

SUSCEPTIBILITY TO DERMATITIS FROM RHUS DIVERSILOBA

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The word "immunity" is used in this article to designate the effective resistance of the organism against the principal, or most active, irritant in *Rhus diversiloba*. A high degree of immunity, therefore, designates a low degree of susceptibility and vice versa. Immunity is generally used to designate a low degree of susceptibility toward foreign protein. As the irritant poison of *Rhus diversiloba* is not a protein, the term is used in this paper to denote a natural or acquired resistance toward nonprotein substances, such as occurs with alcohol, chloroform, ether, atropin, cocain and opium. In this terminology, immunity includes what is commonly known as tolerance.

Judging by the evidence at present at hand, there seem to be two forms of immunity—natural and acquired.

NATURAL IMMUNITY

According to Kolmer, natural immunity is the resistance to infection normally possessed, usually as the result of inheritance, by certain persons or species under natural conditions.

This type of immunity to lobinol (the poisonous principle of *Rhus diversiloba*) is frequently relative and seldom, if ever, absolute. Persons are frequently found who are immune to lobinol when it is applied in the same concentration and condition as it exists in the sap of the plant, but when applied in a more concentrated form these persons are affected by it. Von Adelung,¹ in 1912, found that the concentrated alcoholic extract of *Rhus diversiloba* affected every immune person to whom it had been applied. Similar results were obtained by Warren,² in 1909, with *Rhus toxicodendrol*. Bibb,³ in 1914 and 1915, however, in experimenting with the sap of *Rhus toxicodendron*, found a person on whom it had no deleterious effect. Earlier immune results with the

1. Von Adelung, Edward: An Experimental Study of Poison Oak, M. A. Thesis, University of California (Nov.) 1912.

2. Warren, L. E.: The Poisonous Principle of Rhus, Pharmaceut. J. & Pharmacist, 4 S. 29:521 and 562, 1909.

3. Bibb, L. B.: Experimental Rhus Poisoning, Texas M. J. 30:162, 1914-1915.

sap of *Rhus toxicodendron* were noted by Kalm,⁴ in 1748, by van Mons,⁵ in 1797, and Blackwood,⁶ in 1880. I have observed similar cases with *Rhus diversiloba*. The sap of both the poison ivy and the poison oak has frequently been observed to have been transmitted from the hands and clothing of immune gardeners and those who have been working with the plants to others who were susceptible to it (Planchon,⁷ 1887; Busey,⁸ 1873; White,⁹ 1873; Lindley,¹⁰ 1908). Similar examples of relative immunity are found in experiments with bacteria and toxins on animals; for instance: rats are highly immune to diphtheria toxin, and readily withstand the effects of an amount equaling 1,000 lethal doses for a guinea-pig, but still larger doses may prove fatal; hedgehogs possess complete or almost complete immunity for the amount of snake venom deposited in an ordinary strike, but if venoms of several snakes are collected and injected at one time, death will result.

The commonly considered species immunity to rhus dermatitis in cases of the lower animals is frequently due to the protection of the skin by hair. White, in 1873, noticed that hunting dogs which have traversed woods infested with poison ivy are sometimes affected about the eyes. Kobert,¹¹ in 1906, stated that sheep and goats that eat the leaves and fruit of poison sumach (*R. vernix*) become sick and much harm results. Mackie,¹² in 1903, said:

On the ranges the leaves and berries (of poison oak) are readily eaten by sheep, goats, and horses, but not by cattle, as far as could be ascertained by observation and numerous inquiries. Many of the bushes are stripped entirely of leaves before they would naturally drop them.

4. Kalm, Peter: Travels Into North America, English tran., London, 1772, Ed. 2 **1**:53, 60-64, 139; **2**:20.

Travels Into North America. Trans. into English by John Reinhold Forster. In Pinkerton, John: A General Collection of the Best and Most Interesting Voyages and Travels, London, 1808-1814 **13**:402-403, 434, 1812.

5. Van Mons, J. B.: Memoire sur le *Rhus radicans*, Actes la soc. de méd. chir. et pharm. **1**: part 2, 136-167, 1797.

6. Blackwood, W. R. D.: Some Thoughts on Rhus Poisoning, Philadelphia Med. Times **10**:618, 1880.

7. Planchon, L.: Accidentis causes par le contact du *Rhus toxicodendron*, Montpellier Medical, 1887.

8. Busey, S. C.: Poisoning by the *Rhus toxicodendron*, Am. J. M. Sc. **17**: 436-442, 1873.

9. White, J. C.: On the Action of *Rhus venenata* and *Rhus toxicodendron* on the Human Skin, New York M. J. **17**:225-249, 1873.

10. Lindley, J. S.: Rhus Poisoning, Am. J. Dermat. & Gen.-Urin. Dis. **12**: 342-344, 1908.

11. Kobert, R.: Lehrbuch der Intoxikationen, Stuttgart, 1906 **2**:511.

12. Mackie, W. W.: The Value of Oak Leaves for Forage, Bull. 150, California Experiment Station, Berkeley, California, 1903.

Pfaff,¹³ in 1897, when administering toxicodendrol per os to rabbits, noticed that it caused nephritis and death of the animals. Ford,¹⁴ in 1907, made similar statements. McNair,¹⁵ in 1917, cited one case in which a rabbit was given the sap of *Rhus diversiloba* per os, which caused albuminuria.

Many birds normally eat the fruits of the poisonous rhus.

It seems to be well liked by horses, according to interviews with United States government forest rangers. Jepson, in 1902, noted one observer, however, who asserted that "horses who feed on poison oak if driven until they become warm tremble and shake, and will die if not taken off the roads. Driven cattle are similarly affected."

Racial immunity is that type of natural immunity which exists among members of the same species. Dakin,¹⁶ in 1829, noted that mulattoes, negroes and Americans were equally susceptible to *Rhus toxicodendron*. French,¹⁷ in 1903, also stated negroes were not immune to *Rhus toxicodendron*. Lindley, in 1908, noted that the full-blooded Indians in California were immune while the half breeds were susceptible to *Rhus diversiloba*. Hrdlicka,¹⁸ in 1908, listed remedies for this dermatitis used by the Indians of the Southwest. Severe cases occur quite frequently in California among the Mexicans, Chinese and Japanese as well as among the native and foreign whites. There seems, therefore, to be no high degree of immunity existing among the principal types of races toward *Rhus diversiloba* or toward *Rhus toxicodendron*, as far as present knowledge extends.

Examples of individual immunity toward both infection by poison ivy and poison oak are not infrequent. All of these so far tested are relative and none are absolute.

There are many conflicting statements as to whether blonds are more susceptible than brunettes. Blonds, however, as far as I have

13. Pfaff, Franz: On the Active Principle of *Rhus toxicodendron*, Exper. Med. **2**:181-196, 1897.

14. Ford, W. W.: Antibodies to Glucosides, with Special Reference to *Rhus toxicodendron*, J. Infect. Dis. **4**:541, 1907.

15. McNair, James B.: The Pathology of Dermatitis Venenata from *Rhus diversiloba*, J. Infect. Dis. **19**:419-428, 1916. A Study of *Rhus diversiloba*, with Special Reference to Its Poisonous Properties, Amer. J. Botany, 1921.

16. Dakin, R.: Remarks on a Cutaneous Affection Produced by Certain Poisonous Vegetables, Am. J. Med. Sc. **4**:98-100, 1829.

17. French, J. M.: *Rhus toxicodendron* and *Rhus* Poisoning, Merck's Arch. **5**:223-5, 259-61, 1903.

18. Hrdlicka, Ales: Physiological and Medical Observations Among Indians of Southwestern United States and Northern Mexico, Bur. Amer. Ethnology, Bull. 34, 1908.

been able to ascertain, have never been said to be less immune than brunettes, but, on the contrary, always have been said to be more susceptible. The question, however, is of little value as both are affected in large proportions. Dakin stated that persons with light and dark skins were equally susceptible. Planchon regarded blonds as not more susceptible than brunettes. Lindley considered those with fair skins more liable to attacks than those with dark skins. Ward,¹⁹ in 1908, noted that brunettes were slightly less susceptible than blonds, although, he said, this observation was not to be relied on.

Horsfield,²⁰ in 1798, made the statement that females are more susceptible than males to *Rhus radicans*. In compiling the statistics of the cases of *Rhus diversiloba* dermatitis treated at the infirmary of the University of California for five years, the percentage of cases among males was less than the percentage of cases among females.¹⁵ This may be due to the fact that the skin of the female is generally more susceptible. The statistics, however, are not reliable for drawing these conclusions as (1) the total number of males and females exposed is not known, (2) the total number of males and females affected is not known, (3) the table shows only the number of students who came to the infirmary for treatment, which is not the total number affected, although it may be nearly the total number.

According to Baldwin²¹ (1887), fat people are more susceptible than thin people to the effects of *Rhus diversiloba*.

Some physicians believe also that children are less immune than adults (Horsfield, Dakin). There are cases in which the reverse condition holds true, as stated by Blackwood and by Cundell-Juler.²² It is quite probable that people, after reaching the age of 60 years, have a diminishing immunity in accordance with the general pharmacologic law.

Certain persons appear to possess a definite immunity to the poison or poisons, although they may be freely exposed for many years. In other persons immunity may increase or decrease. I have known of a forest ranger, in service in a California forest for many years, who

19. Ward, Ralph F.: Severe Ivy Poisoning, New York M. J. **88**:1224 (Dec. 26) 1908.

20. Horsfield, Thomas: An Inaugural Dissertation on *Rhus vernix*, *R. radicans*, and *R. glabrum*, Commonly Known in Pennsylvania as Poison-Oak, Poison Vine, and Common Sumac, University of Pennsylvania, 1798; C. Caldwell's Medical Theses, Philadelphia, 1805, p. 113.

21. Baldwin, A. E.: A Case of Poisoning by *Rhus toxicodendron*, Pacific M. & S. J. **30**:509 and 643, 1887.

22. Cundell-Juler: The Poison Vine. Cincinnati Lancet and Clinic **11**: n. s.: 73-76, 1833.

escaped infection, though he frequently was brought in contact with the sap of poison oak in clearing trails; finally he contracted the disease on returning to the habitat of the plant after a number of years' absence. Similar cases are of common occurrence in medical literature, especially in connection with poison ivy (Kalm, Dakin, Blackwood and Cundell-Juler).

Such variations of the degree of susceptibility in the same person may be dependent on the condition of the general health (Blackwood). Yandell,²³ in 1876, stated that enfeebled persons were most likely to be poisoned. The condition of the glands of the skin may have an influence, as has been previously considered (McNair²⁴). Horsfield considered persons more susceptible immediately after than before a full meal. Park²⁵ enlarged on this idea when he said that a "patient with an irritable skin, which reacts promptly to irritation in the digestive tract or elsewhere, should be particularly liable to annoyance from contact with such a pronounced irritant as *Rhus*."

There may be a relation between the sensitivity of the skin to *Rhus* and toward other irritants. Attacks of rhus dermatitis are known to have left a hypersensitivity toward sunlight and common English ivy (Stirling,²⁶ 1913). Perhaps the reverse holds true as well. Several persons immune to *Rhus* are greatly annoyed by mosquitoes while they are not bothered by fleas. On the other hand, one person who is quite susceptible to both *Rhus* and fleas is not appreciably susceptible to mosquitoes. Perhaps tolerance to *Rhus* may establish, or be the result of, a tolerance to other irritants of the same class as the prolonged use of alcohol creates a tolerance for chloroform. Chloroform and alcohol are considered to act on the same nerve cells and in the same direction.

Causes of Natural Immunity.—1. Various nonspecific factors may prevent infection. Among these may be mentioned the thickness and imperviousness of the skin, especially of the stratum corneum, and the physical action of the various secretions of the sebaceous and sudoriparous glands.

23. Yandell, L. P.: Poison Oak Eruption, Louisville Med. News **2**:32, 1876.

24. McNair, James B.: Pathology of Rhus Dermatitis, Arch. Dermat. & Syph. **3**:383, 1921. Lobinol-a Dermatitant from *Rhus Diversiloba*, J. Am. Chem. Soc., January, 1921.

25. Park, R.: Dermatitis Venenata; or *Rhus toxicodendron* and Its Action, Arch. Dermat. **5**:227-234, 1879.

26. Stirling, E. C.: An Eruption of the Skin Caused by the Poison Ivy, Australian M. Gaz. **33**:355-359, 1913.

2. The particular structure of the sebaceous and sudoriparous glands and the chemical nature and abundance of their secretions. This phase of the subject has previously been exhaustively considered in a previous article (McNair²⁴).

3. Phagocytosis may be of importance in natural immunity. Leukocytes may act either by engulfing and carrying away small particles of the poison, or their oxidizing and other enzymes may have a protective action against the poison.

4. A natural antitoxin immunity may exist. Although attempts to demonstrate such an immunity have never been successful either with lobinol, according to von Adelung (1912), or with toxicodendrol, according to Strickler²⁷ (1918), this failure may be due to the unsuitability of the present methods. Ford, in 1907, demonstrated the acquirement of tolerance in guinea-pigs and rabbits to six or seven times their minimum lethal doses, as well as the immune properties of the resultant serum. These experiments von Adelung was unable to repeat.

The chemical defense against lobinol may include oxidation, reduction, hydration, dehydration, substitution and addition. Such protective substances as may play a part may include carbonates, phosphates, protein, sulphur-containing substances and glucuronic acid. The probable phenolic nature of lobinol²⁴ would cause one to expect that it might form lobinol glucuronate and lobinol sulphate.

As iodine has the power to render lobinol nontoxic in vitro (Von Adelung, 1913), perhaps the thyroid secretion may play a part in susceptibility. It would be interesting to determine whether there is any relation between susceptibility and goiter.

There may also be substances present that do not chemically combine with the poison to render it physiologically neutral, but which antagonize it by stimulating other defense mechanisms, causing an antagonism similar to that which exists between chloroform and strychnine.

5. It may be that even after the introduction of the poison no great harm results because of a lack of suitable solvents or receptors on the part of the body cells of the host for the transmission or union of the pathogenic agent. The effect of the poison, therefore, may remain strictly localized to the point of immediate contact.

6. Immunity may be due to the absence of synergists, the absence of substances in the tissue that increase the toxicity of the poison.

27. Strickler, A.: Treatment of dermatitis venenata. *J. Cutan. Dis.* **36**: 327 (June) 1918.

ACQUIRED IMMUNITY

Acquired immunity may occur in two distinct forms: active and passive. A mixed type may exist.

Active Acquired Immunity.—Active acquired immunity is, according to Kolmer, that form of a resistance to infection brought about by the activity of the cells of a person or animal as a result of having had the actual disease in question, or as a result of artificial inoculation with a modified or attenuated form of the causative agent.

Such active acquired immunity may be found against rhus dermatitis when the defense mechanism of the body is stimulated by an attack of rhus dermatitis and antitoxic elaborations formed. Whether such a result is actually accomplished in rhus poisoning has often been questioned. Many observers assert that by chewing the leaves of the plant and swallowing the juice immunity can be acquired (Duncan,²⁸ 1916). I have not had an opportunity to experiment with such an immune person, but many cases are known in which susceptible persons who have followed these directions have been severely poisoned internally (Dakin; Conner,²⁹ 1907, and Alumbaugh,³⁰ 1903). I know of such cases in which the patient did not acquire immunity on recovery.

Another type of immunity may be caused similar to the common immunity toward nicotin. In acquiring such immunity by smoking tobacco the absorption of nicotin is not retarded nor its excretion accelerated, but the tissues become accustomed to small quantities of nicotin, and thus fail to react to it. Much of this tolerance is lost when the habit is discontinued, as in the case of opium.

Lindley states that "some persons doing manual labor are never free from the eruption entirely; it could be seen about the eyes, neck and wrists almost constantly." I contracted severe dermatitis several times from poison oak when about 13 years of age, but I have not been bothered with it since, although I not only frequently make trips into the habitat of the plant, but also rub the sap on my hands. Over a period of six years during which I have been experimenting with poison oak, I have always been able to produce local dermatitis in equally severe forms by applying the sap of the plant to the skin. The disease produced, although always mild, has never decreased in mildness with successive experiments. Strickler, in 1918, asserted that he had

28. Duncan, C. H.: Autotherapy in Ivy Poisoning, New York M. J. **54**: 901, 1916.

29. Conner, J. J.: Poisoning by Rhus toxicodendron, Am. J. Dermat. & Gen.-Urin. Dis. **11**:368, 1907.

30. Alumbaugh, W. E.: How Not to Do It, and Why! Rhus toxicodendron poisoning, Med. World **21**:176, 1903.

produced absolute immunity of short duration by the intramuscular administration of the poison.

There are many cases in which persons who have been able to handle any variety of poisonous *Rhus* with immunity on whom later a small amount of the sap would cause severe dermatitis (Kalm, Blackwood and Cundell-Juler). Persons who have frequently been subject to mild attacks may be liable to increased sensitivity, as shown in several University of California Infirmary cases (cases 4710, 4713, 4723, 5000, 5385).

The reverse has also been noticed. Horsfield, in 1798, stated that children are more readily poisoned than adults, and Dakin said that susceptibility recedes as age advances. I have known a number of people with a high degree of susceptibility which did not appreciably vary throughout a period of years. This opinion is supported by statements made by patients at the University of California Infirmary; for instance, the patient in Case 4536. Dr. von Adelung³¹ has also maintained a low immunity for a number of years.

Fluctuating degrees of susceptibility may occur in the same person, as shown in some of the cases of the University of California Infirmary (Cases 4814, 5665). Apparent changes in the degree of immunity may not always be actual for the severity of the dermatitis is governed, to a certain extent, by the amount of poison acting, as well as on the degree of resistance of the person.

Passive Acquired Immunity.—As the name indicates, this is a form of immunity that depends on defensive factors not originating in the person or animal protected, but is passively acquired by the injection of serum from one that has acquired an active immunity to the disease in question, according to Kolmer.³² Such immunity may perhaps result from drinking the milk of a cow fed on a mixture of grass and poison ivy plant, as cited by Dieffenbach,³³ 1917.

SUMMARY

In this paper immunity is used to include tolerance.

Natural immunity exists toward the principal irritant. It is usually relative and seldom absolute. Specie immunity exists among some animals and birds. As far as we know, racial immunity does not exist among Chinese, Japanese, Mexicans, negroes, the North American

31. Von Adelung, Edward: An Experimental Study of Poison Oak, Arch. Int. Med. **11**:148-164, 1913; Interstate M. J. **20**:139-142, 1913.

32. Kolmer, John A.: Infection, Immunity, and Specific Therapy, W. B. Saunders Company, Philadelphia, 1917.

33. Dieffenbach, W. H.: Treatment of Ivy Poisoning, South. Calif. Pract. **32**:91-92, 1917.

Indians or any other race. There are examples of individual immunity in which immunity is relative rather than absolute. Blonds and brunettes are both affected in large proportions. Females are apparently more susceptible than males. According to one writer, fat people are more susceptible than thin people. Age may influence immunity. There is no proof, however, that children as a class are more susceptible than adults. In the same individual the degree of immunity may vary or may remain constant. The degree of immunity is probably influenced by the condition of the health and the condition of the skin. Natural immunity may be due to: the thickness of the skin and the condition of the dermal glands, phagocytosis, natural antitoxin, lack of a suitable solvent or receptors for the poison, and an absence of substances in the tissues that increase the toxicity of the poison.