

The Longwood Herbal Task Force
(<http://www.mcp.edu/herbal/default.htm>) and
The Center for Holistic Pediatric Education and Research
(<http://www.childrenshospital.org/holistic/>)

White Willow Bark (*Salix alba*)

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Principal Proposed Uses: Analgesic, antipyretic, anti-inflammatory

Other Proposed Uses: Wart remedy

Overview

White willow bark has been used throughout the world as an antipyretic and analgesic. Since the development of synthetic acetylsalicylic acid in the 1890's, willow bark has fallen into disuse and has not undergone rigorous scientific evaluation. The concentration of salicin is actually much lower in willow bark than in other *Salix* species. The high concentration of tannins in willow bark (8-20%) usually leads to gastrointestinal toxicity before therapeutic concentrations of salicylates are achieved. Willow bark does not appear to affect coagulation and has not been evaluated for use in preventing colorectal cancer, strokes or myocardial infarctions. Its topical use as an analgesic and wart remover appear safe. Caution suggests avoiding willow bark in children with influenza or varicella to minimize the risk of Reye's syndrome, and in patients with asthma, allergies to aspirin, active peptic ulcer disease, diabetes, or hepatic or renal disorders. There are no data evaluating its safety during pregnancy or lactation.

Historical and Popular Uses

Ancient Egyptians used the bark of the white willow to treat pain and inflammation¹. Hippocrates and Dioscorides recommended willow bark as a remedy for gout and rheumatic joint diseases, but it fell into disuse in Europe during the Middle Ages. Kuan-Yin, the bodhisattva of compassion, is often depicted holding a willow branch as a symbol of healing. Native American healers also relied on willow for its analgesic properties². The English

clergyman Edward Stone rediscovered the therapeutic value of willow bark in 1763³. Willow bark has been used to treat many different kinds of pain, including rheumatic pain, back pain, toothache, headache, and menstrual cramps. It is also used to relieve sore throat, fever and headache associated with upper respiratory tract infections and influenza⁴⁻⁶.

Willow's active chemical constituent, salicin, was identified in 1829 by the French pharmacist H. Leroux³. Salicylic acid was prepared in pure form by an Italian chemist in 1838. Salicylic acid was also extracted from wintergreen, spirea and other plants³. Salicin and salicylic acid were widely used by 19th century European physicians to treat rheumatic fever and as an antipyretic, gout remedy and analgesic, particularly for joint pain⁴. However, the high doses used (8-10 grams daily) routinely led to vomiting and gastric irritation, and the search was on for a less noxious salicylate.

Acetylsalicylic acid was first synthesized by a French chemist in 1853 and was rediscovered by Felix Hoffman at the Bayer Company in Germany who created acetylsalicylic acid from the spiric acid (spirin) found in meadowsweet in the 1890's⁷. Bayer Aspirin quickly became one of the most popular drugs sold worldwide.

Nowadays, synthetic acetylsalicylic acid is used not only as an analgesic and antipyretic, but to prevent myocardial infarctions, strokes and colorectal cancer. Some herbalists recommend willow bark extract as a natural substitute for aspirin to achieve these same benefits. In Germany, willow bark is often taken along with aspirin to enhance the therapeutic effects while minimizing side effects⁸. The European Scientific Cooperative on Phytotherapy (ESCOP) has approved willow bark extract to treat fever, pain, and mild rheumatic complaints⁹.

Botany

Medicinal species: *Salix alba* L (NOTE: There are over 300 *Salix* species called willow)

Common names: White willow, catkins willow, European willow, salicin willow, withe withy; Weidenrinde, Fieberweidenrinde, Maiholzrinde (Ger); ecorce de saule (Fr)

Botanical family: Salicaceae

Plant description: Willow trees grow 6-18 meters high with supple branches. The male flowers are yellow and the female flowers are green. Catkins are cylindrical, approximately 6-7

cm long¹⁰. The outer surface of the bark can range in color from yellowish-green to brownish-gray and from a smooth texture to faint longitudinal striations. The inner surface is smooth and white to pale yellow or cinnamon brown color¹¹.

Where it's grown: White willow is native to Europe, Asia and North America. Like birch, it is very cold hardy. White willow grows in a variety of climates from Maine to the Amazon¹². The bark of young, two- to three-year-old branches is harvested during the early spring¹³; it is dried and prepared in liquid, cream, ointment, tablets and capsule forms. Imports typically come from Bulgaria, Hungary, Romania and the former Yugoslavia¹¹.

Biochemistry

White Willow Bark: Potentially Active Chemical Constituents^{11, 14}

- Glycosides (1.5-11%): salicylates (salicin, salicortin, populin, fragilin, tremulacin)^{15, 16}
- Tannins (8-20%)¹⁷
- Aromatic aldehydes and acids: salidroside, vanillin, syringin, salicylic acid, caffeic and ferulic acids
- Salicyl alcohol (saligenin)
- Flavonoids

Salicylates are found in a number of plants including other *Salix* species, wintergreen (*Gaultheria procumbens*), black cohosh root (*Cimicifuga racemosa*), poplar tree bark (*Populus spp.*) and sweet birch tree bark (*Betula lenta*). Other *Salix* species (e.g. *S. nigra* or black willow, *S. daphnoides* or violet willow, *S. purpurea* or purple osier, and *S. fragilis* or crack willow) are frequently substituted for white willow in commercial products. Salicylate content appears to be highest in *S. fragilis* bark (1-10%), *S. purpurea* bark (3-9%), *S. repens* leaves (5-12%), and *S. rosmarinifolia* leaves (7-10%) and lowest in white willow bark (1.5-11%)^{12, 14, 18, 19}. The concentration and availability of salicylates also varies within species according to growing conditions, processing and preparation^{15, 20, 21}.

Salicin and *salicortin* are the primary salicylates found in white willow bark. They are metabolized by intestinal flora to saligenin²², absorbed into the blood stream, and metabolized by the liver to salicylic acid; excretion is primarily renal^{11, 23}. More than 80% of salicin is absorbed after oral administration²⁴. Because of the time required to metabolize the willow's salicylates, the time to achieve therapeutic effects and the duration of effects are longer than with synthetic salicylates^{19, 25}.

Salicylic acid is approved by the US Food and Drug Administration (FDA) as a topical treatment for warts and calluses. It is also included in many non-prescription medications to treat bunions and corns, and some over the counter acne remedies.

Tannins are phenolic compounds found in many herbs and common foods such as sorrel and rhubarb. Tannins are astringent and are traditionally used topically to treat wet or oozing skin conditions such as poison ivy and eczema. Tannins have also been used internally to treat diarrhea and inflamed mucus membranes. Plants that contain more than 10% tannins have potential adverse effects including upset stomach and nausea and vomiting acutely, and renal damage, hepatic necrosis, and increased risk of esophageal and nasal cancer with long term use. Willow bark contains between 8-20% tannins, a higher concentration than in almost any other plant. Tannins may interfere with the absorption of alkaloid compounds, salicylic acid, iodine, zinc, iron and copper. Drug-tannin precipitates may form in alkaline environments, interfering with proper dosing²⁶.

Experimental Studies

White Willow Bark: Potential Clinical Uses

1. Cardiovascular: none
2. Pulmonary: none
3. Renal and electrolyte balance: none
4. Gastrointestinal/hepatic: none
5. Neuro-psychiatric: Analgesic
6. Endocrine: none
7. Hematologic: Anticoagulant and antithrombotic
8. Rheumatologic: Arthritis (See Immune modulation: Anti-inflammatory)
9. Reproductive: none
10. Immune modulation: Anti-inflammatory
11. Antimicrobial: Antifungal
12. Antineoplastic: Prevention of colorectal cancer
13. Antioxidant: none
14. Skin and mucus membranes: none
15. Other/miscellaneous: Antipyretic; wart remedy

With the advent of synthetic aspirin, the use of willow bark fell by the wayside both clinically and scientifically. Very few studies have addressed the physiologic effects of willow bark as opposed to aspirin. Modern herbalists have tended to extrapolate the data from studies on aspirin and apply those findings to willow bark. Studies cited refer to willow bark and/or salicin.

1. **Cardiovascular:** none
2. **Pulmonary:** none
3. **Renal and electrolyte balance:** none
4. **Gastrointestinal/hepatic:** none
5. **Neuro-psychiatric:** Analgesic. Salicin does have analgesic properties. However, due to the low concentration of salicin in willow bark, the amount extracted in typical preparations and the metabolic transformation required to convert salicin and salicortin to salicylic acid,

achieving therapeutic effects would require approximately 35 grams of white willow bark three times daily. At typical doses, willow bark is not expected to exert significant analgesic effects¹⁹. However, recent unpublished data suggests that willow bark extracts may provide significant therapeutic benefit even with low salicylate levels.

i. *In vitro data*: none

ii. *Animal data*: none

iii. *Human data*: In a randomized, double-blind placebo-controlled trial of 54 migraine sufferers, half were given a topical medicament containing salicin (dose unknown) and half were given a placebo. All were advised that when a headache began, they should lie down, apply the medicament to their forehead (amount unknown), cover the face with a photo-occlusive mask and take their regular headache medications. Those treated with salicin reported significantly more improvement than those assigned to placebo treatment⁵.

6. **Endocrine**: none

7. **Hematologic**: Anticoagulant and antithrombotic: Some herbalists recommend willow bark as a natural alternative to aspirin to prevent myocardial infarction and strokes. However, willow's salicylates do not appear to interfere with coagulation.

i. *In vitro data*: Unlike aspirin, sodium salicylate had no effect on platelet adhesion or platelet release of ADP²⁷.

ii. *Animal data*: none

iii. *Human data*: Unlike aspirin, sodium salicylate did not prolong bleeding time in adults; nor did it inhibit platelet aggregation²⁷.

8. **Rheumatologic**: Arthritis (See Immune modulation: Anti-inflammatory)

9. **Reproductive**: none

10. **Immune modulation**: Anti-inflammatory

i. *In vitro data*: Unlike aspirin, salicin did not inhibit PHA-induced lymphocyte transformation²⁸.

ii. *Animal data*: none

iii. *Human data*: Although salicin does have anti-inflammatory properties, the concentration in willow bark is so low that 25-35 liters of willow bark tea would be required to achieve

dosages comparable to 4 grams of aspirin daily. However, a recent unpublished case series suggests that standardized willow bark extracts may provide significant therapeutic benefit for patients with rheumatic pain. Randomized controlled trials are underway. See the report from the International Association for the Study of Pain:

<http://www.rzuser.uni-heidelberg.de/%7Ecn6/iasp-sig-rp/willow.html>

11. Antimicrobial: Antifungal

- i. *In vitro data:* Aqueous extracts of dried willow bark displayed antifungal activity against *Botrytis cinerea* and *Penicillium digitatum*, but were inactive against *Aspergillus fumigatus*, *Aspergillus niger*, *Rhizopus nigricans*, *Trichophyton mentagrophytes* and *Candida albicans*²⁹.
- ii. *Animal data:* none
- iii. *Human data:* none

12. Antineoplastic: Prevention of colorectal cancer. No data on willow bark for this use.

13. Antioxidant: none

14. Skin and mucus membranes: none

15. Other/miscellaneous: Antipyretic; wart remedy

- a. Antipyretic: no recent scientific evaluation
- b. Wart remedy
 - i. *In vitro data:* none
 - ii. *Animal data:* none
 - iii. *Human data:* In central Italy dried willow bark is applied topically to treat warts³⁰; a modern home remedy is to tape a plain adult aspirin over a wart. There have been no controlled trials reported on willow bark's use for this purpose, but it is likely to be as effective as other home remedies.

Toxicity and Contraindications

All herbal products carry the potential for contamination with other herbal products, pesticides, herbicides, heavy metals and pharmaceuticals.

Allergic reactions can occur to any natural product in sensitive persons.

Allergic reactions to willow bark have been reported²⁶. Persons known to be allergic to aspirin should avoid herbal remedies containing willow bark.

Potentially toxic compounds in willow bark: Salicin, salicortin, tannins

Acute toxicity: Toxicity is far less with willow bark than with aspirin due to the low levels of salicylates in the plant products. High doses can be associated with gastric and renal irritation, nausea, vomiting, and gastrointestinal bleeding, but side effects are far more likely from the high tannin levels than the salicylates. There is one case report of a woman with glucose-6-phosphate dehydrogenase deficiency (G6PD) who developed massive hemolysis after taking an herbal preparation containing salicin³¹.

Chronic toxicity: None reported with willow bark, but theoretically possible due to salicylates.

Limitations during other illnesses or in patients with specific organ dysfunction: Patients with tinnitus should avoid using herbal remedies such as willow bark that contain salicylates. Although side effects have not been reported, the salicylate content warrants cautious use by patients with allergies to aspirin, asthma, active peptic ulcer disease, diabetes, gout, hemophilia and other bleeding disorders, or hepatic or renal disease³².

Interactions with other herbs or pharmaceuticals: None reported. There is a potential for interaction with salicylate-containing medications and other non-steroidal anti-inflammatory medications (NSAIDs). There is not expected to be a negative interaction with anticoagulant medications. Tannins may interfere with absorption of other medications.

Safety during pregnancy and/or childhood: Due to the potential of developing Reye's syndrome from salicylates, children with influenza or varicella should avoid willow bark. Safety has not been established for pregnancy and lactation. Salicylates in breast milk were reported to cause a rash in one breast-fed baby³².

Typical Dosages

Provision of dosage information does NOT constitute a recommendation or endorsement, but rather indicates the range of doses commonly used in herbal practice.

Doses are given for single herb use and must be adjusted when using herbs in combinations. Doses may also vary according to the type and severity of the condition treated and individual patient conditions.

Plants containing salicylates have a very bitter taste, so willow bark tea may be unpalatable for most patients, particularly for children.

A typical 500 mg dose of aspirin is equivalent to 794 mg of salicin. If extraction was 100% effective, this amount of salicin could be derived from 80-150 grams of dried willow bark³³. The usual dose of willow bark tea is typically 1-3 grams of bark per cup of water. Thus, the usual herbal products contain minute amounts of salicylates compared with aspirin.

Tea is made by steeping ½-2 tsp. (1-3 grams) of the dried bark in 1 cup of boiling water for 10-20 minutes (infusion) or bringing this amount of cold water and dried bark to a boil for 5 minutes (decoction)^{11, 12}. Some herbalists suggest drinking one cup a day to help prevent myocardial infarction and stroke. To treat fever and pain, 3-5 cups a day are recommended (containing a total of 60-120 mg of salicin)⁶. Larger amounts are likely to lead to gastrointestinal upset due to the high tannin content of the bark.

Tincture or glycerite: ½ tsp. three times daily³⁴

Liquid extract (1:1 in 25% alcohol): 1-3 ml three times daily^{8, 35}

Capsules: Two to three 379 milligram capsules taken every 3-6 hours⁸

Topically: Infused in vegetable oil and rubbed over painful joints or muscles as needed³⁴

Pediatric dosages: Unknown

Dosages used in herbal combinations: Variable

See Also:

Willow Bark Clinician Information Summary:

<http://www.mcp.edu/herbal/willowbark/willowbark.cis.pdf>

Willow Bark Patient Fact Sheet: <http://www.mcp.edu/herbal/willowbark/willowbark.ph.pdf>

The International Association for the Study of Pain:

<http://www.rzuser.uni-heidelberg.de/%7Ecn6/iasp-sig-rp/willow.html>

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