Scientific Section

Papers Presented at the Sixty-First Annual Convention

COMPARATIVE ACTIVITY OF VARIOUS SPECIES AND VARIETIES OF DIGITALIS.

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But few of the many species and varieties of the genus Digitalis have been examined for comparative toxicity, Paschkis (1) claims that Digitalis ambigua contains the same constituents as Digitalis purpurea and that the medicinal properties of the two are the same. Goldenberg (2) concludes that all species exert the same action on the heart of a frog as the infusion of Digitalis purpurea, but differ considerably in the energy of their action. He says that Digitalis eriostachys and Digitalis glandulosa are only slightly active and that Digitalis fontanesii is extremely feeble. Digitalis nervosa he finds to be 1.5 times and Digitalis ferruginea even 10 times more active than purpurea. This is indeed a small number of species upon which to formulate conclusions for a genus consisting of twenty-three or more species and numerous varieites. Boudgest (3) has examined Digitalis grandiflora which is synonymous with Digitalis ambigua and says that it possesses activity as a cardiac remedy which is fully equal to that of Digitalis purpurea.

This leaves a large number of species and horticultural varieties which have not been investigated for comparative medicinal value. For this reason as well as to gain more information upon the effects of cultivation, soils, geographical distribution and time of collection it was thought desirable to examine samples of as many species and varieties as could be obtained. Only samples from plants grown under uniform conditions and from seed of known source were used in the experiment. Catalogues from the most prominent seedsmen and nurserymen of the United States, England, Germany, and Japan were examined and all the species and varieties listed by them were obtained for planting. The first of these plantings were made as early as December, 1911, and the others extended through January, February, March, and April of 1912.

All seed were germinated in the greenhouse in seed pans filled with sterile soil. Other precautions were taken to guard against accidental mixture of seed. The small seedlings were transplanted to flats as soon as the second leaves had made their appearance. They were retained in the greenhouse in these plant flats until weather conditions would permit of their being transferred to cold-frames. Transplanting from the cold-frames to the open field commenced May 10th and continued without interruption until all plants were transferred. All varieties were grown in the same field upon a uniform soil consisting of clay loam. Cultivation was thorough, frequent, and continued throughout the growing season.

With few exceptions the various forms were grown in uniform plots of one fortieth acre, requiring two hundred and sixty-four plants each. Leaves for the purpose of testing were collected seven months from the date of seed germination. The last collections were made September 19th. With two exceptions all samples were collected from non-flowering plants. The samples consisted of all the leaves from ten representative plants of each plot. These were dried either at room temperature or in a hot air oven at one hundred degrees centigrade. They were immediately reduced to a number sixty powder and sealed in amber bottles until tested. The following table gives the species or variety, source of seed, date of germination, manner of curing, and effective dose as obtained by the frog-heart method of Cushny.

ARRANGED ACCORDING TO NATURAL OR BOTANICAL RELATIONSHIP.

Species or Variety.	*Source of Seed.*	*Germination.*	*Manner of Drying.*	*Effective Dose.*
Digitalis purpurea	Watkins & Simpson, England..	12-1-11	100° C.	0.0009
" purpurea	From wild plants, Oregon.....	12-14-11	Room temp.	0.0009
" purpurea alba	A. T. Boddington, New York.	2-15-12	100° C.	0.0005
" purpurea rubra	A. T. Boddington, New York.	2-15-12	Room temp.	0.00045
" purpurea rosea	A. T. Boddington, New York.	2-15-12	Room temp.	0.0004
" gloxiniæflora purpurea	A. T. Boddington, New York.	2-10-12	Room temp.	0.00045
" gloxiniæflora lilicina	A. T. Boddington, New York.	2-14-12	100° C.	0.0005
" gloxiniæflora rosea	A. T. Boddington, New York.	2-15-12	Room temp.	0.0006
" gloxiniæflora rosea	Henry A. Dreer, Philadelphia.	1-19-12	100° C.	0.0006
" gloxiniæflora alba	A. T. Boddington, New York.	2-15-12	Room temp.	0.0019
" alba	Watkins & Simpson, England..	12-1-11	100° C.	0.0007
" monstrosa	Watkins & Simpson, England..	2-15-12	100° C.	0.0008
" monstrosa	Henry A. Dreer, Philadelphia.	2-15-12	Room temp.	0.00055
" gloxinioides	Horsford's Nurseries, Vermont	2-16-12	Room temp.	0.00045
" maculata iveryana	A. T. Boddington, New York.	1-25-12	100° C.	0.0005
" ivery's spotted	D. M. Ferry & Co., Michigan.	3-11-12	100° C.	0.00085
" purpurea maculata superba..	Ernest Benary, Germany.....	4-1-12	Room temp.	0.0005
" mixed	J. A. Salzer, Wisconsin.....	3-18-12	100° C.	0.00075
" sp.	Yokohama Nursery Co., Japan.	3-18-12	100° C.	0.0009
" sibirica	Horsford's Nurseries, Vermont	12-28-11	100° C.	0.00055
" buxbaumii	Ernest Benary, Germany.....	4-1-12	Room temp.	0.0005
" gloxiniæflora lutea	A. T. Boddington, New York.	2-13-12	100° C.	0.0005
" lutea	Ernest Benary, Germany.....	4-1-12	100° C.	0.00065
" macranthus	Ernest Benary, Germany.....	4-1-12	100° C.	0.0008
" macranthus (flowering)	Ernest Benary, Germany.....	4-1-12	100° C.	0.0005
" ambigua	Horsford's Nurseries, Vermont	12-29-11	100° C.	0.00055
" ambigua (flowering)	Horsford's Nurseries, Vermont	12-29-11	100° C.	0.0006
" grandiflora	Henry A. Dreer, Philadelphia.	2-19-12	100° C.	0.0009
" lanata	Horsford's Nurseries, Vermont	12-28-11	100° C.	0.0004
" lanata	A. T. Boddington, New York.	2-19-12	100° C.	0.0003
" canariensis	Watkins & Simpson, England..	1-15-12	100° C.	0.0005

The foregoing table shows a variation of 84 percent in the effective dose as determined for the thirty-one samples. With few exceptions closely related forms show little uniformity in toxicity. The varieties which have originated from the species purpurea (Numbers 1 to 19) show a variation of over 75 percent. Contrary to all expectations the highest value was obtained from lanata, a species, quite distinct from purpurea. Gloxiniæ flora alba a purpurea strain gave the lowest value. Eighty-three percent of the total number of samples tested indicate a greater toxicity than the official purpurea. Compared with average digitalis leaf, 55 percent of this number exceed the commercial article as indicated by the effective dose.

With two exceptions all samples were collected from non-flowering plants. These exceptions were the synonymous forms, ambigua and macranthus, from which it was possible to collect samples from both the flowering and non-flowering plants. Macranthus shows a greater toxicity in the flowering stage while ambigua shows practically the same value for both the flowering and non-flowering plants. It is of interest to note that the species purpurea from England, Ore-

gon, and Japan have the same indicated value. The Japanese form which was supplied as Digitalis sp. proved upon flowering, to be one of the purest forms of Digitalis purpurea under investigation.

In this respect there is much uncertainty as to the nomenclature of the purpurea group and many of the varieties now recorded will doubtless be reduced to synonymy. Many of these varieties consist of a conglomeration of types which must be isolated and cultivated as pure strains before they will possess further value for experimental purposes.

The narrow leafed forms, represented by such species as canariensis ambigua, lutea, and lanata have been found true to name and reproduce themselves in pure stand. Synonymy also exists in this group but the classification will be easier than in the broad leafed forms. A thorough systematic investigation of the whole genus will be necessary before further work can be done upon the comparative medicinal value of the various species and varieties.

In conclusion it may be pointed out that accurate botanical investigations should precede or accompany any comparative investigations of this group of plants; that the results indicate that good digitalis leaf may be obtained from the first year flowerless plants; that cultivation in itself does not lessen toxicity and, that valuable forms other than purpurea may be found among the many species and horticultural varieties not hitherto investigated.

LITERATURE CITED.

(1) Paschkis: Apoth. Ztg., 1888, 869.
(2) Goldenberg: Nouv. Remedes, Nov., 1893, 509.
(3) Boudgest: Pharm. Ztg., 1903, 48, No. 92, from Nouv. Remed., 1903, No. 21.

DEPARTMENTS OF BOTANY AND EXPERIMENTAL MEDICINE, ELI LILLY & COMPANY, Indianapolis, August, 4th, 1913.

INFLUENCE OF HEAT AND METHOD OF STORING UPON THE POTENCY OF DIGITALIS LEAVES.

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Two points of much interest to the pharmacist and to the physician are the most desirable methods of curing and preserving digitalis leaves.

It is important to know whether the use of a moderately high degree of temperature is permissible, because, if such be the case, rapid drying can be accomplished and the theoretical, injurious enzyme destroyed and dependence upon favorable atmospheric conditions can thus be obviated.

Hart[3] finds that subjecting the leaves to an "excessive temperature" caused a loss in activity of 25 percent. Unfortunately, he does not state what this temperature was. Hale[2], using dried leaves (moisture content of about 10 percent), concluded that the strength of the leaves, as determined by Cushny's method, is unaffected by a temperature up to 120° C., but that a temperature of 140° C. for two hours has an injurious action.

Our experiments were carried out upon leaves from conservatory grown plants of Digitalis gloxiniæflora. These plants were eight months old when tested, and in some instances a sufficient supply of leaves was secured from each plant to