "**Ginseng"** has become a blanket term that covers all the species
- Medicinally used part: **ROOT**
  - Roots are **collected** at the **age of 3-6 years**.

Ginseng Saponins

- **Chemical Constituents:**
- Ginseng contains up to **3% of saponins** (ginsenosides / panaxosides)
- More than **200** ginsenosides have been reported
- **Ginsenosides** can be broadly divided into two groups based on the carbon skeletons of their aglycones**:**
  - **Dammarane Type Saponins:** protopanaxadiols, protopanaxatriols
    - **Accounts for significant portion of saponins in Ginseng species**
  - **Oleanane Type Saponins:** Ginsenoside Ro
    - Rare except Ginsenoside Ro

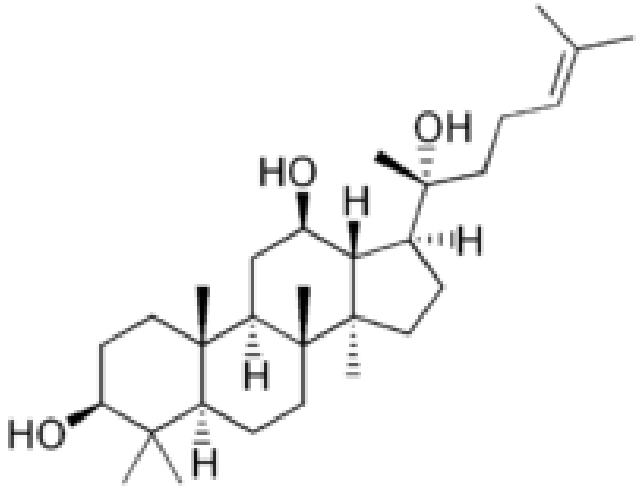


Protopanaxatriol

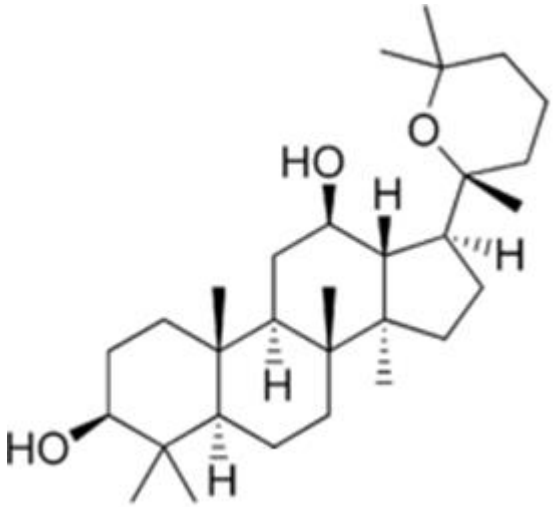


Panaxatriol

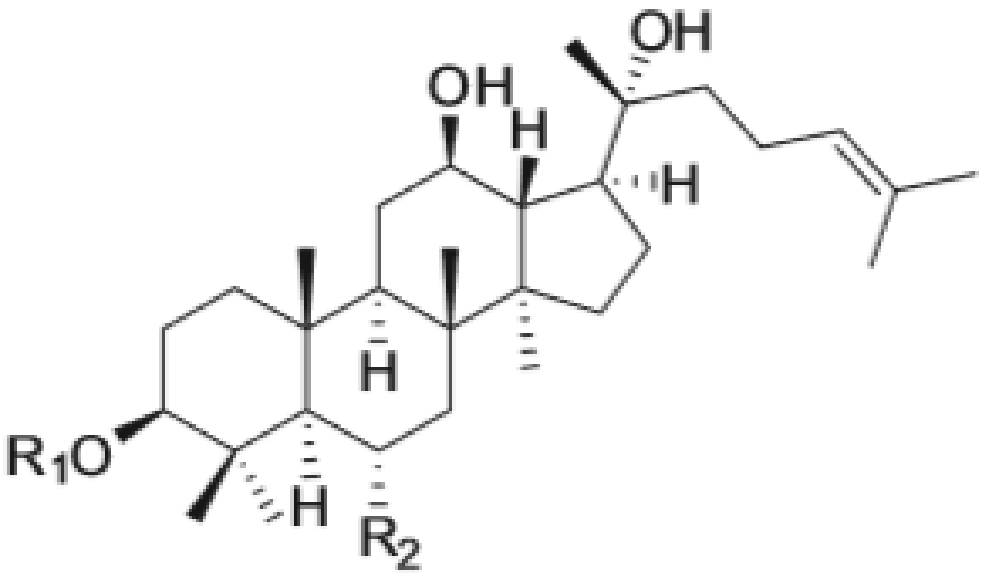
Panaxatriol is formed by the dehydration of protopanaxatriol.



Protopanaxadiol



Panaxadiol

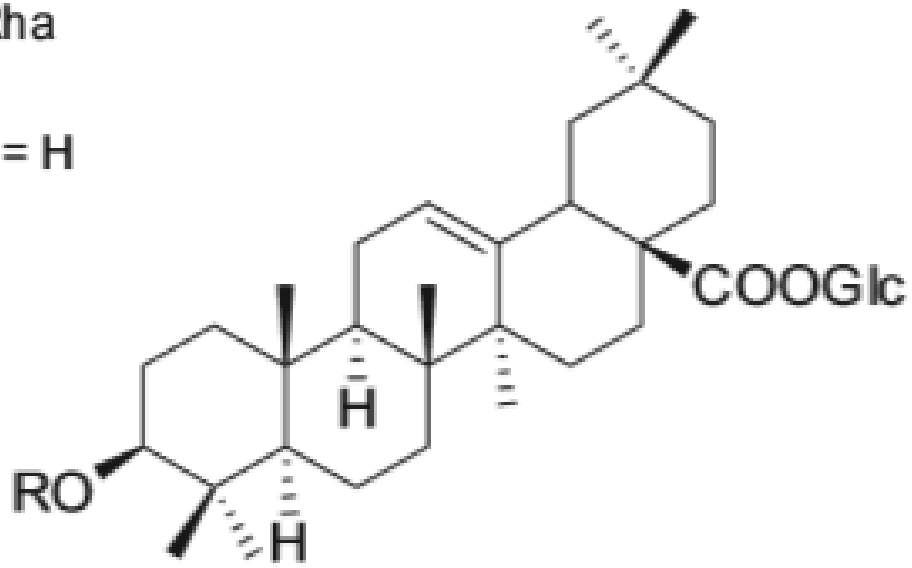


20(*R*)-ginsenoside Rh1: R_1 = H, R_2 = O-Glc

20(*R*)-ginsenoside Rg2: R_1 = H, R_2 = O-Glc^2-Rha

20(*R*)-ginsenoside Rg3: R_1 = Glc^2-Glc, R_2 = H

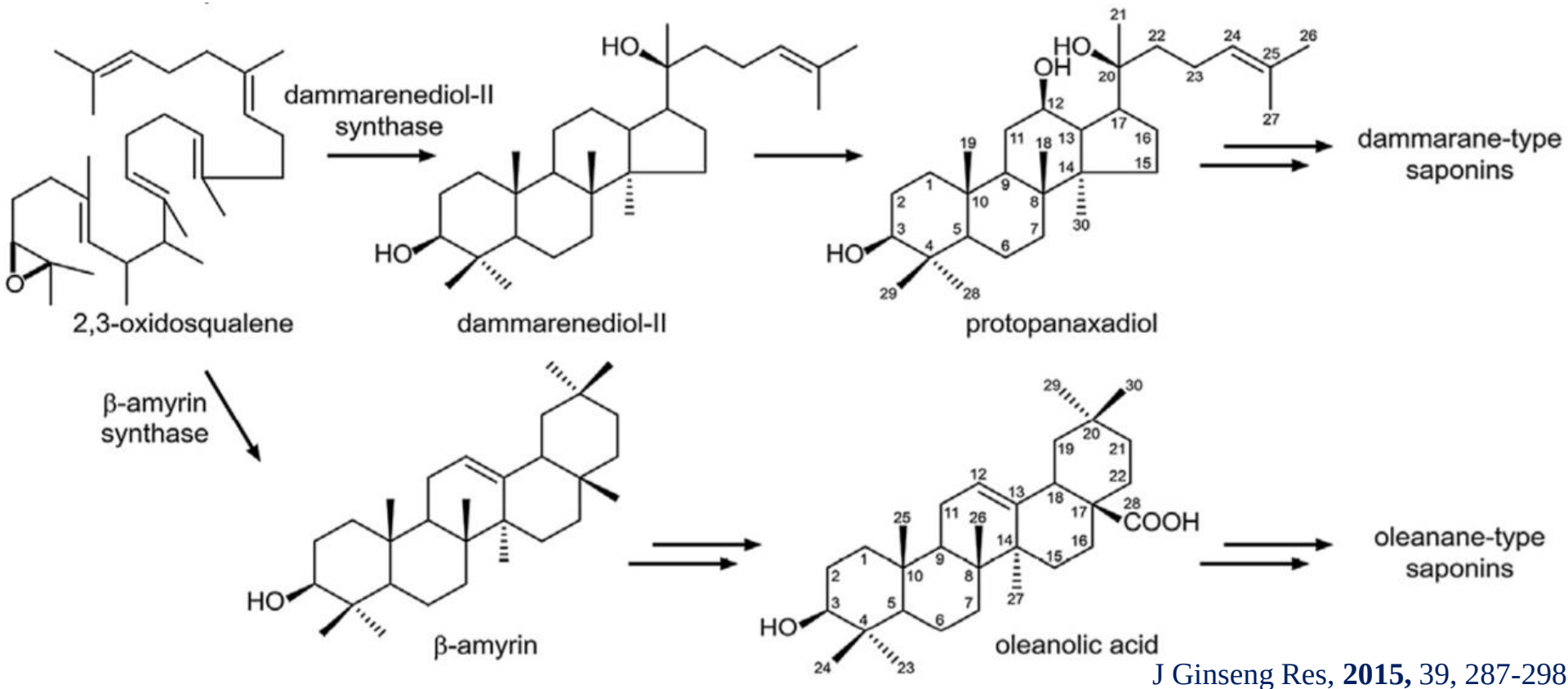
20(*R*)-ginsenoside Rs3: R_1 = Glc^2-Glc^6-Ac, R_2 = H



Ginsenoside Ro: R = $GlcUA^2$-Glc

Biosynthesis of Ginseng Saponins (*Ref. J Ginseng Res, **2015**, 39, 287-298*)

- Most ginseng saponins are biosynthesized from **2,3-oxidosqualene**
- **Dammarenediol-II synthase** converts **2,3-oxidosqualene** to **dammarenediol-II**
  - **Dammarenediol-ii is the** precursor of dammarane type saponins
- **β-amyrin synthase** converts **2,3-oxidosqualene** to **β-amyrin**
  - **β-amyrin is the** precursor of oleanane type saponins



J Ginseng Res, **2015,** 39, 287-298

Medicinal Uses of Ginseng Saponins

- **Fresh ginseng** tends to be **degraded at room temperature**
- It is processed into **white ginseng** through **air drying of the root**
- It is processed into **RED ginseng** through **root steaming** following air drying
- **Red ginseng** is **more beneficial** than **fresh** and **white ginseng:**
  - As functional food or nutritional supplements
  - **Higher pharmacological and medicinal functions**
  - In **reducing side effects**

J Ginseng Res, **2015,** 39, 287-298

Medicinal Uses of Ginseng Saponins

Uses

- It has an adaptogenic (antistress, anti-fatigue) effect.
- It improves both physical and mental performance including learning, memory and physical capabilities.
- It improves the immune function.
- It improves liver functions and metabolism.
- It stabilizes blood glucose and blood pressure.
- Ginsenosides believed to act on **CNS**, and also found to have **antioxidant** and **antiinflammatory** properties as well as **cortisol-modulating effects**.

Ginseng abuse syndrome:

a. Hypertension
b. Skin eruption
c. Edema
d. Diarrhea
e. Mastalgia in females (mastalgia: breast pain)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Mental Clarity
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FOCUS
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Lemon Balm
Gingko
6-1.69 FL OZ BOTTLES
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90 Tablets

Siberian ginseng

Eleutherococcus senticosus

- The **rhizomes** are used for their medicinal effect and it contains constituents termed ***Eleutheroside glycosides*** **(A-G, M).**
- Panax-type ginsenosides of Asian ginseng are not found in Siberian ginseng
- Also, it has **coumarins**, and a group of compounds which are called **heteroglycans** (eleutherans A-G), which have **hypoglycemic effect.**
- The plant has been used in China for many centuries for the treatment of **rheumatoid arthrities.**

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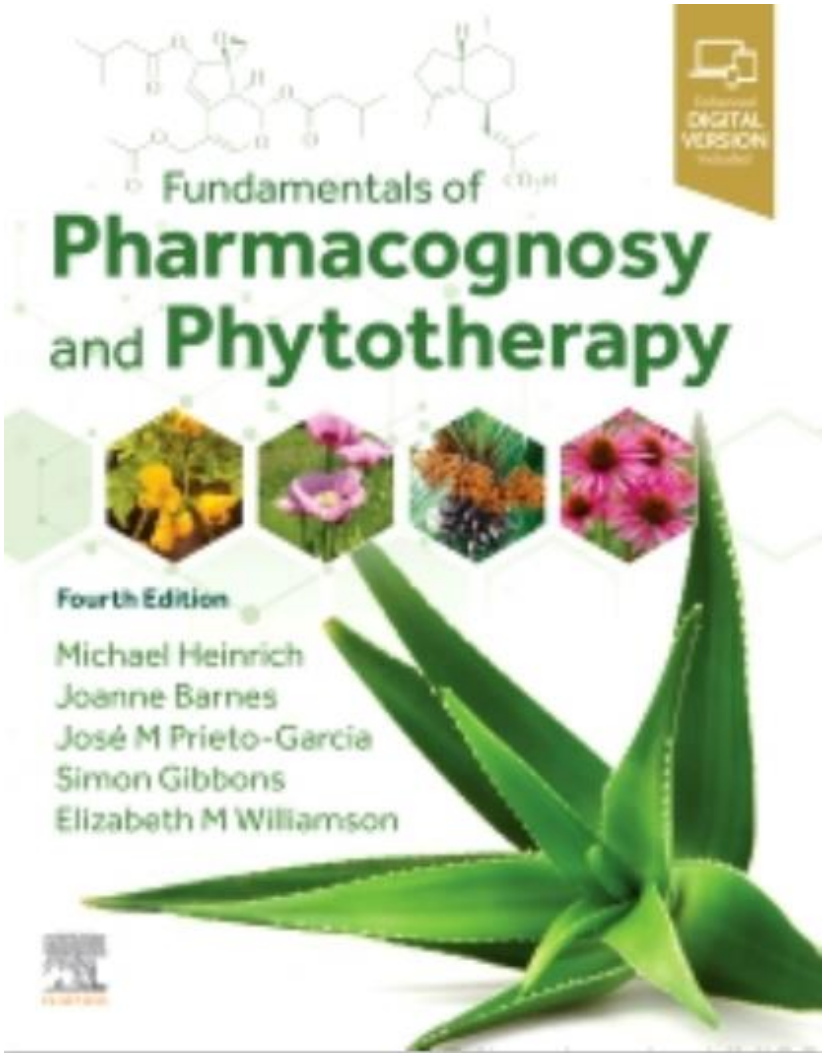
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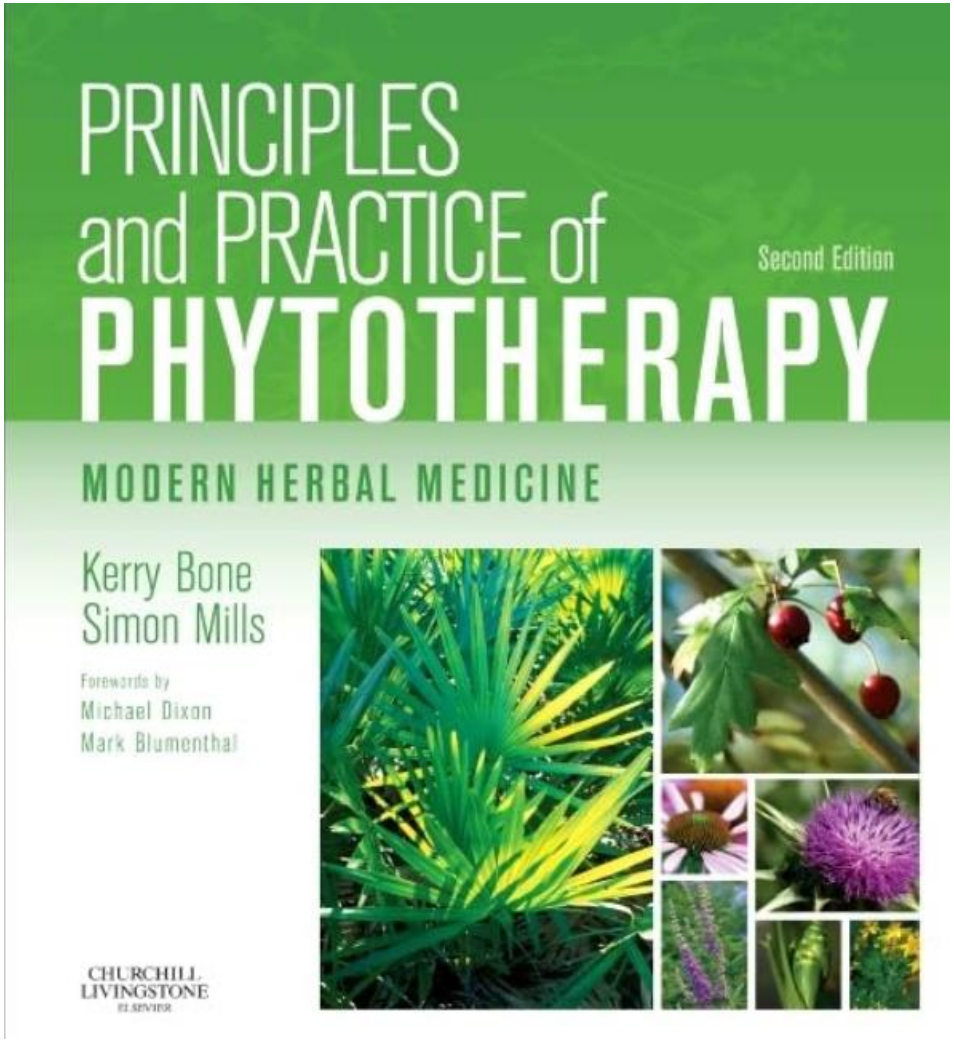
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