A striking contrast to the usual attempt to obtain reliable opinion on organoleptic properties resulted, the unanimous opinion being that no one was better than another.

As a further test, the same samples were diluted with water to obtain a 1–10 dilution, and submitted to other individuals for taste. The opinion obtained on the diluted product substantiated the former expression on undiluted fluidextract.

On this basis it is concluded that ammonia does not enhance the taste value of a fluidextract of licorice.

In passing, it may be interesting to note that the degree of precipitation in the above-prepared samples is directly proportional to the amount of ammonia added.

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AN EXPERIMENT IN EXTRACTION.*

BY E. F. KELLY AND JOHN C. KRANTZ, JR.

INTRODUCTION.

The purpose of these experiments is to determine whether or not the method named by the authors, the displacement method, can be used advantageously in the process of extraction. This method has for its aim the obtaining of an increased amount of extractive with the use of a decreased amount of menstruum, without the application of heat. The method depends upon the use of a long column percolator, small in diameter, through which ordinary percolation reaches its maximum efficiency and, further, assuming that after twenty-five per cent. of percolate is collected (considering now the preparation of fluidextracts), the next seventy-five per cent. is partly saturated with extractive matter and, therefore, capable of becoming more saturated by repercolation through the same drug.

The details of the displacement process follow those given by the Pharmacopœia in the manufacture of fluidextracts, so far as packing and maceration are concerned; however, the stratum of menstruum above the column of drug is reduced to a minimum. Twenty-five per cent. of the percolate is collected and set aside as a reserve, then three portions of 25 cc. each are collected and considered as stronger percolates 1, 2, 3, respectively. The drug now contains weaker percolates 1, 2, 3 and a total of 100% percolate has been collected. Stronger percolate No. 1 is now poured slowly upon the surface of the column of drug, allowing one portion to become completely absorbed before adding the next; thus 25% of weak percolate is forced out of the drug and collected as weak percolate No. 1. Likewise stronger percolates No. 2 and No. 3 are made to displace weaker percolates No. 2 and No. 3 and the drug now contains all of the stronger percolate, which is assumed to be unsaturated and, therefore, capable of further extracting the drug. This strong percolate is displaced by adding weaker portions Nos. 1, 2, 3, respectively, and collecting the strong percolate displaced corresponding to 75% of the drug. This percolate is added to the reserve and thus 1 cc. of percolate is obtained for each gram of drug used.

* Section on Practical Pharmacy and Dispensing, A. Ph. A., Buffalo meeting, 1924.

EXPERIMENTAL.

The following drugs were subjected to this process in the fineness of powder as designated by the Pharmacopœia and the column of drug in the percolator was ten times higher than the diameter of its cross-section.

1. Belladonna leaves—Percentage yield, 72.1%.
2. Aconite root—Percentage yield, 55%.
3. Podophyllum root—Percentage yield, 69%.

The average percentage yield from the three drugs representing a number of extractions is 65.3%, which was far lower than anticipated by the writers. Using belladonna leaves as an example, experiments were carried out to establish an efficiency relationship between the displacement process and the present official method for preparing fluidextracts; and also to determine if possible the phase of cell extraction which prevented the displacement method from developing a higher efficiency.

Fifty grams of belladonna leaves assaying 0.319% of mydriatic alkaloids were percolated until exhausted with diluted alcohol. The extraction required 210 cc. of menstruum. To percolate the same quantity of drug by the displacement process, it required from 150 to 156 cc. of menstruum. The pharmacopœial fluidextract contained all of the alkaloids from the drug, whereas the residual menstruum in the drug after the completion of the displacement process showed that alkaloids were still present. Of the four fluidextracts prepared by the displacement process, the highest yield was 0.23%. Assuming it possible to repeat this optimum experiment by carefully regulating the conditions of percolation, we have the following proportion

$$0.23:0.319::153:x \qquad x = 211 \text{ cc.}$$

It would follow, using the foregoing proportion as a basis, that the amount of menstruum necessary to completely extract the drug by the displacement process, is practically the same as that used in simple percolation.

The next series of experiments were carried out in the following manner. Three fluidextracts of belladonna leaves were prepared by the pharmacopœial method; it required an average of 190 to 200 cc. of menstruum to completely extract three 50-Gm. samples of this drug. The drug contained 0.319% of alkaloids, hence 50 Gm. of the drug contained 0.00319 × 50 or 0.1595 Gm. of alkaloids.

One part of atropine is the chemical equivalent of 1.122 parts of the sulphate crystallizing with one molecule of water of hydration. It seemed therefore reasonable, as the belladonna alkaloids are isomeric compounds, to assume that 0.1595 × 1.122 or 0.1789 Gm. of atropine sulphate would be a fair representation of the amount of alkaloids naturally present in 50 Gm. of the drug.

The marc obtained from fifty grams of the drug was dried, and the atropine sulphate, carefully weighed, was dissolved in 10 cc. of alcohol and this alcoholic solution carefully distributed through the drug and allowed to evaporate. The impregnated marc was prepared for percolation and as far as possible the conditions were kept constant. An average of three extractions on the marc the first time required 183 cc. of menstruum. It is interesting to note that these fluidextracts, after dissolving the concentrated weaker percolate in the reserve, precipitated a large amount of extractive matter within a few days after preparation.

These marcs were again impregnated with the alkaloid, and this time an average 155 cc. of menstruum was required for extraction. The third time after the same impregnation with the alkaloid, only 135 cc. of menstruum were required for extraction. The marcs were impregnated with the free alkaloid and similar results were obtained; that is, when the marc was fresh and comparatively filled with extractive matter, it required almost as much menstruum for extraction as does the drug, but for each subsequent operation a smaller amount was required. The quantity of menstruum seemed to reach its minimum at 130–135 cc.

Sodium salicylate was selected as another substance with which to impregnate the marc and using the ferric chloride test for recognition of salicylate in the percolate, it required 170 cc. of menstruum for extraction. In the third and fourth operations on the same marc, this quantity was reduced to 155 cc.

THEORETICAL CONSIDERATIONS.

The difficulty in the displacement method seems to be in the fact that the diffusion of the stronger percolate into the weaker menstruum is apparently not prevented.

Considering that the drug cell is permeated with the weak menstruum, the only way in which it can be displaced by the stronger is by osmosis, in which an interchange of solute particles is established, and the weaker solution within forces its way out to dilute the stronger solution without. This is simply obeying one of the laws of diffusion through a porous membrane, namely, the solvent tends to create a uniform concentration on both sides of the membrane. The rates in which the weaker solution is passing out and the stronger solution coming in will not be equal until both are of uniform concentration and a physical dynamic equilibrium is established. This phenomenon is certainly one of the facts serving to frustrate the efficiency of the displacement process, as the stronger percolate thus becomes diluted.

Another factor that warrants consideration is the question of whether or not the stronger percolate will extract more of the drug when passed through the same column of drug from which it has been collected. Undoubtedly the problem of partition enters into the process and the well-known case of an aqueous solution of benzoic acid and ether may be cited as an analogous case. Benzoic acid is soluble in 273 parts of water and 3 parts of ether, yet when a saturated solution of benzoic acid in water is shaken with an equal volume of ether 80 parts of the acid are removed and one part remains, and no matter how much you shake the solution with the original ether no more acid will be removed, although the ether is not nearly saturated with benzoic acid. An equilibrium is established which might be represented by the following equation:

$$\frac{\text{B water}}{\text{B ether}} = \text{K}$$

A fresh portion of ether, however, will extract 80 more parts of the acid and leave one behind so that the same saturation constant is satisfied. Theoretically it is impossible to remove all of the benzoic acid from the water, but that portion which remains approaches zero as its limit and finally becomes infinitesimal in quantity. Applying the same principle to the displacement process, it would be quite impossible to extract any appreciable amount of the same drug with a percolate that has once established a saturation equilibrium with the extractive material in the plant cells. The second series of experiments seems to indicate that a large amount of the difficulty in extraction, which has been ascribed to the impenetrability of the plant cells to the menstruum, is probably not due to that at all, but likely due to the fact that the menstruum is functioning simultaneously as solvent for the alkaloids and the inert extractive material and that the relative proportions of each extracted are determined by the relative quantities present. Therefore after the removal of a portion of the extractive material, the relative quantity of alkaloid that will dissolve in any given portion of the menstruum is greater and thus a smaller quantity is required.

It is interesting to note that the quantity of solvent required ultimately reaches a minimum, which fact is in accordance with the theory discussed in the foregoing paragraphs, namely, the equilibrium theory, which puts the extraction problem in the realm of an experiment in osmosis.

CONCLUSION.

A search for a solvent in which inert extractive matter is quite insoluble and alkaloidal salts wholly dissolve, would seem to be the next reasonable investigation of this problem.

SOME OBSERVATIONS ON GLYCERIN SUPPOSITORIES.*

BY WILBUR L. SCOVILLE.

One of the simplest preparations in the Pharmacopœia from a chemical standpoint, is that of glycerin suppositories, but from the physical standpoint it is the most complex.

Chemically they consist simply of glycerin in which is dissolved sufficient sodium stearate to form a solution, which when cold is firm enough to hold its form and can be handled easily, and yet will melt or dissolve in the body secretions at body temperature. The U. S. P. suppositories are thus composed, and in addition they contain a slight excess of sodium carbonate and a little water. In making the suppositories some water is necessarily formed in the reaction between the stearic acid and sodium carbonate, and more is introduced by dissolving the sodium carbonate in water as the easiest method of manufacture.

The official suppositories are of fair consistence, but they are opaque. Most of the glycerin suppositories of commerce are transparent, or at least translucent. This quality adds to the appearance of the suppository, though it makes no difference with its medicinal value.

As compounded, the U. S. P. formula produces the following composition:

Glycerin	80.00%
Sodium Stearate	6.50%
Sodium Carbonate	0.17%
Water	13.33%
	100.00%

* Read before Section on Practical Pharmacy and Dispensing, A. Ph. A., Buffalo meeting, 1924.