$C_{20}H_{21}O_4N$ = 12.13-dimethoxy derivative = dicentrine
Derivatives of compound *h* = $C_{19}H_{17}O_2N$:
Similar to those of compound G
Derivatives of compound I = $C_{11}H_{11}O_4N$:
$C_{19}H_{17}O_6N$ = 12.13-dihydroxy derivative (1 compound)
$C_{20}H_{19}O_6N$ = hydroxy-methoxy derivative (2 compounds)
$C_{21}H_{21}O_6N$ = 12.13-dimethoxy derivative = hydrastine
Derivatives of compound *j* = $C_{19}H_{17}O_4N$:
Similar to those of compound I
Derivatives of compound *k* = $C_{19}H_{19}O_3N$:
Similar to those of compound L
Derivatives of compound L = $C_{19}H_{19}O_3N$:
$C_{19}H_{19}O_5N$ = dihydroxy derivative (1 compound)
$C_{20}H_{21}O_5N$ = hydroxy-methoxy derivative (2 compounds)
$C_{21}H_{23}O_5N$ = 12.13-dimethoxy derivative = cryptopine
Derivatives of compound M = $C_{18}H_{13}O_2N$:
$C_{18}H_{13}O_5N$ = 9.12.13-trihydroxy derivative (1 compound)
$C_{19}H_{15}O_5N$ = dihydroxy-methoxy derivatives (3 compounds)
$C_{20}H_{17}O_5N$ = 9-hydroxy-12.13-methoxy derivative = berberine
$C_{21}H_{19}O_5N$ = 9.12.13-trimethoxy derivative (1 compound)
Derivatives of compound *n* = $C_{18}H_{13}O_2N$:
Similar to those of compound M
Derivatives of compound *o* = $C_{19}H_{17}O_4N$:
No hydroxy or methoxy derivatives possible
Derivatives of compound *p* = $C_{20}H_{17}O_6N$:
No hydroxy or methoxy derivatives possible
Derivatives of compound *Q* = $C_{20}H_{19}O_5N$ (protopine):
No hydroxy or methoxy derivatives possible
Derivatives of compound *r* = $C_{17}H_{15}O_4N$:
No hydroxy or methoxy derivatives possible

THE EXTRACTION OF LICORICE.*

BY WILBUR L. SCOVILLE.

Licorice is one of the troublesome drugs from which to make galenical preparations. Its use chiefly as a flavoring agent, and the fact that its flavoring principle, glycyrrhizin, is easily soluble in water, and supposedly more soluble in alkaline solutions, have led to the general application of weak ammonia solutions as a menstruum.

But licorice root contains a large amount of soluble matter of an albuminoid character which is dissolved by the ammoniacal menstruum, and which is prone to mould or sour in the extract form, or to precipitate or even gelatinize from solution. Some samples of licorice root contain so much of this extraneous matter that it cannot be held in solution in fluidextract strength. Obviously this reflects upon the present U. S. P. process and menstruum.

The use of an alcoholic menstruum would easily solve that part of the problem, but such would be an unwarranted expense if other means can be found to satisfactorily extract and hold the flavoring principles.

At the New York meeting of the American Pharmaceutical Association Dr. Anthony Armentano recommended boiling water as the most satisfactory men-

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struum for fluidextract of licorice, with evaporation of the percolate *in vacuo* (temperature not stated) and the addition of 20 percent of alcohol to the concentrate.

This process is an improvement over that of the U. S. P. IX, but the product is not as miscible with other fluids as may be desired. It however furnished a good basis for further investigation. I first learned that, as compared with the ammoniacal menstruum, boiling water yields about half as much extractive matter but fully as much flavor. This indicates that the boiling water rejects some inert material which is dissolved by the ammoniacal menstruum.

Then a series of extracts and fluidextracts were prepared with variations in the process.

Ten experiments were made with boiling water, evaporating the percolate (a) *in vacuo*, or (b) slowly at a temperature between 40° and 50° C. in open dishes, or (c) boiling down the percolate in open pans. All of these fluidextracts were finished by adding glycerin to the percolate—usually to contain 375 Cc. per 1000 Cc. In this series the percolates which were evaporated at a low temperature show more precipitate in the bottle than those which were subjected to greater heat. It was also noticed that in evaporating at or near 100° C. a precipitate formed which was not again soluble in water, or even in weak ammonia solution. But the solutions which were boiled down in open dishes showed no less flavor or aroma than those evaporated at lower temperatures. One sample, which was evaporated at low temperature, was saturated with sugar and adjusted to fluidextract strength. This contains about 75 grammes of sugar per 100 Cc. and has remained perfectly clear.

Hot percolation with a glycerinated menstruum in two cases gave unsatisfactory results. Instead of adding the glycerin to the concentrated percolate obtained with hot water, the glycerin was mixed with an equal volume or twice its volume of water and the drug digested in this, then exhausted with hot water, then concentrated. In each instance the finished fluidextract precipitated badly on standing, one of them completely gelatinizing in the bottles.

Five samples were made by exhausting the licorice with boiling water, concentrating to a small volume and adding acid to precipitate the glycyrrhizin. This settled down in a firm mass on standing, from which the acid mother liquid could be decanted, the glycyrrhizin was washed two or three times with water, the glycyrrhizin dissolved in ammonia water, the excess of ammonia driven out by heating on the steam-bath, then glycerin and water added to volume. Both hydrochloric and sulphuric acids were tried, and in two instances the precipitating liquids were chilled for a number of hours to promote the full precipitation of glycyrrhizin. But the finished preparations all showed a loss of 20 to 30 percent in flavor. In physical appearance they are all ideal, being clear and of good flavor and color after standing six months or more.

Two samples were made in which the gummy and albuminous matters were precipitated by alcohol. In one instance the aqueous percolate from 250 Gm. of drug was concentrated to 200 Cc. and 200 Cc. of alcohol were added. In the second instance 400 Cc. of alcohol were added to a like amount. After standing three days, the liquids were filtered, the precipitates washed with some alcohol-water mixture corresponding to that in the clear filtrate, then the alcohol was recovered

by distillation, the liquids concentrated to a volume of 156 Cc. and 94 Cc. of glycerin were added.

The product which was treated with an equal volume of alcohol has precipitated some on standing, while that to which two volumes of alcohol were added remains perfectly clear.

All of the above tend to show that cold water and ammoniated water extract a lot of gummy and albuminous matters which are of no value but on the contrary are troublesome in producing precipitation or growing bacteria and moulds. A further evidence is found in the fact that the fluidextracts which were made by percolating with boiling water and concentrating the percolate by boiling in open pans mix well with 73% alcohol, and those which were extracted with boiling water but concentrated at a low temperature mix well with 65% alcohol, while the alkaline extracted samples do not mix well with diluted alcohol.

None of the above samples contains alcohol in the finished preparation. One sample which contains 25 percent of glycerin, by volume, has precipitated considerably and shows a fungoid growth at the top. A sample containing 30 percent of glycerin has kept well for eight months. The rest all contain 37.5 percent of glycerin, by volume, which seems to be sufficient to preserve the liquid and it adds to the sweetness also.

In this respect as well as in cost and the avoidance of restrictive factors it has an advantage over alcohol.

For the solid extract the drug was extracted by boiling water, the percolate boiled down to a small volume, then filtered and the filtrate evaporated to extract consistency. None of the four samples so made shows any change on standing whereas some made by extracting with ammoniated water have moulded.

While the use of heat in extracting and concentrating licorice percolates has not proved altogether satisfactory in preventing precipitation in the fluidextracts, yet the amount is very much diminished and in none of my samples is there enough precipitation to be really troublesome. In economy of extraction and in miscibility with alcoholic fluids they are a decided improvement over the present official methods, and there is also less tendency to mould or sour.

For a fluidextract of licorice, glycerin is recommended as a preservative in preference to alcohol.

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OBSERVATIONS ON MUIRA-PUAMA.*

BY HEBER W. YOUNGKEN.

Several months ago, the writer was called upon to determine the authenticity of a woody root which was labeled Muira-Puama. Being interested in the new problem, he compared this specimen both as to macroscopical and microscopical features with two samples of a root likewise marked "Muira-Puama" in the crude drug collections of the Philadelphia College of Pharmacy and Science. On the label of one of the specimen jars containing the root appeared the botanical origin

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