INVESTIGATION FOR TOXICITY OF A HOUSEHOLD PLANT - AUSTRALIAN UMBRELLA TREE

(*BRASSAIA ACTINOPHYLLA* ENDL.)

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Many relatives of the Australian umbrella tree (*Brassaia actinophylla* Endl.) native to India and the Far East are used as a pulpwood source. The Australian umbrella tree can grow up to 30-35 feet in its native Queensland. It has spread throughout the tropics as an ornamental landscape tree. The Australian umbrella tree has become widely used as a foliage plant in both private (homes) and public locations in North Dakota and throughout the United States. This plant has become one of the most important horticultural indoor plants because it is easy to grow, requires little care, and is decorative.

The National Clearing House of Poison Control Centers has reported that plants, especially household plants, are in the top 5 percent of substances most frequently ingested by children under the age of five. The scarcity of information on the chemical composition of the Australian umbrella tree and its ready availability to man and animals, makes it necessary to know more about the relative toxicity of this plant.

The plants of the umbrella tree species complex *(Brassaia-Schefflera)* have gone through a number of name changes and reclassifications. Synonyms for the Australian Umbrella-tree species, *Brassaia actinophylla* (Endl.), are *Schefflera actinophylla* (Endl.) Harms, *Schefflera macrostachya (Seeman) Harms, Brassaia macrostachya* Seeman.

The first indication of potentially toxic compounds (alkaloids, saponins, and indoles) in this plant was noted in a 1970 Taiwanese study (4) of genera related to *Brassaia*. An Indian study (2) reported flavonoids and steroids in related *Schefflera* species.

More recently, toxic skin reactions to the umbrella-tree species have been reported. Alpin (1), Hammershoy (3), and Mitchell (6) reported leaves and stems are capable of causing allergic contact dermatitis to some individuals. However, this problem has been reported only rarely. Relative to systemic (internal) toxicity, a Minnesota veterinarian (8) has reported toxic symptoms

in a poodle that had ingested leaves and stems of the Australian umbrella tree. The total oxylate content of fresh tissue was determined to be 0.9 to 1.5 percent. The presence of the toxic soluble form of oxylate was not determined.

Since the research to date indicates the probable presence of toxic compounds in the plant tissue and because there is a discrepancy as to the presence of alkaloids, a further study of the chemical nature and preliminary study of the physiological effects of *Brassaia* extracts was undertaken.

EXTRACT PREPARATION

Leaves at different stages of maturity were collected during January 1981, from *Brassaia actinophylla* Endl. grown in the NDSU Horticulture Greenhouse. They were thoroughly washed, cut into 1-inch strips and freeze dried. The dry plant tissue was pulverized into a fine powder. To determine the presence of potentially toxic substances, the plant tissue was macerated and extracted with select solvents. The tissue was initially defatted using petroleum ether and then consecutively extracted with 95 percent alcohol and with distilled water. The petroleum ether and alcohol extracts were concentrated under vacuum. To avoid chemical decom-

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position the water extract was freeze dried and then reconstituted as needed. Chemical change was minimized by storage of the alcohol and water extracts at -20°C.

CHEMICAL ANALYSIS

The extracts were qualitatively tested for chemically reactive substances by thin layer chomatography. The tests were for constituents such as steriods, alkaloids or those chemical classes which most commonly yield physiologically active agents. The extract was spotted on glass plates coated with silica gel. The petroleum ether extracts were developed using an ether, chloroform and methanol mixture (3:3:1). The alcohol and water extracts were developed using a standard butanol, acetic acid, and water mixture (7:2:1). The presence (location) and chemical class of compound(s) on the chromatograms was determined by reaction with group specific color reagents and visualization under visible and long ultra violet light. Color tracings were used as a permanent record.

PHARMACOLOGICAL STUDY

The tests for toxicity were accomplished in two species, mice and rats. The extracts were administered by the oral and intraperitoneal routes of administration.

To determine oral toxicity, male mice were used. The animals were randomly assigned and fed (free choice) pelletized diets as follows:

Control (treatment 1)-Rat Chow 100%
Umbrella-tree (treatment 2)-90% Rat Chow/10% dry leaf
Umbrella-tree (treatment 3)-50% Rat Chow/50% dry leaf

The dried leaf and Rat Chow (Purina) were ground to a pwder and then mixed in a blender before pelletizing.

Daily water intake and weight changes were recorded and the animals observed for eight days. The initial study using six male mice established the base line and need for additional testing. The test was repeated and expanded to 16 mice in each treatment. Postmortem examinations were conducted by the Veterinary Science Department Diagnostic Laboratory at North Dakota State University.

To determine acute toxicity, rats were individually housed and fed a diet of Rat Chow (Purina) and water ad libitum. The rats were each injected with a solution or suspension of one of the extract concentrates (residues).

All solutions were injected into the peritoneal cavity and the animals observed for 24 hours using the Hippocratic Screen to evaluate for pharmacological activity (7). Control animals also were observed.

RESULTS

CHEMICAL ANALYSIS

PETROLEUM ETHER SOLUBLE COMPOUNDS

The non-polar (petroleum ether) fraction gave several positive tests for potentially toxic compounds as well as many non-toxic substances. Positive tests were obtained for quinones, steroids (terpenoids), fatty substances and flavonoids. The strong reaction to the test for saponins or terpinoids is consistent with the reported occurrence of significant concentrations of these substances in related species. Alkaloids with three different Rf values were present.

ALCOHOL SOLUBLE COMPOUNDS

The alcohol extract, as expected, yielded the largest number of visible spots with the selected reagents. A large number of amino acids, phenols and carbohydrates were present but no attempt was made to identify specific ones at this time. Several tannins and quinones as identified by different Rf values were contained in the extract.

In addition, six or more steroids, or terpenoids, were determined to be present, which is consistent with the known occurrence of 12 compounds of this type of structure in members of the Araliceae family. Positive alkaloid tests were obtained at the same Rf locations as noted for the petroleum ether extracts. Several positive tests for cardiac glycosides were obtained.

WATER SOLUBLE COMPOUNDS

These extracts like the alcohol fraction contained several different amino acids, carbohydrates, phenols and tannins. There was a strong positive test for a flavonoid(s) at the same position on the chromatogram as that recorded for the petroleum ether extract.

In summary, the chemical tests indicate that several glycosides and steroidal (terpenoid) like compounds are present in the leaf tissue. A positive test for three different alkaloids also was indicated as shown with two different test reagents.

PHARMACOLOGICAL STUDY

A preliminary seven-day study indicated potential toxicity since all the mice fed a diet of 50 percent umbrella tree and 50 percent Rat Chow died. The potential for toxicity/mortality following oral ingestion of umbrella tree leaflets was confirmed using 16 mice in each treatment (Table 1). Death occurred after the fourth day and after each mouse had eaten an average of 3.2 grams of the leaf tissue within seven days.

The results of the postmortem examination (Table 2) indicated that all mice were free of lesions in the brain, liver, kidney and heart. However, all mice showed extramedullary hematopoiesis in the spleen, being more marked in the animals receiving 50 percent **Brassaia** - 50

Table 1. Survival Rate of Mice Following Oral Ingestion of Australian Umbrella Tree (Brassaia Actinophylla) Leaflets

Treatment No. 1	Treatment No. 2	Treatment No. 3
Control Pellets 100% Purina Chow*	Treatment Pellets 10% Plant Tissue 90% Rat Chow*	Treatment Pellets 50% Plant Tissue 50% Rat Chow*
16	15	0

* Laboratory Chow 5001, Ralson Purina Company

Table 2. Results of Postmortem Examinations of Mice Following Oral Ingestion of Australian Umbrella Tree (Brassaia Actinophylla) Leaflets

CONTROL	- No gastrointestinal hemorrhage - Slight extramedullary hematopoiesis in the spleen
10% TREATMENT	- No gastrointestinal treatment - Slight extramedullary hematopoiesis in the spleen
50% TREATMENT	- Smaller size than above animals - Gastrointestinal hemorrhage - Extreme extramedullary hematopoiesis in the spleen

percent Rat Chow treatment (Treatment number 3). The mice receiving Treatment number 3 were also smaller, less thrifty in appearance, and had black tarry gastrointestinal contents due to the presence of blood. All mice receiving Treatment number 3 died within seven days of initial treatment.

The evidence obtained thus far directs our attention to the fact that mortality was caused by intestinal hemorrhage. Since both saponins and oxylates are recognized for their ability to produce severe gastroenteritis and intestinal hemorrhage, the likelihood is that one or both of these substances are producing the toxic effects observed.

The pharmacological effects of the extracts of **Brassaia** on rats is presented in Table 3. The petroleum ether extract is recognized for its lack of pharmacological activity. However, pharmacological activity was produced by the alcohol and water extracts ¢ the central nervous system depressant activity, drop in body temperature, and death are all note worthy effects.

CONCLUSIONS

The existence of potentially toxic compound(s) in *Brassaia* leaflet tissue was confirmed by positive chemical test for quinone(s), terpenoid(s), saponin(s), tannin(s), cardiac glycoside(s) and alkaloid(s). Toxicity to animals was confirmed by acute toxicity studies in two species (rats and mice) by two routes of administration (oral and intra-peritoneal).

Table 3. Pharmacological Effects of (Brassaia) Fractions Administered Intraperitoneally to Rats

FRACTION	ACTIVITY
Petroleum Ether	Reduced activity, no other observed response.
Alcohol	Decreased activity, ataxia, reduced muscle tone, decreased body temperature, prolongation of 2% alcohol sleep time, death within 24 hours of injection.
Water	Decreased activity, reduced muscle tone and respiration rate, decreased body temperature, death within 35 minutes of injections.

The production of decreased activity, depressed respiratory rate, drop in body temperature, and death evidence the fact that the plant leaflets contain pharmacologically active agents.

Additional studies are in progress to further assess the potential for toxicity to man.

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