SECTION ON PRACTICAL PHARMACY AND DISPENSING, AMERICAN PHARMACEUTICAL ASSOCIATION

A STUDY OF SOME PERCENTAGE SOLUTIONS.*

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In general, it is impossible to prepare a pre-determined volume of a solution of a definite percentage strength, as we can not know the specific gravity of the solution before it is made. Nevertheless, such solutions are frequently prescribed, and this paper is a report on a study of the problem of preparing them so as to closely approximate the required strength and volume.

Assuming that he knows that "percentage solution" means that the given number of parts by weight of the chemical are contained in 100 parts by weight of the solution, the thoughtless dispenser who has a call for a fluidounce of a percentage solution will most often calculate the required percentage of 480 grains, assuming that this is the weight of the finished solution, which is seldom the case. A more careful worker will calculate the required percentage of 455, or thereabouts, assuming that the finished solution weighs the same as one fluidounce of water, which is seldom quite true. Either of these men will weigh the calculated amount of the chemical, introduce it into a graduate or an ounce bottle and add sufficient of the solvent to make one fluidounce.

Remembering that it is practically impossible to make an absolutely accurate solution of any strength, these methods are sufficiently accurate for weak solutions, say up to 5 percent strength, perhaps even up to 10 percent strength, but such methods will not do for strong solutions, the specific gravities of which are markedly greater than that of water. In various parts of the country, strong solutions of silver nitrate, argyrol, potassium iodide and other chemicals are frequently prescribed, and the druggist who is asked for a 50 percent solution and weighs 240 grains of a chemical, adding enough water to make a fluidounce, will dispense a solution of about 35 percent strength. If the physician calls for a percentage solution, it is not safe or wise to assume that he means a 50 percent weight to volume solution, as in the foregoing examples.

It is entirely correct to dispense percentage solutions entirely by weight, but this is contrary to American custom and not many pharmacists will do it.

An indefinite volume of a correct percentage solution can be made by dissolving as many parts of the chemical as the percentage required in sufficient water to make 100 parts by weight of the solution, and this method can be used to prepare a volume greater than any given number of fluidounces, as in the following example:

To dispense 2 fluidounces of a 25 percent solution of silver nitrate.

100 — 25 = 75 parts of water in 100 parts of the solution.

455 × 2 = 910 grains, weight of two fluidounces of water.

75 : 25 = 910 : x = 303 grains, weight of silver nitrate to be added to 2 fluidounces of water.

(Notice that 2 fluidounces of water are to be used, *not* enough water to make 2 fluidounces.)

While this method is accurate, it is wasteful, as the surplus is generally thrown away, or it is impracticable in requiring the preparation of unstable stock solutions.

In studying this question percentage solutions of quinine bisulphate, an alkaloidal salt of average density, and of silver nitrate, a heavy chemical, were made and their respective gravities taken. From the results the following tables were constructed:

PERCENTAGE SOLUTIONS OF QUININE BISULPHATE.

Strength. Percent.	Specific gravity at 25° C.	Weight of 1 fl.- oz. at 25° C. in grains.	Grains of salt in 1 fl.-oz.
0	1.000	454.6	0.0
1	1.003	456.0	4.6
2	1.006	457.3	9.1
3	1.008	458.2	13.7
4	1.010	459.1	18.4
5	1.013	460.5	23.0
6	1.016	461.9	27.7
8	1.021	464.1	37.1
10	1.026	466.4	46.6

PERCENTAGE SOLUTIONS OF SILVER NITRATE.

Strength. Percent.	Specific gravity at 25° C.	Weight of 1 fl.- oz. at 25° C. in grains.	Grains of silver nitrate in 1 fl.-oz.
0	1.000	454.6	0.0
1	1.009	458.7	4.6
2	1.017	462.0	9.2
3	1.025	466.0	14.0
4	1.034	470.0	18.8
5	1.043	474.1	23.7
6	1.052	478.2	28.7
8	1.071	486.9	39.0
10	1.096	498.2	49.8
12	1.128	512.8	61.5
15	1.162	528.2	79.2
20	1.216	552.8	110.6
25	1.276	580.1	145.0
50	1.688	768.4	393.2

An examination of these tables will show that the common methods of dispensing are approximately correct for both solutions up to about 5 percent and for the alkaloidal solution up to about 10 percent, but that solutions made by such methods are grossly inaccurate for strong solutions of heavy chemicals. The last column of the second table can be used for preparing percentage solutions of silver nitrate, multiplying the quantity for any required number of fluidounces, and adding sufficient distilled water to make the required volume.

This is only a preliminary paper on the subject and it is the writer's intention to extend the tables to include other chemicals prescribed in percentage solutions.

and to endeavor to calculate average weights per fluidounce for solutions of different strengths and of different chemicals. Suggestions for chemicals to be included will be gratefully received.

ABSTRACT OF DISCUSSION.

W. L. SCOVILLE: I think the average physician, at least that is my understanding, if he prescribes a 10 percent solution of a salt, expects to get 48 grains in a fluidounce. That is not percentage in the strict, technical sense of the term, but it is the common equivalent, as I understand it.

CHARLES HOLZHAUER: I have always understood percentage solutions in prescriptions were percentage to volume because the dose becomes a dose by volume and not a dose by weight. I have always held that when a physician wrote for a percentage solution that he meant a given amount of the chemical in a given volume.

T. J. BRADLEY: I anticipated that very question. I am very familiar with the custom that Mr. Scoville and Mr. Holzhauer refer to, but the product is not a percentage solution, and unless we have a written agreement or some other form of protection it is not safe to claim that we dispensed an incorrect solution according to common custom.

W. L. SCOVILLE: It is legal if it is common; common law is legal.

O. F. CLAUS: I am satisfied that most physicians feel just as I do, that when they prescribe a 10 percent solution they want 48 grains in one fluidounce.

P. H. UTECH: I am also re-affirming the statement of Dr. Claus. I think the opinion prevails among physicians that they are getting 48 grains of ingredient.

C. M. SNOW: It seems to me there might be a different view on this from the fact we now have the Harrison Law. How do the narcotic inspectors interpret a four percent solution of cocaine hydrochloride?

L. C. HOPP: I would like to know what the percentage strength of tincture of iodine is. How many can give me the percentage strength of tincture of iodine according to the new Pharmacopoeia?

F. W. NITARDY: Out West we interpret it exactly like Dr. Bradley has illustrated.

G. C. DIEKMAN: I do not think the physicians in different parts of the country have the same views on the subject. In the Pharmacopoeia we have illustrations of these different solutions. When we say percentage solution, without qualification, I think Professor Bradley is entirely right in saying it ought to be parts by weight. Whether the physicians mean that or not, I do not know; but a percentage solution, without qualification, to my mind means parts by weight.

H. V. ARNY: I was interested to hear Mr. Holzhauer give the reason for his conclusions, that the doctors prescribe in volume. We have a great opportunity to adjust this matter because I noticed last year in looking over literature that in a great number of the medical journals the physicians put down "Percent w. v." If we could only persuade the doctors to write the percent with a little "w. v." following the question would be solved. I agree with Mr. Holzhauer that I never would have thought of giving a weight by weight solution when the doctor prescribed a ten percent solution. Of course, this does not detract from the value or quality of the work of Professor Bradley.

T. J. BRADLEY: We have no defense if we dispense a weight to volume solution when a percentage solution is called for in writing. If the physician does not know what he calls for, that is not our fault, and it would not be a defense, if a prescription happened to be written by a physician who meant exactly a correct percentage solution.

W. L. SCOVILLE: Percentage means parts per hundred. That is a definite meaning. There can be parts in volume per hundred, there can be parts by weight in volume per hundred, and there can be parts in weight per hundred, and they are all percentage solutions. I maintain that they are all correct terms.

(A vote was taken by the members which showed about an equal division of views on the subject under discussion.)