

## SOLUTION OF MAGNESIUM CITRATE.\*

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JOSEPH W. ENGLAND.

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The official formula for Solution of Magnesium Citrate is being considered by Sub-Committee No. 10 of the U. S. P. Revision Committee and suggestions are invited.

C. H. LaWall states that in his analyses of this solution as marketed he has sometimes found a deficiency in magnesium content, and sometimes sulphate in excess of the official limit, indicating the presence of magnesium sulphate. He suggests that standards be given for magnesium content in the residue obtained by ignition, and for maximum content of magnesium sulphate.

The official formula for this widely-used preparation has undergone little change during the past three decades save in the quantities of active ingredients. In 1880, 200 grains of magnesium carbonate and 400 grains of citric acid were called for in the formula, equivalent to 13 grammes of the former and 26 grammes of the latter. In 1890, the carbonate in the formula was increased to 15 grammes and the acid to 30 grammes, or in the same relative proportions as before. In 1900, the formula called for the same quantity of carbonate as before—15 grammes, but increased the acid to 33 grammes.

In 1880, the flavoring was syrup of citric acid (containing citric acid and spirit of lemon); in 1890 it was the same, but in 1900, while the use of syrup of citric acid was continued, tincture of fresh lemon peel was directed to be used in place of the spirit of lemon.

The main criticisms made against the present official solution of magnesium citrate are that it is excessively acid in taste, putting the teeth on edge and causing griping, that it is too weak in flavor, and that, on keeping, it sometimes forms fungus growth.

The increase of acid from 26 grammes in the 1880 formula to 33 grammes in the 1900 formula was made to prevent precipitation and secure a more permanent preparation. But, the quantity of acid should be reduced, if possible, to the lowest point that will insure proper keeping for a reasonable length of time. The solution is not intended to be kept for a long time, but to be prepared freshly when wanted, or in small quantities.

A tentative formula for solution of magnesium citrate was sent to a number of pharmacists by the writer, and the following opinions have been received:

George M. Beringer writes that:

"I have for years followed a formula somewhat along the lines that you propose, but have always used the light calcined magnesia, the magnesium oxide, U. S. P., in place of the carbonate. You are entirely correct in directing the use of *hot* water to dissolve the citric acid. The trouble in making of solution of magnesium citrate is to avoid the introduction of bacteria and spores which not infrequently develop in this solution fungus growth and disagreeable taste in a very short time. There are other points which should be included in an official formula to avoid such introduction. First, distilled water should be used; it should be heated to the boiling point and in this the citric acid dissolved.

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\*Read before the Philadelphia Branch.

"Magnesium carbonate of the market is usually dried in the air and is more prone to contain bacteria and spores from the exposure in drying than is the calcined magnesia. The very process of calcination destroys thoroughly bacteria then present, and if after preparation it is properly stored it is much less likely to be contaminated in this way than the carbonate. If this change be made in the formula, then one-half as much oxide as the prescribed amount of carbonate will be sufficient.

"I would suggest that the oil of lemon be increased to 0.1 cc. and that it be mixed with the magnesium oxide before addition to the citric acid solution. Purified talc is unnecessary and simply adds another source of contamination.

"Your caution regarding the sterilization of the bottle is very important."

Robert C. Cadmus writes that he uses the official formula, but employs syrup instead of syrup of citric acid, distilled water in place of water, and flavors with a special tincture of lemon peel, using 55 minims to each bottle. The special tincture of lemon peel he makes by adding 30 cc. of oil of lemon to 1000 cc. of the U. S. P. tincture of lemon peel.

William L. Cliffe employs the following procedure in making the solution:

"Dissolve the citric acid in 120 cc. of hot water. Dissolve the oil of lemon in 1 cc. alcohol and distribute evenly through the magnesium carbonate, and add to the citric acid solution. After complete solution, filter through a *wet* paper filter into a strong bottle of about 360 cc., into which has previously been placed the syrup.

"Then add enough water to nearly fill the bottle and drop in the crystals of bicarbonate of potassium and immediately stopper the bottle in a secure manner.

"If it is desired to keep the preparation for more than a day or two, it should be sterilized by placing the bottle in water and bringing to the boiling point, which should be maintained for about 20 minutes."

Henry L. Klopp follows the official formula, but uses syrup in place of citric acid and mixes oil of lemon (1 minim to bottle) with the magnesium carbonate before adding the latter to the acid solution. He prefers to use magnesium carbonate in the *block* form, believing that this yields a more permanent solution than powdered magnesium carbonate.

William E. Lee dissolves the citric acid in hot water, and uses Jennings' light calcined magnesia. As a flavor, he uses oil of lemon (1 drop) and tincture of ginger (9 drops) to each bottle, and employs syrup instead of syrup of citric acid. He filters his solution while hot into a bottle (which has been sterilized with hot water) containing the syrup, then adds enough hot water to nearly fill the bottle, dropping in the crystals of potassium bicarbonate, and immediately stoppers the bottles securely. The solution is kept in a cool place. If a bottle is used a second time for solution of magnesium citrate, he cleans it out with strong sulphuric acid, and then washes it with water until all traces of the acid have been removed.

Richard W. Cuthbert follows the official formula, but sterilizes the bottle, and employs Jennings' carbonate of magnesium, natural spring water, purified talc, syrup, and crystalline potassium bicarbonate. He flavors with oil of orange (0.06 cc.) and tincture of ginger (0.4 cc.). He writes:

"We have been able to keep the preparation prepared as above for a period as long as three weeks and believe it could be kept in a salable condition for even a

longer period. Of course it was kept on ice, but the only sterilization done in its preparation was in boiling the bottles for at least half an hour.

"We credit our success in the keeping qualities of our product to the use of pure water, sterilization of the bottles, the use of oil of orange instead of oil of lemon, filtration through purified talc and the use of crystals of bicarbonate of potassium instead of the tablet usually employed for this preparation, and most of all, by using Jenning's carbonate of magnesium, which is a much superior article to any made in this country."

In this connection, it should be stated that M. D. Allen (*American Journal of Pharmacy*, December, 1911, 564) recommends a formula calling for one ounce (av.) of citric acid, one-half ounce (av.) of magnesium carbonate, two ounces (av.) of sugar, 48 grains of purified talc, and sufficient water to make 12 fluid-ounces, flavoring with 24 minims of a flavoring tincture. The bottles after being filled with the solution are closed and placed in an ordinary wash boiler, covered with water, and boiled for about 30 minutes. The solution so made has been kept for five months. The potassium bicarbonate is added at the moment of dispensing. The flavoring tincture consists of oil of lemon 6 fluid drachms, oil of orange 4 fluid drachms, tincture of ginger 6 fluid drachms, and alcohol sufficient to measure 4 fluid ounces.

The consensus of opinion expressed seems to be that the bottle should be sterilized; that the quantity of citric acid in the official formula should be reduced, if possible; that hot sterile water should be employed in making the solution; that oil of lemon, alone, or with tincture of ginger, should be used in place of the tincture of fresh lemon peel in the syrup of citric acid now required; that syrup should be directed in place of the syrup of citric acid, and that crystalline potassium bicarbonate should be used.

In making a number of bottles of the solution, instead of filtering into individual bottles containing the syrup, as officially directed, it is better to filter into a separate sterile container, and pour the filtrate very carefully down the inside of each bottle upon the syrup, avoiding diffusion of the syrup with the supernatant solution, and then to add the potassium bicarbonate and immediately stopper the bottle. In this way, there is very little loss of carbonic acid gas. The bottle should be laid on its side in a cool place until needed.

Some pharmacists do not add the potassium bicarbonate to the solution until the moment of dispensing; others add it when the solution is made, claiming that the carbonic acid gas in the bottle keeps the air out and makes the solution more permanent.

As to the employment of magnesium oxide or light calcined magnesia in place of magnesium carbonate there are some differences of opinion.

The National Standard Dispensatory (1908, 944) claims that "magnesium carbonate is preferable to the oxide as it is less apt to vary in composition, but if the latter is chosen, 6.23 grammes of magnesium oxide may be used in place of the 15 grammes of the official carbonate."

On the other hand, there are pharmacists who claim that they get better and more uniform results by using light calcined magnesia instead of magnesium carbonate. The U. S. Dispensatory (1907, 725) states that "It is somewhat

more convenient to use calcined magnesia in place of the carbonate, and in one of the best processes we have seen the fifteen grammes of the carbonate in the official formula are replaced by five grammes of Jennings's light calcined magnesia."

It may be added that the Pharmacopœia requires that magnesium carbonate shall yield upon ignition "not less than 40 per cent. of residue, of which not less than 96 per cent shall consist of pure magnesium oxide."

The following formulas are suggested, not for inclusion in the Pharmacopœia, but for the purpose of eliciting discussion, so that they will lead to the framing of an official formula that will give general satisfaction to all sections of the country.

SOLUTION OF MAGNESIUM CITRATE.

Magnesium Carbonate .....	13	gm.	201	grs.
Citric Acid.....	27.5	gm.	424	grs.
Syrup .....	60.0	cc.	2	fl. oz.
Oil of Lemon.....	0.05	cc.	1	drop.
Purified Talc.....	5.0	gm.	77	grs.
Potassium Bicarbonate.....	2.5	gm.	39	grs.
Sterile water, a sufficient quantity.				

Dissolve the citric acid in 250 cc. (8 fluid ounces) of hot sterile water, add the magnesium carbonate, and stir until it is dissolved. Then add the oil of lemon previously triturated with the purified talc. Filter the solution, first, into a sterile container, passing the filtrate through the filter repeatedly until it is perfectly clear, and then filter all the solution into a strong sterile bottle holding about 360 cc. (12 fluid ounces), containing the syrup. Add enough sterile water to nearly fill the bottle, drop in the potassium bicarbonate and immediately stopper the bottle securely. Lastly, shake the solution occasionally until the potassium bicarbonate is dissolved. Keep the bottle on its side in a cool place, preferably on ice. The object of this is two-fold; first, to prevent the formation of fungus, and second, to insure the retention of the gas in the solution as much as possible.

By sterile water is meant either distilled water, or the purest obtainable potable water, boiled.

The solution should be made extemporaneously, or as nearly so as practicable.

The bottle used for filling the solution should be previously sterilized by being oiled in water for 15 minutes.

SOLUTION OF MAGNESIUM CITRATE.

Magnesium Oxide.....	5.0	gm.	77	grs.
Citric Acid.....	27.5	gm.	424	grs.
Syrup .....	60.0	cc.	2	fl. ozs.
Oil of Lemon.....	0.05	cc.	1	drop.
Purified Talc.....	5.0	gm.	77	grs.
Potassium Bicarbonate.....	2.5	gm.	39	grs.
Sterile water, a sufficient quantity.				

Follow general directions of preceding formula.