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The effectiveness of jewelweed, *Impatiens capensis*, the related cultivar *I. balsamina* and the component, lawsone in preventing post poison ivy exposure contact dermatitis

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ABSTRACT

Ethnopharmacological relevance: *Impatiens capensis* (jewelweed) is native to the Eastern and Midwestern US and Canada. Many Native American tribes used *I. capensis* and its close relatives to treat/prevent rash from plant sources particularly *Toxicodendron radicans* and *Urtica dioica*. *I. balsamina* (garden balsam) a native of China was used by the indigenous people of Asia for similar purposes.
Aim of study: This study aims to validate ethnopharmacological use of jewelweed in poison ivy (PI) dermatitis prevention and to refute scientific papers denying this efficacy. Additionally, the content of lawsone, the purported effective agent in jewelweed preparations, was measured to see if its concentration correlated with jewelweed preparation efficacy.
Material and methods: Poison ivy was brushed onto forearms of volunteers in 6 locations and exposed areas were treated with jewelweed extracts, fresh plant mashes, soaps made of plant extracts, water and Dawn® dish soap. Rash development was scored on a scale of 0–14.
Results: Jewelweed mash was effective in reducing poison ivy dermatitis, supporting ethnobotanical use. However, jewelweed extracts were not effective; and soaps made of these extracts were effective but no more so than jewelweed-free soaps. Lawsone content varied with harvest season and did not appear to affect rash development.
Conclusion: Jewelweed is an efficacious plant for preventing development of dermatitis following poison ivy contact, but soap is more effective. Lawsone content does not correlate with PI rash prevention. Perhaps saponins, the soapy component of jewelweed are the effective agents.

1. Introduction

Extensive ethnobotanical evidence supports the efficacy of jewelweed (*Impatiens capensis*) in preventing urushiol-induced dermatitis as a result of contact with poison ivy (*Toxicodendron radicans* aka *Rhus toxicodendron*). Jewelweed is a tender, succulent herb, commonly found at wet woodland borders, shaded riverbanks and roadside ditches; the same locations preferred by the poison ivy (PI) plant (Foster and Duke, 1990). It is a self-seeding annual which grows to a height of 2–5 ft and produces orange (*I. capensis* aka *I. biflora*) or yellow (*I. pallida*) flowers with a bell-shaped corolla and a tail-like spur, from June through September (Henn, 2008). The closely related garden balsam, *Impatiens balsamina*, is also a self-seeding annual, which is native to China and India; it grows to a height of 2.5 ft and produces pink to purple axillary flowers on short pedicels (Ellis, 2000).

Historically, the Native American *I. capensis* has been used to treat hives and rashes caused by other plants (poison ivy, stinging nettles (Henn, 2008)) and to prevent poison ivy rash by rubbing it on the skin prior to known exposure or immediately after coming in contact with poison ivy (Foster and Duke, 1990, Lewis and Elvin-Lewis, 1977). The Southern Cherokee used *I. capensis* to treat PI rash (Garrett, 2003; Hamel and Chiltoskey, 1975) and itch, insect bites, plant stings, (Garrett, 2003) and hives (Hamel and Chiltoskey, 1975). The Potawatomi used a fresh juice of *I. capensis* to treat nettle stings or poison ivy rash (Smith, 1933) and it was similarly used by the Chippewa (Gilmore, 1933), Meskwaki (Smith, 1928), and Omaha (Gilmore, 1919) who called it "zhi hin nonxe thionbaba" which means plant like shiny glass (teacherweb). In Japan, the juice from the *Impatiens spp.* flowers is used to stop itching (Ishiguro and Oku, 1997; Oku and Ishiguro, 2002). Chinese herbal medicine uses the aerial parts to treat pain and swelling, and as an antimicrobial agent (Ishiguro et al., 2000;

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Oku and Ishiguro, 2002; Yang et al., 2001). The historical multicultural use of *I. capensis* in treating plant-induced dermatitis, leads many modern day herbalists to recommend rubbing any area which comes in contact with poison ivy with a crushed jewelweed plant (Duke, 1999; Robbers and Tyler, 1998). Commercial, jewelweed-containing products are widely available over the counter and are marketed as effective PI dermatitis remedies. Walgreens® poison ivy soap lists jewelweed as an active ingredient as does Burts' Bees poison ivy soap; and myriad small herbal companies offer jewelweed soaps and creams as poison ivy cures. Contraindications have not been identified when used topically (Peirce et al., 1999) although internal use as a tea can cause digestive upset and consumption of whole plant induces vomiting and acts as a diuretic (Lipton, 1958).

Poison ivy dermatitis has been documented in the US since the 1600s (Armstrong and Epstein, 1995) and is responsible for more cases of allergic contact dermatitis than all other plants combined. *Toxicodendron radicans* produces urushiol, a mixture of catechols (Armstrong and Epstein, 1995) to which 50–70% of the population develops sensitivity. The level of sensitivity is highly variable with some individuals requiring massive exposure to urushiol and others experiencing a full blown allergic response (various combinations of scaling, vesiculation, fissuring, and weeping) to minute amounts (Pray, 2007). Epstein et al. (1974) determined that a 50 μg purified urushiol exposure will elicit a rash in 80–90% of adults. Furthermore, the onset of symptoms can appear in as few as 4 h or as many as 10 days after exposure (Aocd.org/skin, 2012).

Efforts to quantify jewelweed's ability to reduce urushiol-induced dermatitis are few and have taken varied approaches which led Senchina (2005) to conclude that jewelweed does not work. Similarly, small studies using human subjects (Guin and Reynolds, 1980; Long et al., 1997) and guinea pigs (Gibson and Maher, 1950) have found the "juice" of aerial parts to be ineffective in reducing the poison ivy rash. However, human subjects reported it relieved itching (Long et al., 1997). Other investigators report contradictory results. Two compounds found in ethanol extracts of the flowers of *I. balsamina* relieved itching in mice (Oku and Ishiguro, 2002) and jewelweed flowers demonstrate a weak antihistamine effect in the murine system (Ishiguro and Fukumoto, 1997). Lipton (1958), using whole plants, found jewelweed treatment to be comparable to steroid treatment, effectively clearing poison ivy symptoms in 2–3 days. Jewelweed has been prepared as a glycerin or aqueous extract, and used to produce sprays, soaps and creams. United States Patent 5888515 was issued to Brian Albert in 1999 (Albert, 1999) for a poison ivy remedy; a mixture which was predominantly jewelweed to which plantain and oatmeal were added.

The methods of exposure to poison ivy employed in these studies were varied and include direct exposure to urushiol (Long et al., 1997), constant exposure to poison ivy leaves for 15 min (Zink et al., 1991) and exposure to mixtures of poison ivy and jewelweed extracts (Gibson and Maher, 1950) none of which is an accurate representation of normal poison ivy exposure. The treatment options have also been varied; some studies have examined the ability of the *Impatiens* family plants to treat an existing inflammation while others have attempted to prophyllactically prevent poison ivy rash by treating an area with jewelweed prior to poison ivy exposure (Guin and Reynolds, 1980; Long et al., 1997). This study revisits the use of the *Impatiens* family plants and soaps derived from them in an attempt to emulate the successful experience of Native Americans and modern herbalists who use these plants to prevent dermatitis after brushing against a poison ivy plant.

Jewelweed flowers contain kaempferol, quercetin and lawsone (Oku and Ishiguro, 2002) and other aerial parts contain phenolics, flavonols, anthocyanins, quinones, saponins (Yang et al., 2001) and impatienol (Ishiguro et al., 2000; Oku and Ishiguro, 2002). The seeds of *I. capensis* contain antimicrobial peptides (Yang et al., 2001) and saponins (Shoji et al., 1994) and the seeds of *I. balsamina* have cysteine-rich compounds with antimicrobial and antifungal properties (Tailor et al., 1997). Lawsone (2-hydroxy-1, 4-naphthoquinone) was also identified in the roots (Panichayupakaranant et al., 1995; see Fig. 1); it has been used to treat fungal infections and exhibits antioxidant, immunomodulatory and antimicrobial properties (Ganora, 2009). The napthoquinone salts, including lawsone and its derivatives have been shown to be COX-2 inhibitors, which may help to reduce the pain and swelling (Oku and Ishiguro, 2002) typical of a poison ivy response. In prevention of poison ivy dermatitis, lawsone is purported by Rosen of Rutgers University to work by binding to the same site as the urushiol oil, suggesting a competitive binding mechanism to inhibit hypersensitivity (Duke, 1999). This study targeted lawsone effectiveness as a prophylactic agent in the prevention of PI dermatitis by assessing correlation of lawsone dose with symptom development. The impact of lawsone as the chemical mediator of this response was determined. Key to this investigation was a realistic simulation of PI exposure. Consequently, we were able to replicate the successful results of Native Americans and subsequent herbalists in using jewelweed to reduce PI dermatitis.

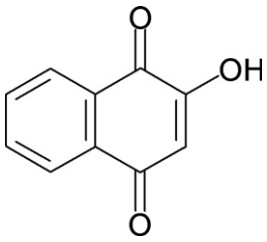

Fig. 1. Lawsone structure.

2. Methods

This Institutional Review Board (IRB) approved study examined both the native *I. capensis* and the alien *I. balsamina* to determine their lawsone content and ascertain the validity of anecdotal reports of jewelweed's ability to prevent poison ivy contact dermatitis. Fresh plant material, as well as aqueous, ethanolic and olive oil extracts of fresh, frozen or dried plants and a steam distillate of *I. capensis* were analyzed. Reversed phase HPLC analyses for the determination of lawsone were carried out with an Agilent 1100 equipped with a UV–vis diode array detector. The detection wavelength was 278 nm. The separations were performed at room temperature using a Zorbax Eclipse Plus C18 column (2.1×50 mm^2, 3.5 μm particle size) in an isocratic mode using a solvent system of 25% methanol and 75% 0.1 M acetic acid. The flow rate was 0.500 ml/min with an injection size of 10 μl.

Fresh plant mash was prepared by chopping whole plants in a blender until a stringy, thickened pulp formed. Aqueous and olive oil extracts of *I. capensis* and *I. balsamina* mashes were cold infused in glass jars by blending 250.00 g fresh plant pulp with 500 ml of distilled water or 500 ml olive oil, respectively. After one week, the infusions were filtered, and both aqueous and oil extracts were used in soap preparation. To prepare soap, 60 g of NaOH was added to 150 ml of the aqueous infusion, and set aside to cool to 38 °C/ 110 °F. In a glass pot, 100 ml grapeseed oil and 200 ml coconut oil were warmed to 38 °C/110 °F. Once both preparations were at 38 °C/110 °F, the aqueous extract was