

Traditional Chinese Medicine (TCM)

- Chinese herbal medicine represents only one part of Traditional Chinese Medicine, which also encompasses acupuncture, cupping theory, meditation and other methods.
- All methods deeply based in Taoist and Buddhist thought.

Chinese Herbal Medicine

- Currently 12,807 Chinese medicines officially documented of which there are 11,146 plants, 1,581 animal species and 80 minerals.
- Of these, roughly 500 are still commonly used.

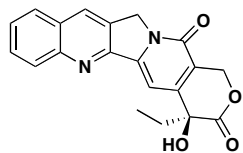
History

- The first records of the use of Chinese medicine date back to hieroglyphics during the Shang dynasty in the eleventh century BC.
- The first formal manual on pharmacology was the Shennong Bencao Jing which lists 365 medicines and dates to roughly the 1st century in the Han dynasty.
- The next major and still most influential text was written during the Ming dynasty by Li Shizhen in 1596. Over a 40 year period he compiled his book Bencao Gangmu (Compendium of Materia Medica) which contains more than 1,800 drugs with 1,100 illustrations and 11,000 prescriptions.

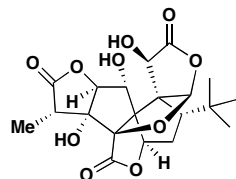
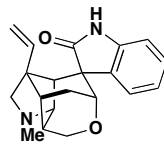
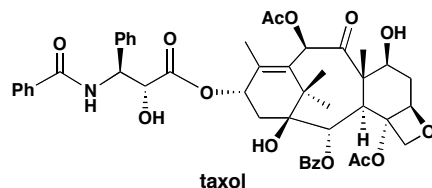
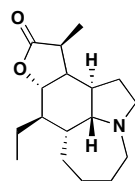


- Treatment with TCM is highly personalized, based on a patient's current state of yin and yang (The Four Natures), the Five Tastes and the Meridians. Unlike in western medicine, many times the efficacy of the treatment is believed to be based upon the balance and interaction of the combined ingredients, rather than on specific constituent being the cure.
- In the Four Natures, each herb has a quality of hot or cold (yin/yang) associated with it, in which it can be used to balance out a person's own yin/yang state.
- The Five Tastes consist of sweet, sour, bitter, salty and pungent, each of which has its own set of features and effects.
- The Meridians involve which organs the herbs effect, which in turn have their own set of elemental qualities associated with them (wood, fire, earth, water and metal).

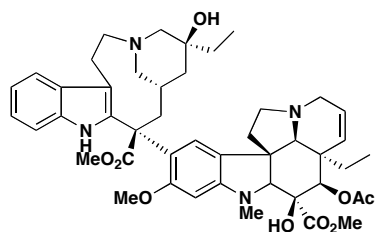
A sampling of the molecules found in Traditional Chinese Medicine that are not covered in this presentation

**Camptothecin**

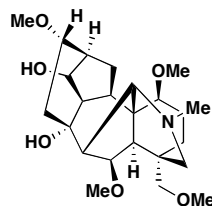
See camptothecin group meeting

**ginkgolide B****gelsemine****taxol****stenine**

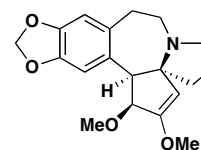
See stemona alkaloid group meeting

**vinblastine**

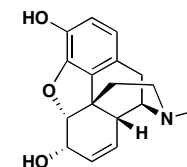
See vindoline group meeting

**chasmanine**

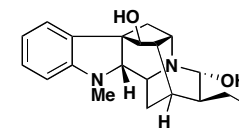
See dendrobine group meeting

**cephalotaxine**

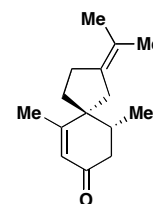
See cephamine and related alkaloids group meeting

**morphine**

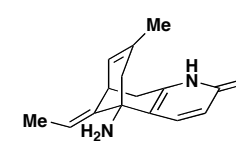
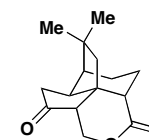
See morphine/codeine group meeting

**ajmaline**

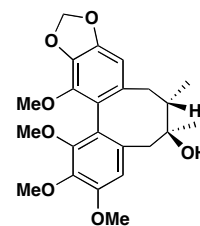
See ajmaline and sarpagine alkaloid group meeting

**vetivone**

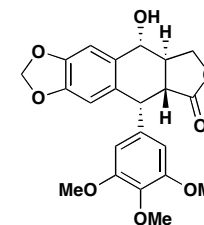
See vetivane sesquiterpene group meeting

**huperzine A****quadrone**

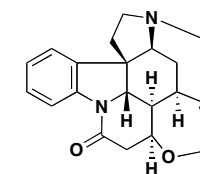
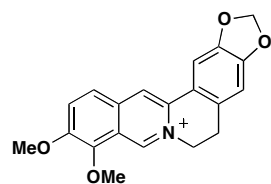
See quadrone group meeting

**gomisin A**

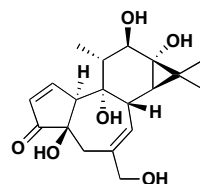
See Stegane Natural Products group meeting

**podophyllotoxin**

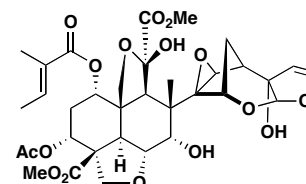
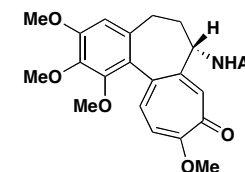
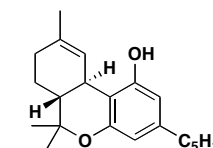
See Lignan Synthesis group meeting

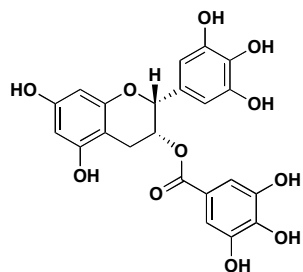
**strychnine****berberine**

See Isoquinoline Alkaloids group meeting

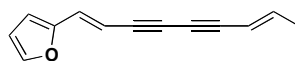
**phorbol**

See Tiglane, Daphnane, Ingenane, Lathyrane Diterpene group meeting

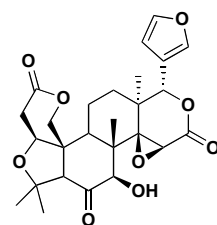
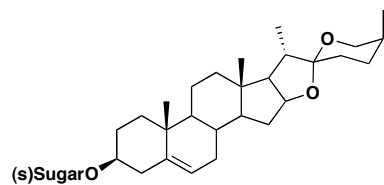
**azadirachtin****colchicine****tetrahydrocannabinol**



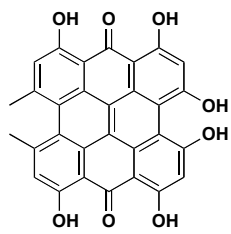
epigallocatechin-3-gallate (EGCG)



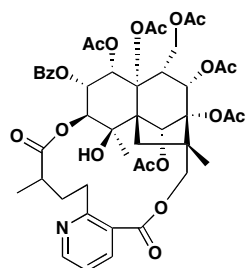
Atractyolodin



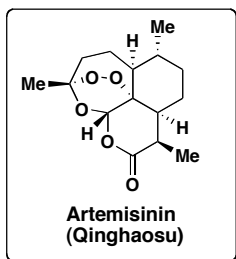
evodinone



hypericin



wilforine

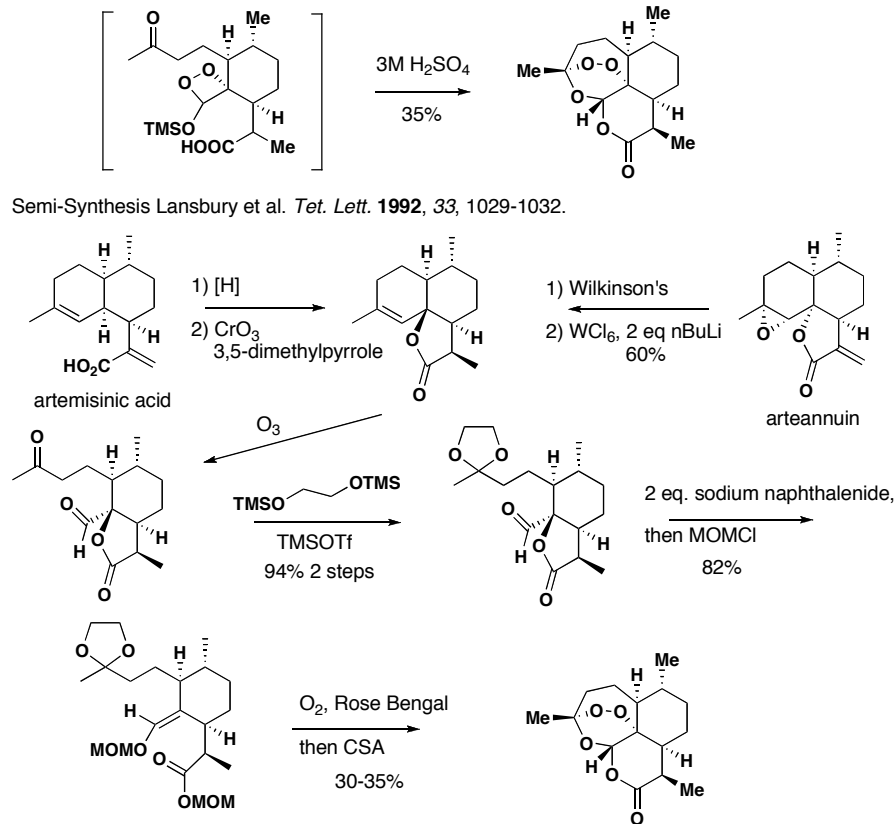
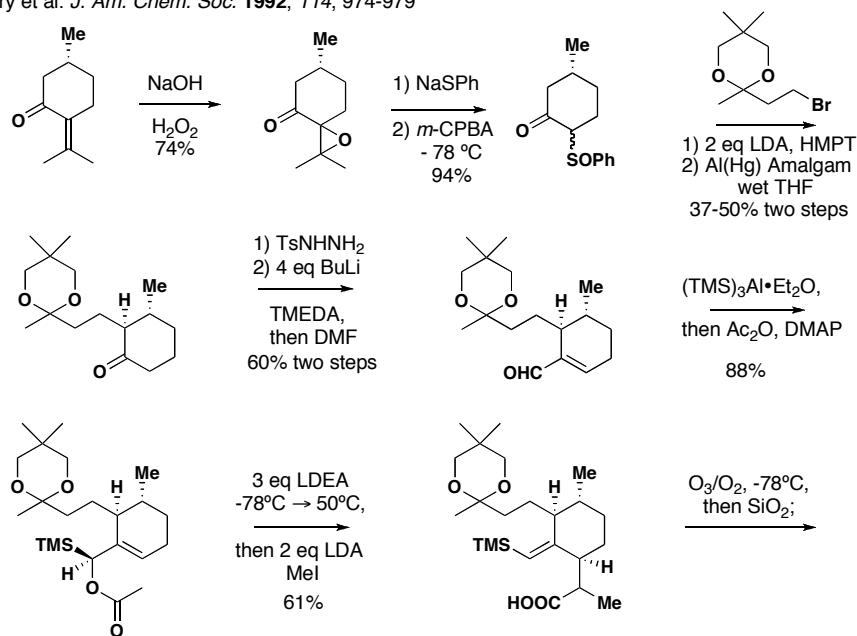


From *Artemisia annua*;
other common names
include Sweet Wormwood,
Sweet Annie and Sweet
Sagewort.
Chinese: Qinghao



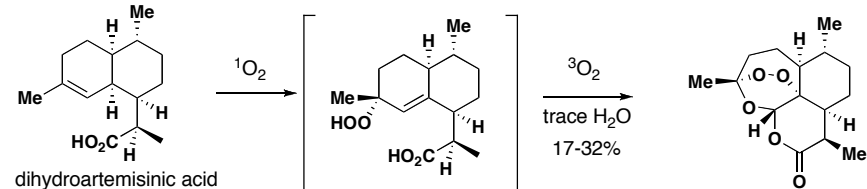
- Qinghao has been used in traditional Chinese medicine for centuries, prepared as a tea for treating fever. Popularized in 1970 when the reemergence of *Chinese Handbook of Prescriptions for Emergency Treatments* from 340AD was rediscovered.
- Qinghaosu (Artemisinin) was first isolated in China in 1972 as a potent antimalarial agent.
- It continues to be a highly important drug in the pharmaceutical arena with its analog Artemether being marketed by Novartis in the drug Co-artem.

Avery et al. *J. Am. Chem. Soc.* **1992**, *114*, 974-979

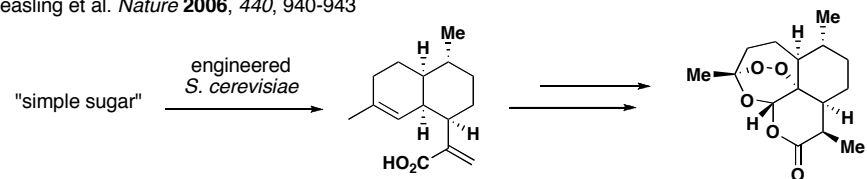


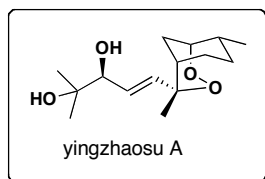
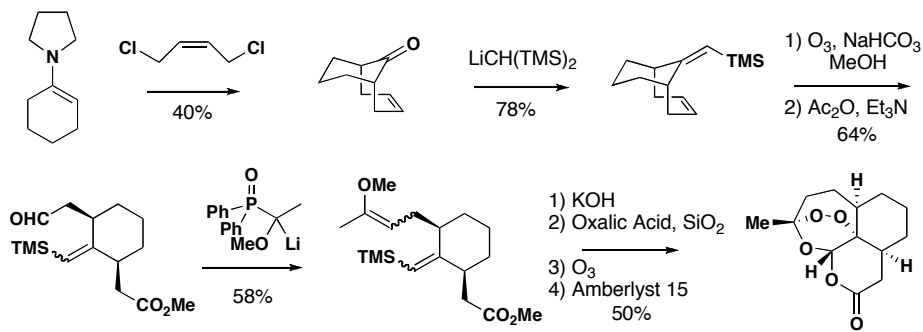
Semi-Synthesis Lansbury et al. *Tet. Lett.* **1992**, *33*, 1029-1032.

Acton et al. *J. Org. Chem.* **1992**, *57*, 3610-3614

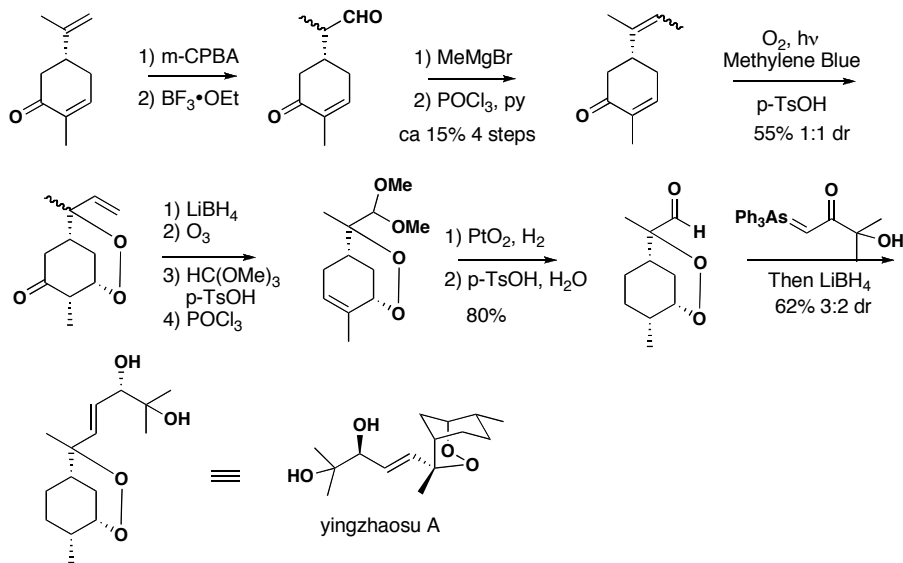
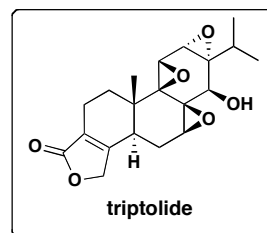
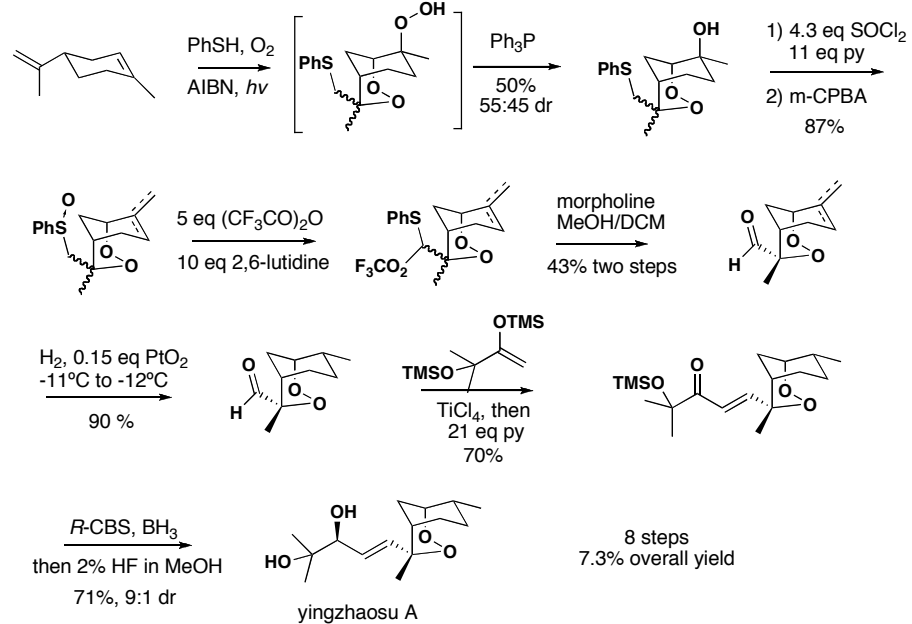


Keasling et al. *Nature* **2006**, *440*, 940-943



6,9-Desmethylartemisinin Avery et al. *J. Org. Chem.* **1989**, *54*, 1792-1795

- Isolated from the Chinese medicine Yingzhao (*Artabotrys uncinatus*)
 - Another antimalarial agent from TCM, but has not received as much attention as its peroxide cousin artemisinin, primarily due lack of available compound.

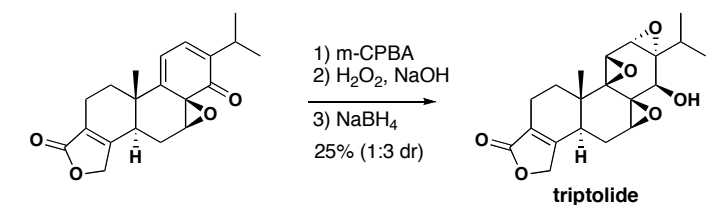
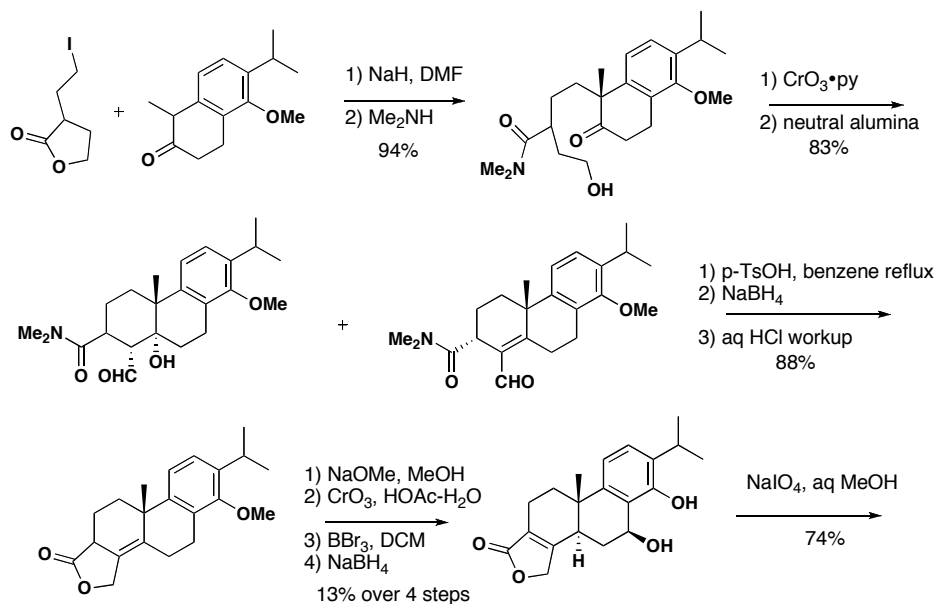
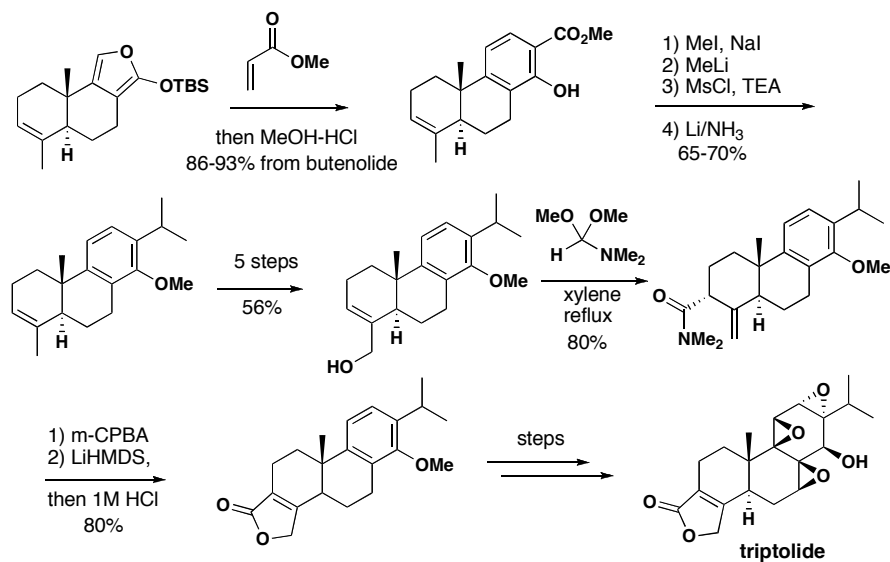
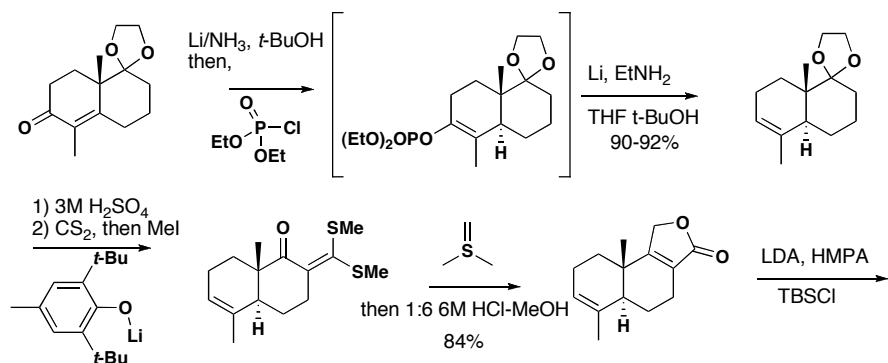
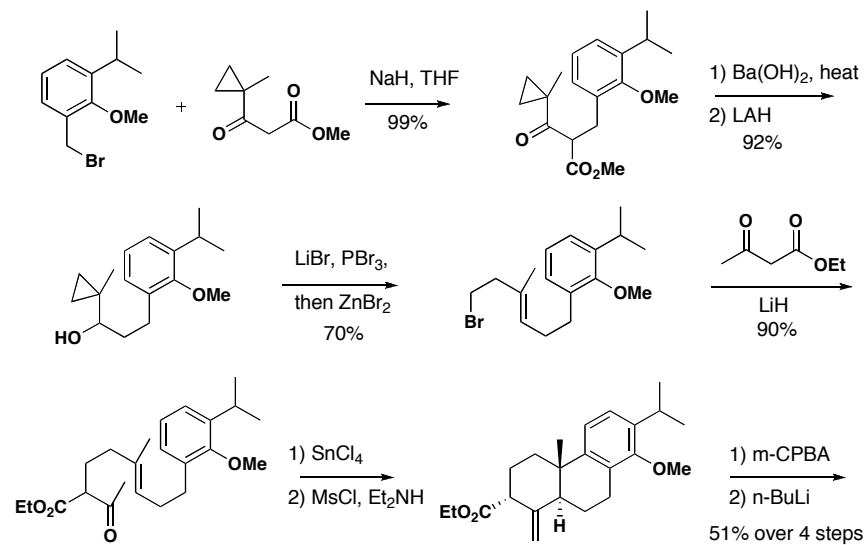
Xu et al. *Tet. Lett.*, **1991**, *32*, 5785-5788Bachi et al. *J. Org. Chem.* **2005**, *70*, 3618-3632Isolated from extracts of *Tripterygium wilfordii* Hook F

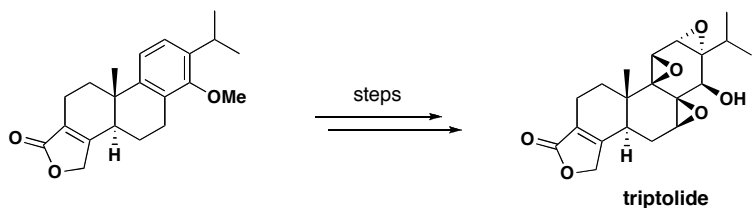
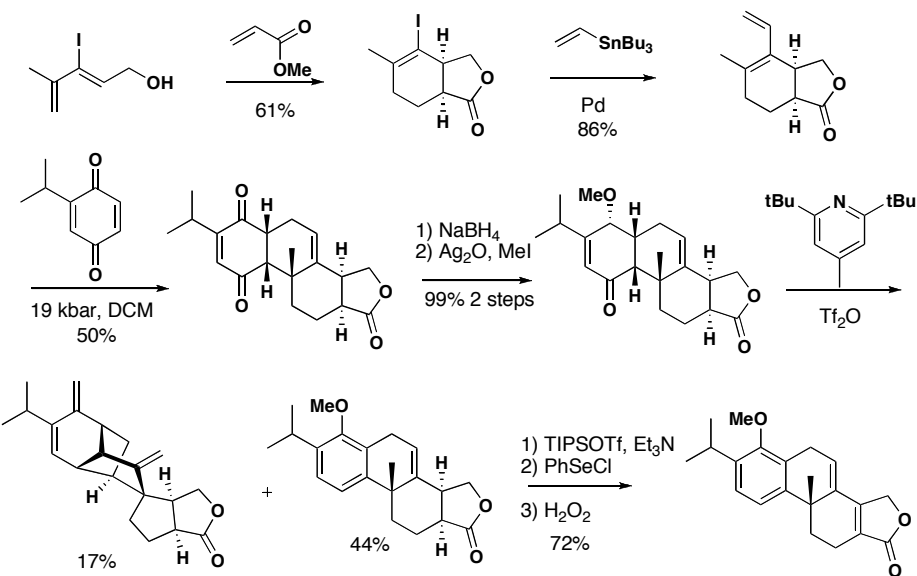
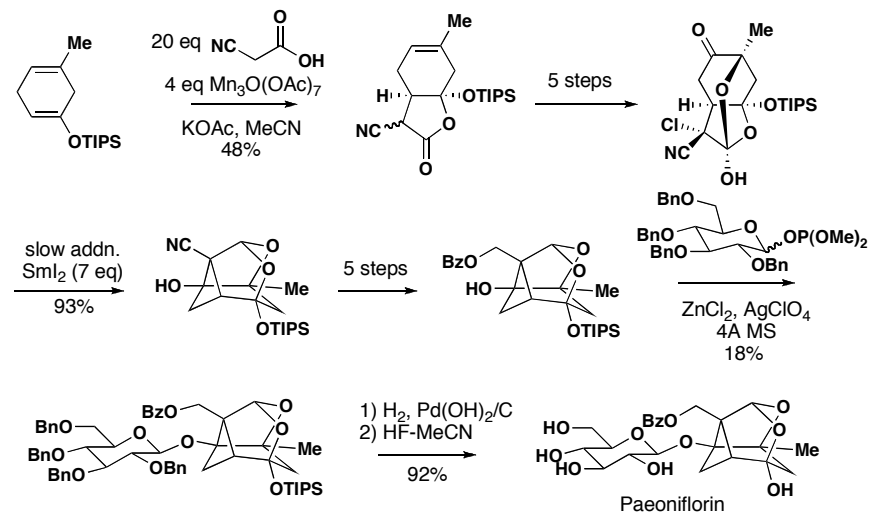
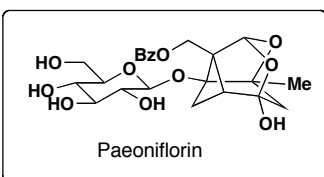
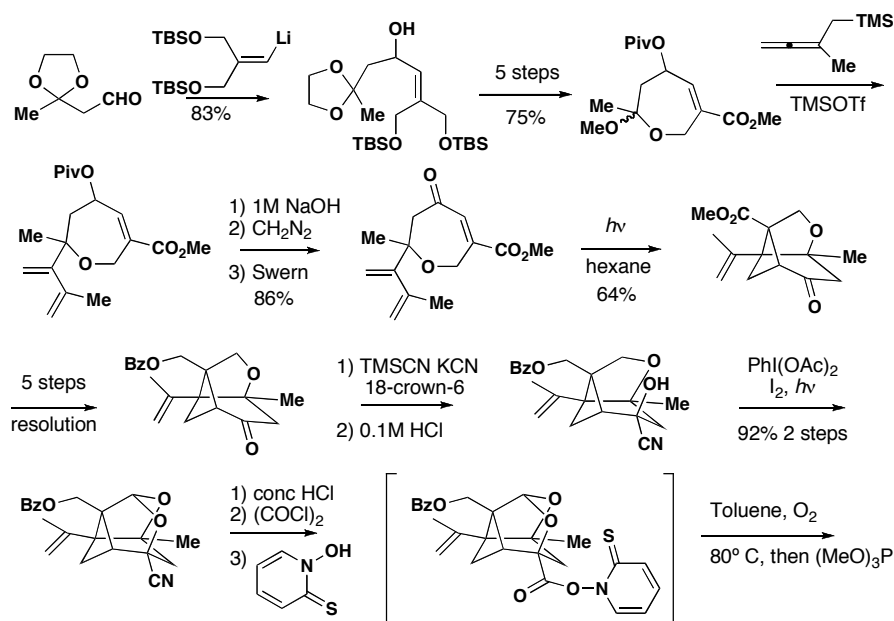
Common names include lei gong teng and Thunder God Vine.

Traditionally used to dispel wind and dampness, it is used to treat people who have swollen joints, difficulty moving, fever, chills, edema, and carbuncle. Also known as "qi bu si" which means "sevens steps to death" as a result of its potential toxicity.

Lei gong teng has been clinically evaluated as a potential treatment for rheumatoid arthritis, leukemia, hepatitis, nephritis, and various skin disorders. More recently triptolide and related structures have been tested for their antifertility properties to be one day used as a male contraceptive.



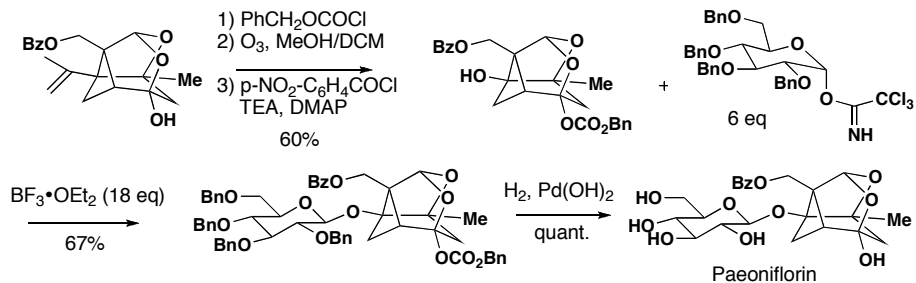
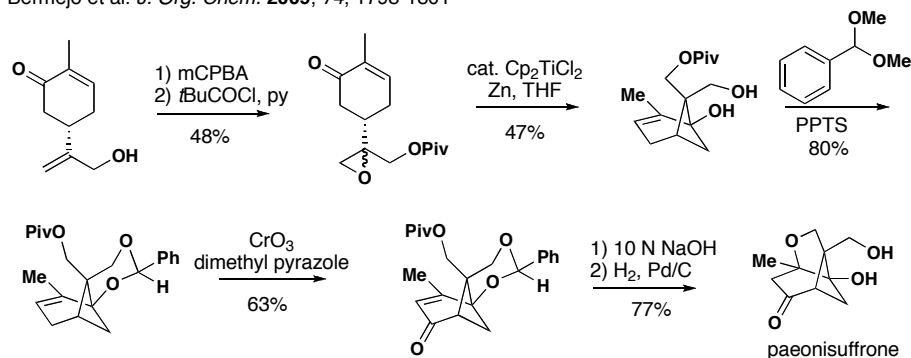
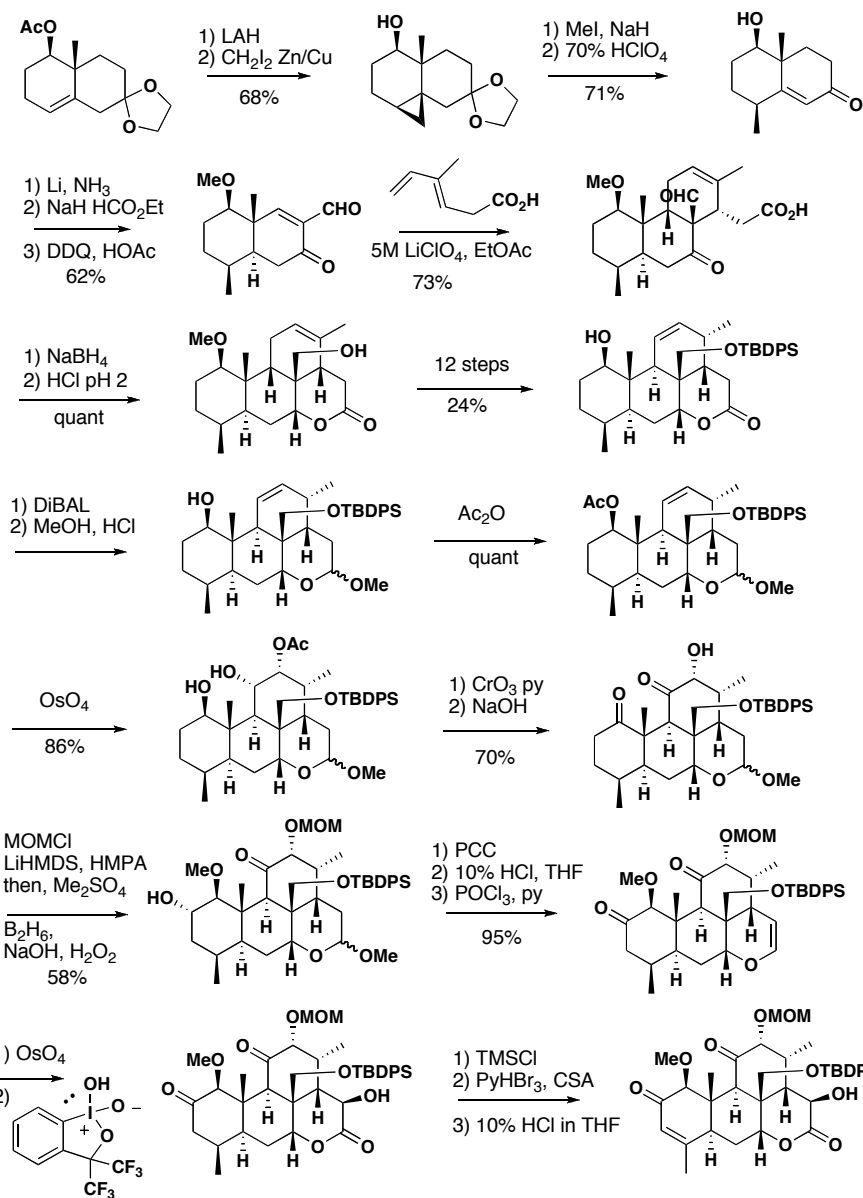
Berchtold et al. *J. Am. Chem. Soc.* **1980**, *102*, 1200-1201van Tamelen et al. *J. Am. Chem. Soc.* **1982**, *104*, 867-869van Tamelen et al. *J. Am. Chem. Soc.* **1982**, *104*, 1785-1786

Sheburn et al. *Chem. Comm.* **2008**, 1226-1228Corey et al. *J. Am. Chem. Soc.* **1993**, *115*, 8871-8872 and Classics in Total Synthesis I pg 633-640.Hatakeyama et al. **1994**, *166*, 4081-4082

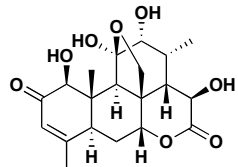
Isolated from the roots of Chinese peony (*Paeonia lactiflora*). In TCM it is known as shao yao or bai shao yao.



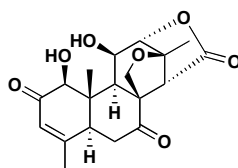
Traditionally used for regulating the blood and Ying, paeoniflorin has displayed anticoagulant, sedative, antiinflammatory, and neuromuscular activities.

Bermejo et al. *J. Org. Chem.* **2009**, *74*, 1798-1801Grieco et al. *J. Am. Chem. Soc.* **1993**, *115*, 6078-6093

Quassinoids



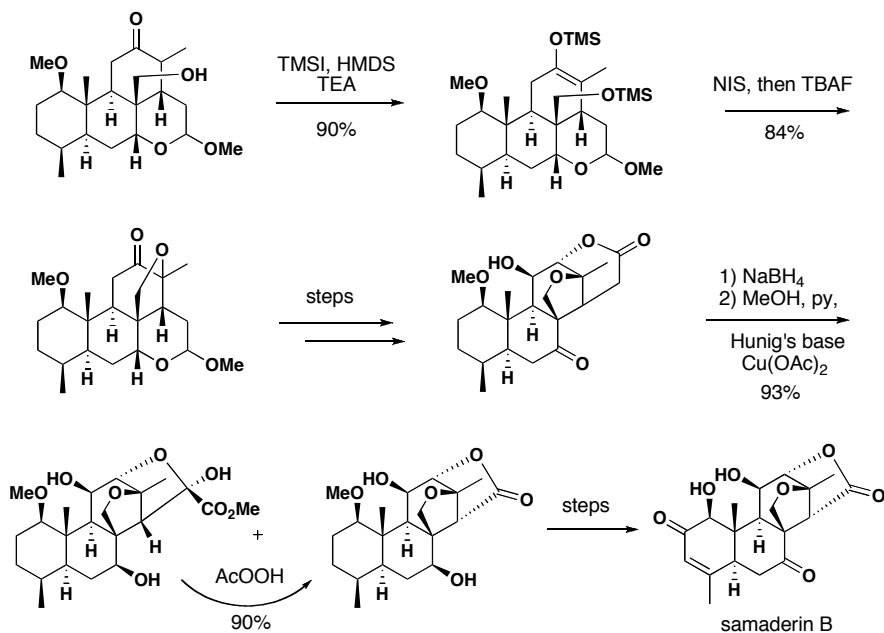
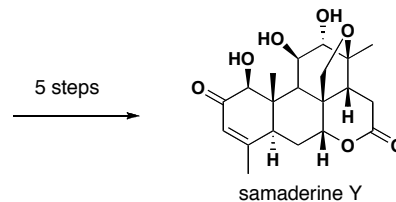
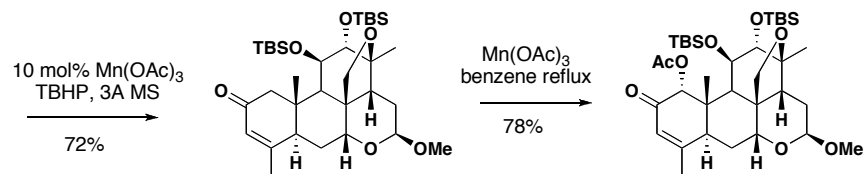
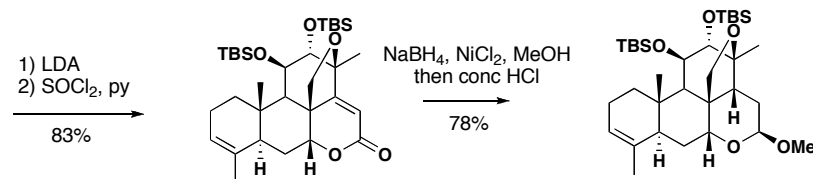
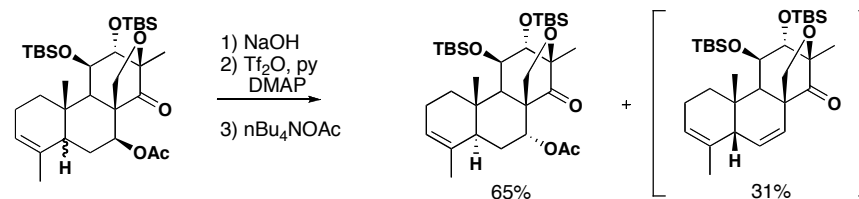
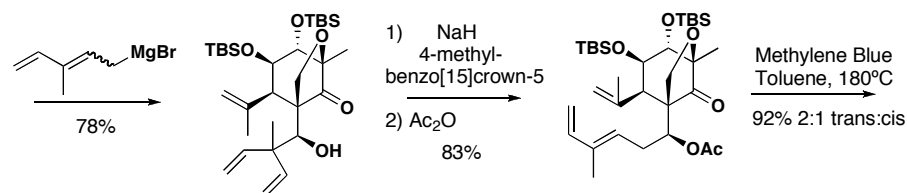
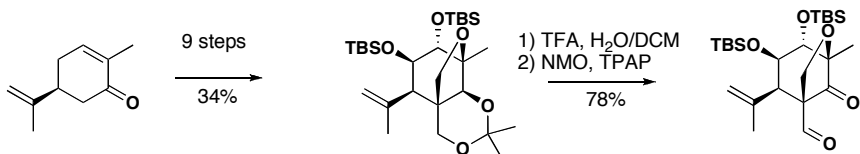
glaucarubolone



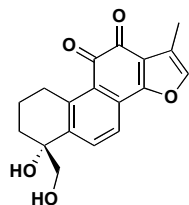
samaderin B

The quassinoids are found in a variety of Traditional Chinese Medicines including chun bai pi (Tree of Heaven) and ya dan zi (Java Brucea). Most are known for their cooling and astringent properties, though quassinoids have been shown to have antimalarial, antiasthmatic and antiepileptic properties.



Grieco et al. *J. Am. Chem. Soc.* **1994**, *116*, 7606-7615Shing et al. *Angew. Chem. Int. Ed.* **2005**, *44*, 7981-7984

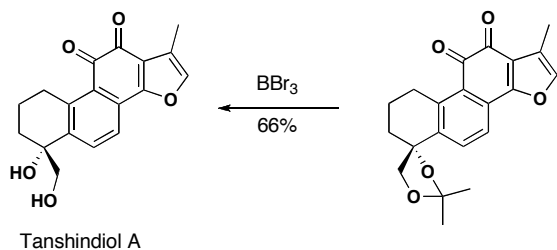
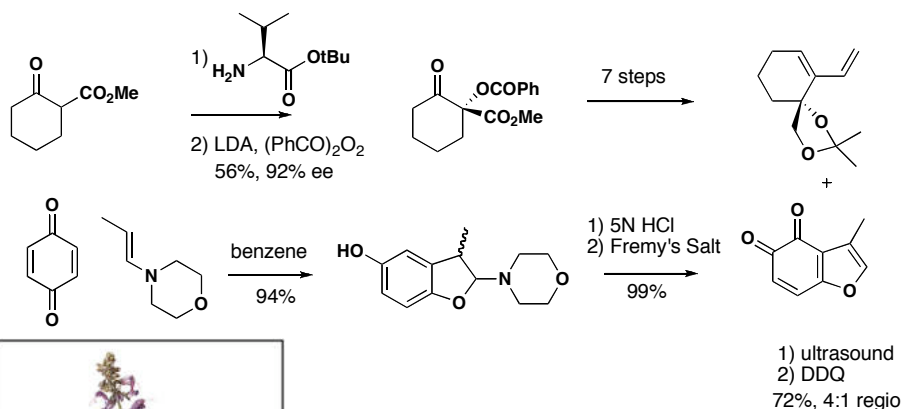
Tanshinones



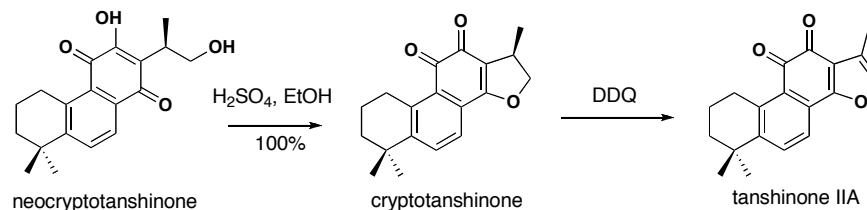
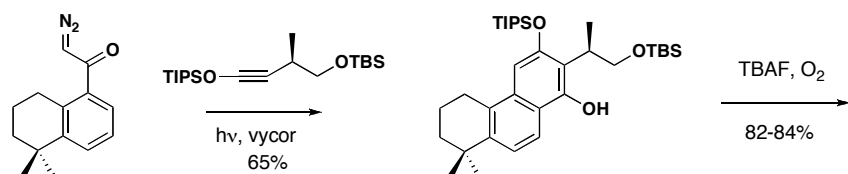
Tanshindiol A

Isolated from the taproot of *Salvia miltiorrhiza*, which has seen heavy use in Traditional Chinese Medicine. Known as dan shen, it has been used to both treat and prevent heart problems and strokes, and has been shown from both animal and human studies that it is an effective anticoagulant. Preliminary results also show dan shen has potential efficacy against HIV. Some studies also show that the traditional preparation of the medicine exceeds the activity of the purified compounds, leading to possibly more bioactive minor metabolites or synergistic effects.

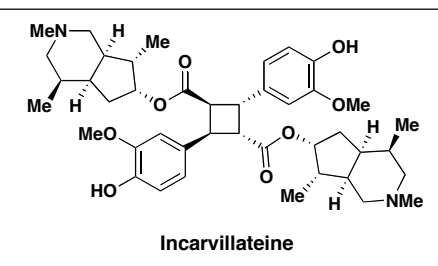
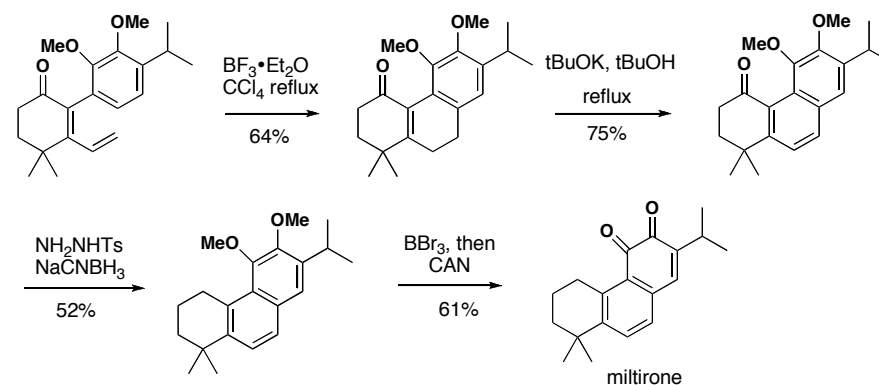
Snyder et al. *J. Org. Chem.* **1992**, *57*, 5301-5312



Danheiser et al. *J. Org. Chem.* **1995**, *60*, 8341-8350

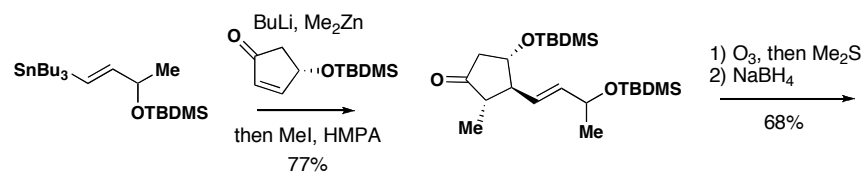


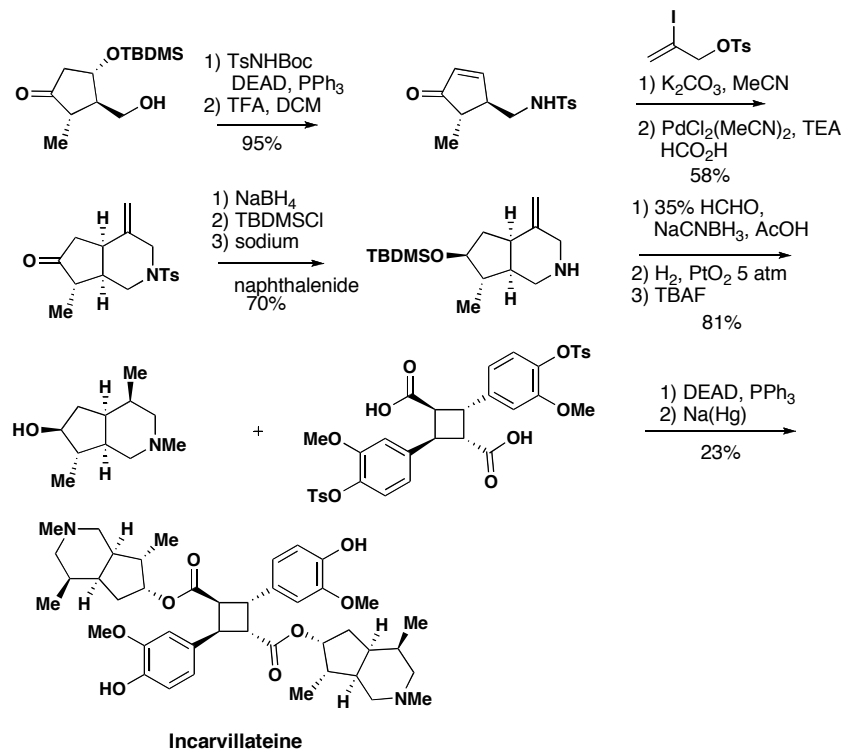
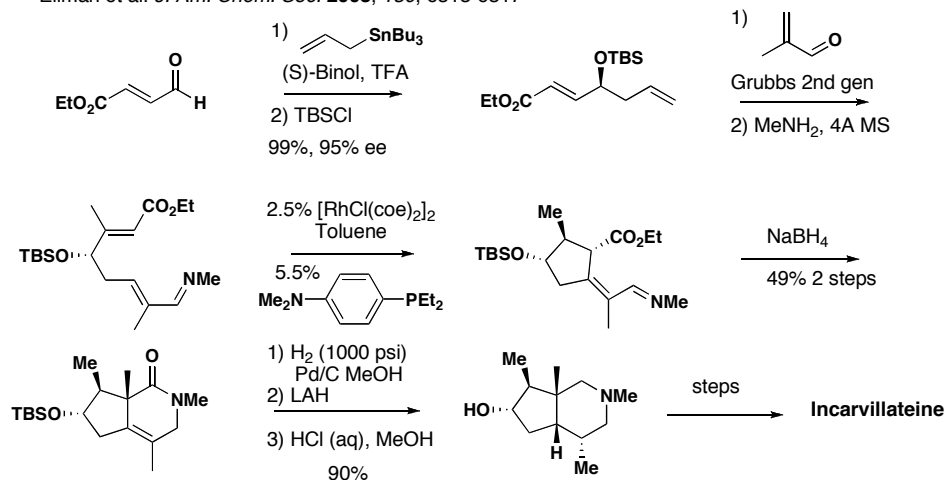
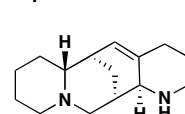
Majetich et al. *J. Org. Chem.* **1997**, *62*, 6928-6951



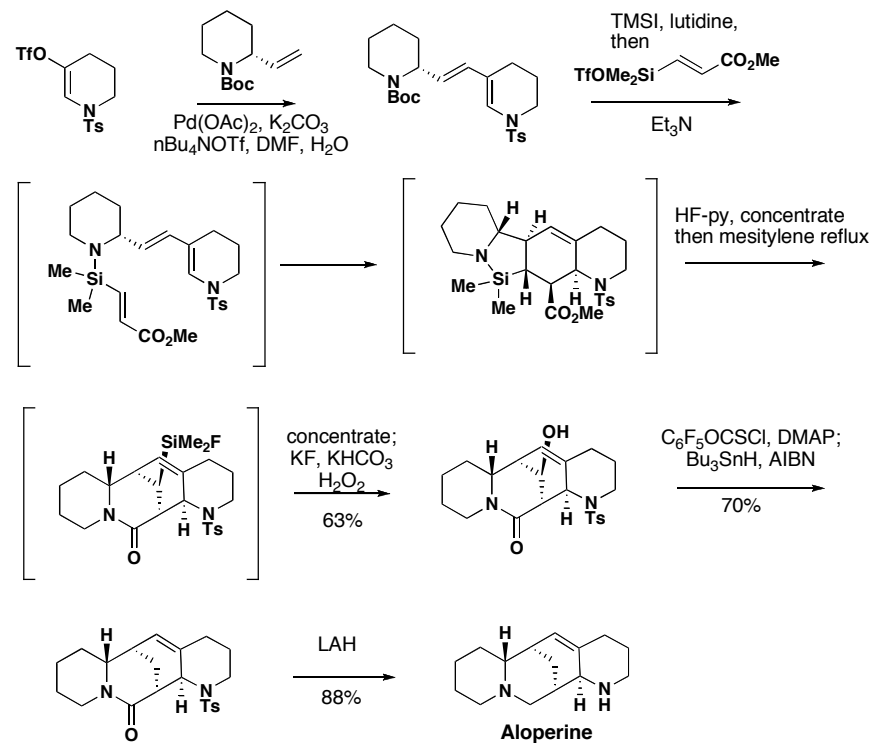
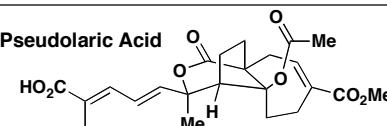
Isolated from the aerial parts of *Incarvillea sinensis*, a wild plant native to northern China. Known in TCM as jiaohao, it is traditionally used to treat rheumatism and as a pain reliever. Incarvillateine has been shown to be a potent analgesic in mice.

Kibayashi et al. *J. Am. Chem. Soc.* **2004**, *126*, 16553-16558

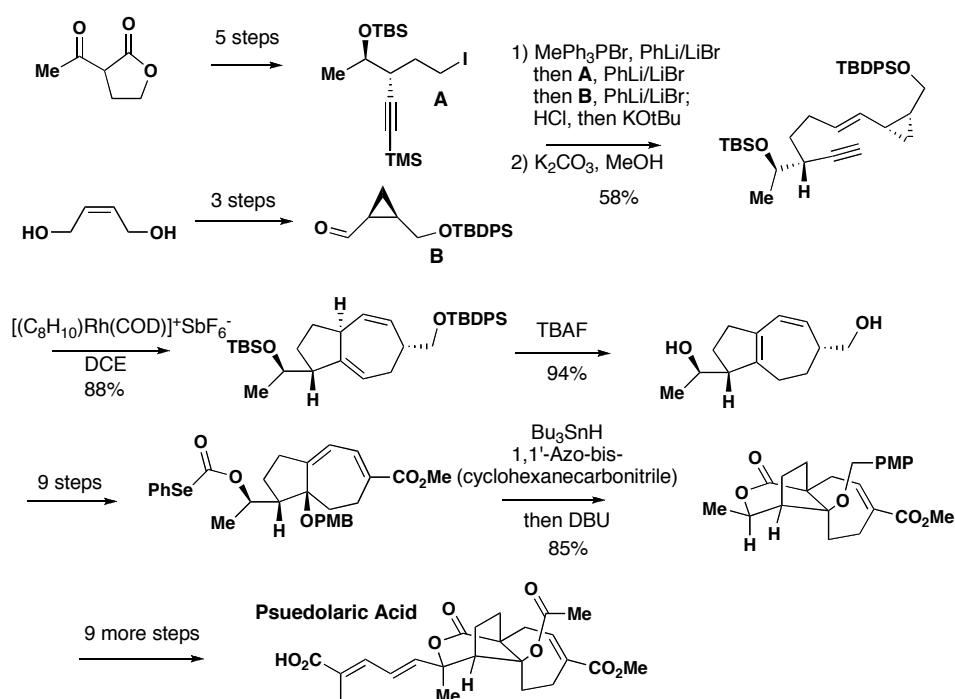


Ellman et al. *J. Am. Chem. Soc.* **2008**, *130*, 6313-6317**Aloperine**

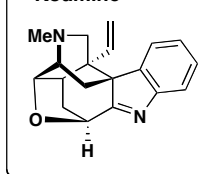
Isolated from *Sophora alopecuroides* (Ku dou zi), which is used to clear heat, dry damp, kill worms and relieve pain. Indications include dysentery stomachache, eczema, boils and intractable lichens. Aloperine in particular has shown to have antiinflammatory and inhibit allergic reactions and heart arrhythmias in rats.

Overman et al. *J. Am. Chem. Soc.* **1999**, *121*, 700-709**Pseudolaric Acid**

The root bark of *Pseudolarix kaempferi* Gordon, known as tujinpi in TCM, has long been used to treat fungal infections of the skin and nails. The pseudolaric acids were identified as potent antifungal agents responsible for this observed bioactivity and also have seen promise against multidrug resistant cancer cell lines.



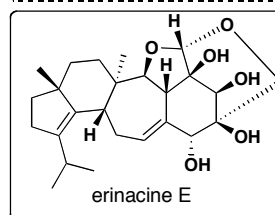
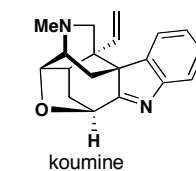
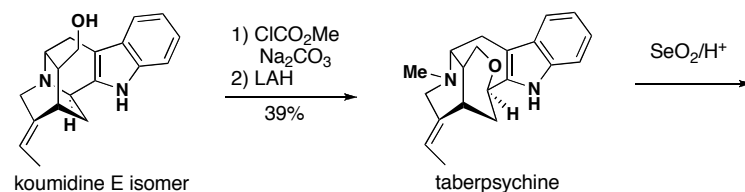
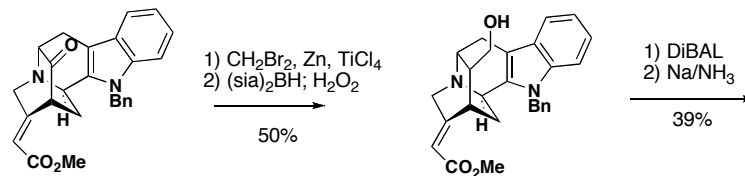
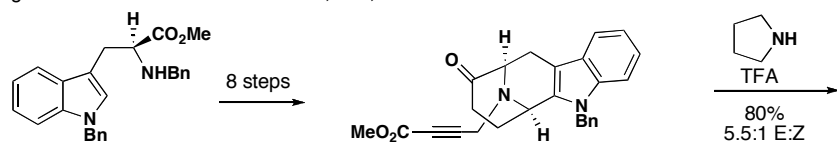
Koumine



Koumine originates from the TCM gou wen (*Gelsemium elegans*), also known as Graceful Jessamine. Gou wen dispels wind, attacks toxins, disperses swelling and relieves pain. Koumine itself displays antitumor activity as well as potent analgesic properties.

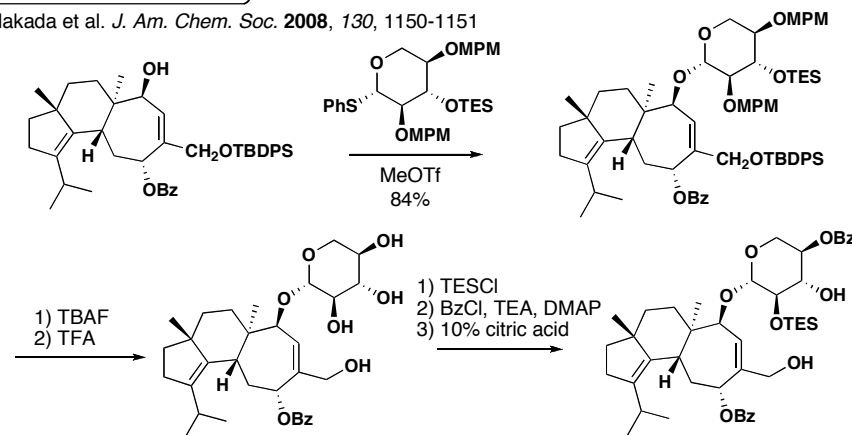


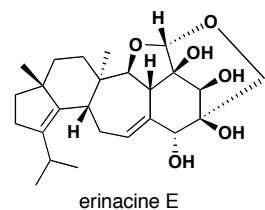
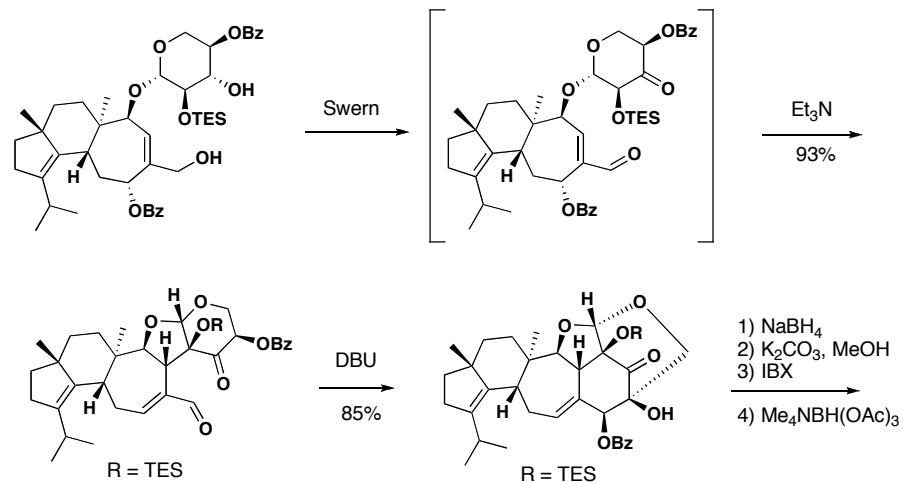
Magnus et al. *J. Am. Chem. Soc.* **1989**, *111*, 786-789



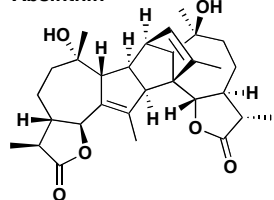
Hou tou jun (Bearded Tooth Carpophore) is the sporocarp of the fungus *Hericium erinaceum* and has been used in TCM as an agent to fortify spleen, nourish stomach and quiet spirit. Erinacine E was isolated the mycelia and has shown to be a strong stimulator of nerve growth factor and a highly selective κ -opioid receptor agonist.

Nakada et al. *J. Am. Chem. Soc.* **2008**, *130*, 1150-1151





Absinthin



Absinthin was isolated as orange acicular crystals from Sievers Wormwood (*Artemisia sieversiana*) as the major guaianolide. In TCM, the plant is known as bai hao and is used as a stomach tonic and anthelmintic. Absinthin has been successfully used to alleviate inflammation of gastric ulcers and regenerate the stomach wall in mice.

Zhao et al. *J. Am. Chem. Soc.* **2005**, 127, 18-19

