with a rod. The solution was next immediately neutralized with a 10% solution of sodium carbonate, and, on cooling, filtered with the aid of a water-pump.

Most of the lead is precipitated as carbonate and the little that remains in solution is easily removed by H_2S. The presence of PbO keeps down the acidity of $PbCl_2$ and thus lessens the chances of hydrolysis of the glucoside. The solution on evaporation gives a far purer product than with lead acetate, while the presence of the harmless NaCl does not interfere with the pharmacological action of the glucoside. The amount of NaCl can be easily estimated by standard $AgNO_3$ and the approximate amount of glucoside settled for clinical use on a large scale for which extra purification is not essential. The NaCl can also be easily eliminated by repeated recrystallizations from alcohol. The method will thus be very useful for pharmacological work in the case of highly water-soluble glucosides and, with the necessary modifications as to the quantities of $PbCl_2$ and PbO, it promises to be of great industrial importance.

CHEMICAL LABORATORY,
SCHOOL OF TROPICAL MEDICINE AND HYGIENE,
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ISOPROPANOL A NEW SOLVENT AND PRESERVATIVE FOR THE PHARMACIST.

BY HENRY C. FULLER.

Considerable interest had developed of late over isopropanol, owing to its sudden appearance in the commercial field, and to the possibilities for its use that have been featured in the scientific press. This had naturally brought about a great deal of discussion as to what the properties of isopropanol really are, and to what extent it may reasonably be considered a valuable commodity in the arts and industries. It is the purpose of this paper to set forth a few facts concerning its possibilities in the pharmaceutical field, the observations being based on intensive researches of some two years' standing.

Pure isopropanol is a colorless liquid with a mild but not unpleasant odor, boiling between 81 and 83° C., and miscible in all proportions with water. As it ordinarily occurs in commerce, it contains about 10 per cent. of water. It is destructive to microörganisms, but has no corrosive action on the skin. It dissolves volatile oils, resins and many different organic and inorganic substances. On account of its solvent and preservative actions, and because it mixes in all proportions with water, it early gave evidence of being a product of great importance to the pharmaceutical trade.

When it was suggested that it might prove to be a valuable commodity for the pharmacist and medicine maker, and that, because of its unrestricted use, it might solve many of the problems that now encumber the use of alcohol and other solvents, it was deemed expedient to see just to what extent it was a good dissolving and holding agent for drug extracts, tinctures, liniments, etc., to what extent it was a preservative and what might result from the ingestion or application of these preparations in so far as the isopropanol was concerned.

In the first place, a number of standard preparations of the Pharmacopœia and National Formulary were made with isopropanol as the solvent instead of

ethyl alcohol. These represented a wide range of types and products that are constantly in use in pharmaceutical and medicinal practice. The fluidextracts included digitalis, belladonna, cinchona, cascara and gentian. The preparation of the same therefore entailed a test of three of the standard type processes for making fluidextracts, as well as a chance to observe the results on a physiologically assayed drug, two alkaloidal drugs, one that depends for its action on a readily decomposed anthraquinone derivative, and another on a bitter glucoside. In all cases the percolation proceeded with the same degree of facility as if the solvent usually prescribed had been employed, and the resultant finished products were of excellent appearance with the full content of active principles. Shelf tests lasting over six months indicate that no changes are taking place.

In preparing tinctures, those selected included jalap, ginger, aloes, opium and iodine. Here a departure was made from the strictly vegetable galenicals noted among the fluidextracts, in that isopropanol was used to dissolve the inorganic substances, iodine and potassium iodide. The tinctures of jalap and ginger contained the full complement of resins that characterize them, and in addition the tincture of ginger was delightfully aromatic and pungent. Tincture of aloes, while not a widely used preparation, was selected in order to test the solvent action on aloin and the results were all that could be desired both as to the bitter property and physiological action. No special comments are necessary in the case of the tincture of opium or iodine; both are of the requisite assay and are of excellent appearance after a six months' shelf test.

Passing to the spirits—there were compounded with isopropanol the well-known preparations, spirit of camphor, aromatic spirit of ammonia, spirit of nitrous ether, and the compound spirits of myrcia, vanillin, orange, cardamom, and juniper. The camphor dissolved perfectly and stayed in solution, and the aromatic spirit of ammonia was comparable in every respect with that made with ethyl alcohol. Particular attention should be called to the spirits made for flavoring purposes which were of excellent appearance and taste, and indistinguishable from those made with the customary solvent.

Among other miscellaneous pharmaceuticals made up with isopropanol were—soap liniment, liquor antisepticus, both acid and alkaline, and aromatic elixir.

Sufficient data have been obtained to indicate that in practically every instance involving a U. S. P. or N. F. product, isopropanol can be substituted for ethyl alcohol without affecting in the least the physical appearance or the therapeutic efficiency.

In several instances, specialties representing formulas of widely diverse character have been compounded with isopropanol as the solvent, and placed alongside those made up in the same way with the solvents ordinarily employed. In every instance, isopropanol has proved to be a satisfactory substitute. It has worked out satisfactorily in rubbing and massaging compounds extensively employed in the hospital, and can be used to advantage in the various types of mouth washes, antiseptic sprays and dentifrices of the dental profession.

The question may naturally arise as to what evidence we possess that isopropanol will act as a preservative against the action of yeasts, molds and bacteria. To answer this query, a series of tests was instituted, which demonstrated that isopropanol would inhibit the development of mold and render dormant the spores to the same degree at least that is done by ethyl alcohol. As to its comparative

action against yeasts and bacteria, the following chart shows that it has an inhibitory value of greater intensity than ethyl alcohol.

In the test against bacteria, increasing quantities were mixed with standard extract broth and inoculated with *Bacillus typhosus*. After incubation subcultures were made whereby the disinfectant effect was determined. In the fermentation tests only the inhibitory values were recorded.

TABLE OF RESULTS SHOWING THE COMPARATIVE ACTION OF ISOPROPANOL AND ETHYL ALCOHOL AGAINST BACTERIA AND YEASTS.

Bacteria.

Technic: Preparations in the following quantities were mixed with 10 cc of standard extract broth, inoculated with one standard (4 mm.) loop of a vigorous 24-hr. broth culture of *Bacillus typhosus* "Rawlings;" cultured at 37.5° C. for 48 hrs. and observed for inhibition; subcultured on agar to determine disinfectant strength.

Quantity of preparation used, cc.	Isopropanol.		Ethyl alcohol.	
	Inhb. cult.	Sub. cult.	Inhb. cult.	Sub. cult.
0.1	+	+	+	+
0.2	+	+	+	+
0.3	+	+	+	+
0.4	+−	+	+	+
0.5	+−	+	+−	+
0.6	−	−	+−	+
0.7	−	−	−	+
0.8	−	−	−	−
0.9	−	−	−	−
1.0	−	−	−	−
1.1	−	−	−	−
1.2	−	−	−	−
1.3	−	−	−	−
1.4	−	−	−	−
1.5	−	−	−	−

Yeasts.

Technic: Preparations in the following percentages of the substances mixed with standard fermentation liquor were planted with bakers' yeast and incubated 24 hours at 36° C.

Percentage mixture.	Isopropanol.	Ethyl alcohol.
7	+	+
8	+	+
9	+	+
10	+	+
11	+	+
12	+	+
13	+	+
14	−	+
15	−	+
16	−	+
17	−	−
18	−	−
19	−	−
20	−	−
21	−	−
22	−	−
23	−	−
24	−	−
25	−	−

Key: + indicates positive growth.
− indicates no growth.

The physiological action of isopropanol has been the subject of considerable investigation, and during the past three years many references have occurred in the literature. These investigations have included studies of the action of the vapor with special reference to its effect on the vision; observations of its local effects when applied to the skin, scalp and open wounds; studies of its action on the internal economy when administered by mouth, and tests on its action when injected intravenously and on isolated animal organs.

The experiments on animals demonstrated that isopropanol had no deleterious action on the vision either when the subject was exposed to the vapors or when taken internally. The conclusions of other workers were checked by the writer on monkeys and human subjects.

As the result of a large number of tests on animals and human subjects, it was apparent that isopropanol was without harmful action when administered

locally. Isopropanol could be safely used for irrigating wounds, rubbing into the skin and scalp, and for local applications generally. It was applied to the hands in the form of lotion, to the face after shaving, in liniments, liquid soap and in antiseptic solutions for the throat. It was used for sponge baths, and in hospital practice for alcohol rubs. As a remedial agent alone dilute solutions have been found beneficial in treating facial acne, bacterial eczema and various diseases of the scalp.

Its employment as a solvent in remedies for internal administration may be seriously considered. Animal experiments have shown that in the case of rabbits and dogs when small doses were properly administered, the isopropanol is largely oxidized in the body, and that when given over a long period there is no inhibition of growth. The conclusions of other workers, whose observations coincide in general with what has just been said, have been confirmed by the present writer in an extensive series of experiments lasting over a year in which isopropanol was tested under a variety of conditions on the lower animals, monkeys and human subjects. In the quantities that might enter the system through such mediums as medicines, isopropanol would have no other physiological action on the internal economy than that which might be induced by a similar quantity of acetone, to which substance isopropanol is oxidized by metabolic changes. Acetone has been a commercial product in general use under unrestricted conditions for a long period and no reports of its being a toxic agent have been recorded. It can be administered in comparatively large quantities to animals without permanent deleterious effect and even large excessive doses, out of all reason to the size and weight of the subject, have, under the writer's observation, failed to cause death.

The tests on isolated organs and through intravenous administration are of interest from a purely scientific standpoint but need no special comment as they are without significance in the present presentation of the subject. Detailed summaries of the researches noted and the complete articles themselves have appeared in the literature within the past year or so, and instead of filling space with individual quotations, the general conclusions of them all have been noted in the above paragraphs and a bibliography occurs below.

It is evident that the pharmaceutical profession has access to a solvent that may be destined to solve some of its most exasperating problems. Isopropanol apparently promises everything that is offered by ethyl alcohol as a dissolving and holding agent and it is a better antiseptic and disinfectant. It enjoys a free and unrestricted sale and its use is not affected by the mass of regulations and restrictions that now hamper the handling of ethyl alcohol.

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