

Digitalis

(Foxglove)

My Very Dear Sir:

As the Gallant Armies of the war weary Southern Confederacy prepare for another spring of active campaigning, the Medical Purveyors are starting to experience difficulties supplying our physicians as a result of the Northern blockade of our ports. As a result, our Surgeon General has instructed his medical officers to rely on the indigenous plants as sources of medicinal agents. The gifted Physician and Naturalist, Dr. Francis Porcher was released from service in the field and hospital and directed by Surgeon General Moore to prepare his work on "Medical and Useful Plants and Trees of the Confederate States" under the title *Resources of the Southern Fields and Forests, Medical, Economical and Agricultural*. It is in this vein that I will discuss with you the medicinal use of the Foxglove plant, known to grow in and around Charleston, South Carolina.

It is the leaves of *Digitalis purpurea* or the foxglove plant that possess the necessary chemical compounds to render the plant of medicinal use. It is a naturally beautiful plant with a biennial or perennial fibrous root. In the first year, it sets forth large tufted leaves and in the following summer, a single erect downy and leafy stem, rising from two to five feet, and terminating in a remarkable grouping of flowers, purplish in color. The leaves on the lower portion of the mature plant are ovate, pointed, and are about eight inches in length, three in breadth. They are connected to the stem by short, winged footstalks. The upper leaves are somewhat different in appearance in that they are alternate, sparse, and lanceolate. Both upper and lower leaves are serrate and have wrinkled velvety surfaces of which the upper surface is a fine deep green while the lower surface is more pale and downy. Each plant possesses numerous flowers which are attached to the upper part of the stem by short peduncles and generally hang down upon one side. At the base of each flower peduncle is a floral leaf that is sessile, ovate, and pointed. The calyx of the flower is divided into five segments, the uppermost of which is narrower than the others. The corolla is monopetalous, of bell-form with a swelling on the lower side, and irregularly divided at the margin into short obtuse lobes. The shape and size of this structure is not unlike the end of the finger of a glove, a circumstance which has suggested the name by which the plant is designated. The mouth of the flower is guarded by long soft hairs. The external color of the flower is a bright purple while the internal is sprinkled with black spots upon a white background. There have been reported a variety of the plant with white flowers. The filaments of the flower are white and curved and have large yellow anthers. The style is simple and supports a bifid stigma. The seeds are very small, numerous, and are of grayish brown color.

As stated earlier in my communication, the foxglove plant has been reported to grow in and around Charleston, though the major portion of this valuable medicinal plant is obtained by import from Europe where it grows in the more temperate climates and flowers in the middle of summer. It is the leaves of the plant that possess the desired medicinal properties. Much care should be employed in selecting, preparing, and preserving them in order to ensure their activity. They should be gathered in the second year, immediately before or during the period of flowering. Those selected should be full grown and perfectly fresh. Plants that are preferable are those that grow spontaneously in elevated places and are directly exposed to the sun. The leaves should be dried in the sunshine or by gentle heat before a fire while care should be taken to keep them separate while drying. Some leaves imported into the young Confederacy have been prepared by drying in a basket in the dark place such as a drying stove. It is probably owing, in part, to the want of proper attention in preparing digitalis for the market, that it is so often inefficient. Much of this medicine imported is in oblong compact masses, into which the leaves have been compressed. In some of these cakes the digitalis is of good quality; but we have seen others in which it is quite the reverse. Some of these cakes are moldy in the interior; and we, on the whole, cannot but consider this mode of preparing the drug as objectionable. The dried leaves should be tightly sealed in tin canisters so as to exclude light and moisture or they may be pulverized and the powder preserved in well-stopped opaque bottles. Foxglove deteriorates with time and should be renewed at least once a year to obtain maximal medicinal benefit. The quality of the preparation should be judged by the degree which it possesses the characteristic color, smell, and taste.

Foxglove has no smell in the fresh state, but acquires a faint narcotic odor when properly dried. It possesses a bitter and nauseous taste. The color of the dried leaf is a dull pale-green with a whitish down on the under surface while the color of the properly prepared powder is a fine deep green.

The active virtues of the leaf reside in a bitter principal called digitalis. It is isolated in the following manner: An alcoholic extract is first prepared. This is treated with distilled water acidulated with acetic acid and then heated to 110 degrees F. A small amount of animal charcoal is added during the heating process. The liquor is then filtered and partially neutralized by ammonia. A fresh concentrated infusion of galls is gradually added so long as precipitate is produced. This precipitate, which is the tannate of digitaline, is obtained separate by decanting the liquid and washing with pure water mixed with a little alcohol. It is then compounded in a mortar. The mixture is heated gently and submitted to the action of twice its volume of alcohol at about 90 degrees F. The alcoholic solution is treated with a little animal charcoal, filtered, and evaporated at a very gentle heat. The residue is acted on twice or three times with a cold and very pure sulphuric ether, which removes impurities and leaves the digitalis. This then may be powdered. From 1000 parts of the leaves, it is reasonable to obtain between 9 and 20 parts of digitalis. Digitalis is a white inodorous intensely bitter powder. It has the characteristic property of giving a fine emerald green color to concentrated muriatic acid.

Digitalis is a narcotic, sedative, and diuretic. When administered in quantities sufficient to bring the system decidedly under its influence, it is apt to produce a sense of tightness or weight with dull pain in the head, vertigo, dimness or other disorder of vision, and some confusion of thought. It may give rise to irritation in the pharynx and esophagus which has been described as extending to the larynx and trachea producing a hoarseness. It has also been described to disturb the bowels, exciting nausea or even producing vomiting. Another noted highly important effect that this substance possesses is to produce an augmented flow of urine. It has been stated to increase absorption and that its diuretic operation is observable only when dropsical effusion exists. Digitalis has a remarkably sedative action upon the heart. This is exhibited in the reduction both of the force and frequency of the pulse, which sometimes sinks to thirty strokes per minute. In some instances, however, it undergoes little change while in others it only becomes irregular. It has been reported to occasionally increase the frequency of the pulse. The effects of digitalis upon the circulation are much influenced by posture. It is well known that the pulse is always more frequent in the erect than the horizontal posture, and the difference is greater in a state of debility than in health. Digitalis diminishes the frequency of the pulsations of the heart by a directly debilitating power. This very debility, when any exertion is made, calls for increased action in that organ. This causes it to attempt, by an increase in the number of contractions, to meet the demand which it is unable to supply by an increase in their force. This may explain this seemingly paradoxical effect on pulsations of the heart. The normal depressing effect of digitalis may be experienced through the nervous centers while the occasional irritation may proceed either from the direct action of the medicine through the blood on the tissues effected, or a sympathetic influence extended from the urinary organs.

The effects detailed above may result from digitalis given in remediate doses. In larger quantities its operation is more violent. Nausea, vomiting, stupor or delirium, cold sweats. Extreme prostration in strength, syncope, and convulsions are among the alarming symptoms which indicate its poisonous character. These effects are best counteracted by stimulants, such as brandy, as well as opium. Should any poison be suspected to remain, it would be proper, before employing other measures, to evacuate the stomach by the free use of warm liquids.

An important aspect of the properties of digitalis is that, after having been given in moderate doses for several days without apparent effect, it sometimes acts suddenly with an accumulated influence, with the above described results. It is, moreover, very permanent in its operation, having once commenced, is maintained for a considerable period without re-dosing of the medicine. The practical inferences deducible from these properties are: first, that after it has been given for some time without effect, care should be taken not to increase the dose too greatly and secondly, after its effects have begun to appear, it should be suspended for a time, or exhibited in smaller doses, lest a dangerous accumulation be experienced. In numerous instances death has resulted from its incautious employment.

Digitalis has been regarded as a standard remedy of dropsy since about the year 1775. It is also presently employed very extensively both for its diuretic power and for its sedative effects

over the circulation. The former renders it highly useful in dropsical diseases, though like all other remedies, it frequently fails; the latter adapts it to cases in which the action of the heart requires to be controlled. Though it certainly has not the power, at one time ascribed to it by some, of curing phthisis, it acts beneficially as a palliative in that complaint by depressing the excited movements of the heart. In the same manner it proves advantageous in the treatment of aneurysm, hypertrophy, and dilatation of the heart, palpitations from rheumatic or gouty irritation, and in various forms of hemorrhage, after action has been sufficiently reduced by the lancet. It has also been prescribed in mania, epilepsy, pertussis, and spasmodic asthma. In delirium tremens it has been recommended as a specific remedy given in the form of infusion, in the full dose repeated every two hours until the symptoms of narcotism are induced. This practice is somewhat hazardous unless the patient is carefully watched. Externally applied, it sometimes acts speedily and powerfully as a diuretic, and has proved useful in this manner as a treatment for dropsy.

The normal dose of the powder digitalis is one grain, repeated twice or three times a day, and gradually increased until some effect is produced upon the head, stomach, pulse, or kidneys, when it should be omitted or reduced. Enormous doses of this medicine have been given with asserted impunity, and when they occasion full vomiting, it is possible that they may sometimes prove harmless. In my and my colleagues experience, when the alarming effects sometimes experienced from comparatively moderate doses are considered, the practice must be condemned as exceedingly hazardous.

It is now that I conclude, I admit, a rather extensive discussion of the foxglove plant and digitalis that only the most ardent student of medicine could complete at one sitting. The demands of the dual profession of a Confederate Officer and physician require dedication, zeal, and a firm belief in the cause for which we have entered this conflict. It is with this thought that I will close and attend to other, more pressing duties.

Your obedient servant,

Jonathan O'Neal, MD
Surgeon, PACS