
Studies on the Toxicity of Poke Berries

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Several times during the fall seasons of the last few years, warnings have been given regarding poisonous plants of Oklahoma. One of the warnings indicated that some children eat the dark purple-red berries of the Poke plant with serious results. Symptoms, according to a television broadcast, included convulsions with death from respiratory paralysis. A cursory investigation of pharmacy literature (Pratt and Youngken, 1956) indicated that the "type of poisoning and symptoms" were "central nervous system depression; purgation, convulsions." While one might not generally expect a C.N.S. depressant to produce convulsions, a diphasic action is seen in substances such as the opium alkaloids and antihistamines. These compounds cause C.N.S. depression very often followed by convulsions when given in toxic amounts. It was decided that an investigation of the toxicity of Poke berries would be undertaken.

A review of the literature indicated problems which apparently are characteristic for the study of plant toxicity in general. Illustrative is the following (Kingsbury, 1961): "It is often difficult to determine what is soundly founded and what is less so. For example, experiment station bulletins on poisonous plants rarely represent the product of original research, yet sources of information are usually not cited. As one attempts to trace an item of information into older literature he is faced with additional problems. Difficulties of availability are compounded by obscure references to ancient literature that require professional bibliographic knowledge to identify.

"I believe that compilers dealing with poisonous plants have often felt an obligation to carry a plant into newer literature even though uncertain of the original authority. This carry-over serves the useful

function of drawing attention to the plant, but may perpetuate error, and may appear to validate what was established on tenuous evidence."

BOTANY

Poke, Pokeberry, and Pokeweed are a few of the common names applied to *Phytolacca americana* L. (*P. decandra* L.), Family *Phytolaccaceae*. Although the name *Phytolacca decandra* was considered a synonym by the National Formulary VII, 1942, this name appears as the botanical origin in many articles of pharmaceutical and medical interest. The Poke plant is native to much of the United States, including Oklahoma. The plant may be found growing wild along streams, fence-rows, and in vacant city lots, and cultivated in flower or vegetable gardens. The characteristic leaves and berries make the plant familiar to most people in the areas where it grows.

The young green leaves of the Poke plant are used as vegetable greens. The roots are seldom used by physicians but are common in some areas as a folk-remedy, used internally for rheumatism and externally against certain skin disorders.

CHEMISTRY

Various chemicals have been isolated from the Poke plant. Most of the studies have been conducted on the roots, since this is considered the most toxic portion of the plant and is the most often used in medicine. The constituents causing toxic symptoms in Poke berries are not known and it may only be supposed that they are identical with the toxic principles of the root. Preston in 1884 reported the presence of traces of alkaloids from the roots to which the name Phytolaccine was given. Many modern publications continue to give this information for the berry as well as the root despite the fact that more recent efforts have failed to confirm the presence of alkaloids in the root (Goldstein, et. al., 1937; Jack & Rogers, 1942). There is good evidence that the toxic principle of the Poke plant is not a single compound.

TOXICOLOGY

Poisoning by Poke root appears to be sufficiently common to warrant the inclusion of *Phytolacca* poisoning in various toxicology books. Symptoms and actions are generally described similar to the following: "One to two hours after the ingestion of Poke root, there is nausea and vomiting followed by diarrhea. Drowsiness, vertigo and dimness of vision, prostration and sometimes convulsions, with death from respiratory paralysis are produced by fatal doses" (Thienes & Haley, 1955). They also state that "the fatal dose is not known."

The toxicity of Poke berries appears to be less common and the literature includes opinions varying from "the berries are innocuous" (Thienes & Haley, 1955) to "Poke root and Poke berry preparations should therefore be considered as not only obsolete but dangerous" (Macht, 1937). Jack and Rogers stated that "Phytolacca root was five to eight times as active as *Phytolacca* berries" (Jack & Rogers, 1942).

The juices of the berries are reportedly used to color wines in European countries (Macht, 1937). Possibly because of this use, there are statements to the effect that the seeds contain the toxic substances (Muenscher, 1937) and that the pulp is believed to be non-poisonous (Macht, 1937; Encyclopedia Britannica, 1961).

EXPERIMENTAL

During the months of September and October, fresh Poke berries

were collected from plants growing wild in Custer County, Oklahoma, and from plants cultivated in Weatherford, Oklahoma, gardens. Part of the berries was air dried and part was stored in a refrigerator until used. So that all comparisons could be made on a weight basis, samples of berries were weighed fresh and dried.

The average fresh berry weighed approximately 0.45 gm. and the average dry berry approximately 0.15 gm. The seed comprises, on a weight basis, about 20 per cent of the fresh berries and 60 per cent of the dry berries.

Attempts were made to determine the lethal dose in albino Swiss mice. Fresh berries were reduced to a fine state of subdivision by the use of a blender and this suspension was injected into the stomach of the mice by the use of an oral needle. Dried berries were ground by the use of a mortar and pestle, suspended in olive oil, and injected into the stomach of the mice. It was impossible to give a large enough oral dose of either of the suspensions to produce death. The dose was limited by the capacity of the stomach of the animal.

Attempts were made to extract the toxic principles by the use of three solvents: water, diluted alcohol, and petroleum benzine. The resultant solutions were evaporated until all of the organic solvents were gone. The residue from the water extraction and the diluted alcohol extraction were dissolved in distilled water. After the benzine was removed, an oily liquid remained, and it was used without dilution. The solution made from the diluted alcoholic extractive proved to be the most toxic, and it was used in further tests. One ml. of the final dilution contained the activity of 3 gm of fresh berries or 1 gm of dry berries. This solution contained no alcohol and will be called a liquid extract of Poke berries.

The liquid extract of Poke berries did not produce death in mice in any amount given as a single oral dose. The largest dose that could be administered easily to a 20 gm mouse was 0.66 ml or 33 ml/kg of body weight. Since this quantity did not produce death, a second dose was given after one hour and a third dose an hour later.

The LD₅₀ was not determined. However, some of the animals receiving three oral doses at one-hour intervals died. It may be concluded that the LD₅₀ may be near this dose. This represented for the dry berries, 100 gm/kg body weight or for the fresh berries, 300 gm/kg. The mechanical effect of the massive quantity of material administered was not determined.

If human beings are equally as sensitive (or resistant) to Poke berry poisoning as were the mice used, it would take about 45 pounds of fresh berries to kill an average adult male.

Intraperitoneal injections of the liquid extract of Poke berries caused death with smaller doses. Death resulted in part of the 20 gm animals injected with a dilution representing 0.025 gm of dry berries. The LD₅₀ dose of the dry berries may be near 1.25 gm/kg. Liquid extract of Poke berries is, therefore, about 80 times as toxic when injected I.P. as when given orally.

In order to determine the relative toxicity of the seeds and pulp of the fruit, the two portions were separated from fresh berries by the use of a sieve. The dried seeds were ground, suspended in olive oil, and varying doses injected intraperitoneally into mice. The pulp was used without the addition of any solvent and injected in a similar manner. The LD₅₀ for the seed, when injected, was estimated as being slightly below 0.7 gm/kg and for the pulp, calculated on the dry weight basis, was

near 1.2 gm/kg. When given by I.P. injection, therefore, both the pulp and the seeds are toxic with the toxic doses not greatly different when expressed on a dry weight basis. Symptoms of toxicity and death were not noticeably different in the two groups.

SUMMARY

(1) The acute oral lethal dose of Poke berries in mice was larger than the quantity that could be administered.

(2) Diluted alcohol was a better solvent for the toxic principles than either water or petroleum benzine.

(3) Based on a liquid extract of Poke berries in mice, the oral LD₅₀ for fresh berries appeared to be about 300 gm/kg body weight and for the dry berries about 100 gm/kg body weight.

(4) The liquid extract of Poke berries was approximately 80 times as toxic when injected intraperitoneally as when given orally.

(5) Both the pulp and the seeds of Poke berries are toxic when injected.

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