SUMMARY

1. Quantitative studies using titrimetric methods in nonaqueous media indicated that ergotamine tartrate U.S.P. with a melting point of 180° (decompn.) contains about 60% ergotamine bitartrate.

2. Melting points between 170–192° (decompn.) indicate the approximate ratio of ergotamine bitartrate-tartrate mixture.

3. Application of the perchloric acid titrimetric method (accuracy, ±0.5%) for the assay of ergotamine tartrate substance yields more exact quantitative data than the official van Urk colorimetric method (accuracy, ±4–6%).

REFERENCES

(1) Semonsky, M., and Beran, M., *Československ. Farm.*, **4**, 85(1955).

(2) Bayer, J., Kováts, T., and Rusvay, M., *Acta Pharm. Hung.*, **26**, 32(1956).

(3) Šafařík, L., and Bumba, V., *Pharm. Zentralhalle*, **96**, 3(1957).

(4) Renneberg, K.-H., and Szendey, G. L., *Arch. Pharm.*, **291**, 406(1958).

(5) Gyenes, I., and Szász, K., *Magyar Kém. Folyóirat*, **61**, 356(1955).

(6) Macek, K., Černý, A., and Semonský, M., *Pharmazie*, **9**, 388(1954).

(7) Macek, K., Semonský, M., Vaněček, S., Zikán, V., and Černý, A., *ibid.*, **9**, 752(1954).

Notes

Quaternary Ammonium Germicides as Surface Disinfectants

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The quaternary ammonium compounds tested proved to be excellent germicides in the dilutions recommended by the manufacturer for waxed and unwaxed floor coverings. In the case of waxed stainless steel, it was assumed that the wax interfered with the disinfectant action because the unwaxed stainless steel was found to be sterile. Quaternary ammonium germicides were found to be unsatisfactory disinfectants for vinyl tile.

THE PURPOSE of this study is to determine whether the quaternary ammonium germicides are useful as sanitizing agents in preventing the spread of infections caused by the staphylococci organisms.

The quaternary ammonium germicides are odorless, colorless, highly stable, and are relatively nontoxic when used in their recommended germicidal concentrations. In general, the quaternary ammonium germicides have been found to inhibit the oxidation of certain carbohydrates (1) and thereby interfere with respiration and glycolysis of bacteria. They are usually tested by the phenol coefficient method. Since in the United States 5% phenol is accepted as the standard of excellence for general disinfection, Reddish (2) has pointed out that dilutions 20 times the phenol coefficient afford a wide margin of safety. The dilution calculated on this basis is usually of sufficient strength to kill all pathogenic microorganisms which cause epidemics.

Although the phenol coefficient is an excellent *in vitro* test, in light of the increase of staphylococcus infections in hospitals, a practical test is recommended. The phenol coefficient test employs *Salmonella typhosa* which is similar in resistance to most disease-producing microorganisms. There are some organisms that are more resistant to disinfectants than *Salmonella typhosa*, one of which is the nonspore forming *Staphylococcus aureus*.

Of particular importance to this study are the incompatabilities of the quaternary ammonium germicides which occur under normal sanitizing conditions. Domagk (3) in 1935 was the first to call attention to the interfering action of ordinary soap on the quaternary ammonium germicides. Since then, incompatibilities such as the nitrate and benzalkonium chloride incompatibility (4) have been pointed out. It is generally recognized that when surfaces have been washed with ordinary soap and water, the objects must be thoroughly rinsed with water before applying a quaternary ammonium disinfectant for sterilizing purposes. This applies to the disinfection of wounds following the cleansing procedure with soap and water.

EXPERIMENTAL[1]

Roccal 10%[2]—The active ingredient is a mixture of technical grade alkyldimethylbenzyl ammonium chlorides in which the alkyl is a mixture of C_8H_{17} to $C_{18}H_{37}$ groups. The phenol coefficient of Roccal 10% is 25 when tested against *Salmonella typhosa* at 20°. It is used for sanitizing eating and drinking utensils.

Quaternary Ammonium Germicide.—The active

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[1] Tabulated data of the experimental results are available from Dr. C. Lee Huyck, Division of Eaton Laboratories of the Norwich Pharmacal Co., Norwich, N. Y.

[2] Winthrop Laboratories, New York, N. Y.

ingredient is *p*-diisobutylphenoxyethoxyethyldimethylbenzyl ammonium chloride. The phenol coefficient is 20. It is used in sanitizing sickrooms.

Anti-Staph. Concentrated Antiseptic Cleaner.—The active ingredients are 10.75% methyliodododecylbenzyltrimethyl ammonium chloride, isopropyl alcohol, methylododecyl xylylene bis-(trimethyl ammonium chloride), triethanolamine, potassium hydroxide, and tetrasodium salt of ethylenediamine tetraacetic acid. Inert ingredients include water, nonyl phenoxypolyoxyethylene ethanol, perfume oils, artificial color, and citric acid. The phenol coefficient by a modified Rideal-Walker method against *Salmonella typhosa* is 10 and against *Staphylococcus aureus*, 20. It is used for ordinary cleansing, sanitizing, and deodorizing.

Braxene.[3] The active ingredients are 20% high molecular weight alkyl (C_{12}, C_{14}, C_{16}, and related C_8 to C_{18}) dimethylbenzyl ammonium chlorides. Water (less than 25 p.p.m. hardness) is the diluent. Braxene is used in the asepsis of linen. The phenol coefficient for *Salmonella typhosa* is 85 at 37° and 50 at 20°; the phenol coefficient for *M. pyogenes* var. *aureus* is 81 at 37° and 55 at 20°. In addition to its effectiveness in the treatment of linen, Braxene is also recommended as a disinfectant for sorting tables, storage shelves, laundry carts, and other equipment used in the handling and storage of clothing.

Blue Chip Concentrate.[4]—The active ingredients are *n*-alkyl (50% C_{12}, 30% C_{14}, 17% C_{16}, 3% C_{18}) dimethylbenzyl ammonium chlorides 1.25%. Inert ingredients are water, detergents, a synergizing compound, water softener, dye, and perfume. In addition to cleaning and disinfecting surfaces it deodorizes, and sanitizes.

METHOD

In any practical test, a large number of organisms must be used. Floor materials used in this test were: painted wood, vinyl tile, terrazzo, and linoleum. Stainless steel was also used because of its widespread use in hospitals.

Unwaxed and waxed floor coverings were used in the tests. After washing with soap and water and rinsing with plain tap water, the slabs of floor coverings (9 in. × 9 in.) were air dried for 20 minutes. The slab was divided into 5 equal parts designated: control I, control II, blank, 5 minutes, 15 minutes, and 30 minutes. One milliliter of 1:1000 dilution of a 24-hour broth culture of *Staphylococcus aureus* at 37° was uniformly spread over the surface of the slab by means of a sterile pipet and allowed to air dry for 20 min. A control count was made on control I by streaking it 3 times with a sterile cotton swab moistened with sterile water followed by inoculation into 20 ml. of nutrient agar, swirled vigorously for 15 sec., poured into a sterile Petri dish, incubated for 48 hours at 37°. Immediately after the control swabs were made, portions designated as 5, 15, and 30 min. were covered with 2 ml. of the dilution of solution being tested which was either 20 times the phenol coefficient, or the dilution (5) recommended by the manufacturer. At the end of 5, 15, and 30 min., the portion of the slab so designated was streaked 3 times with a sterile cotton swab moistened with sterile water, followed by inoculation into 20 ml. of nutrient agar, and incubated at 37° for 48 hours. At the end of the 30-min. period, another control swabbing was made from the second control area designated control II, inoculated as previously into nutrient agar, and incubated. The total counts of the staphylococci present were made and the reductions from the control counts determined.

[3] Wyandotte Chemicals Corp., Wyandotte, Mich.
[4] S. C. Johnson & Son, Inc., Racine, Wis.

DISCUSSION

The floor coverings used were either porous or nonporous. The porous floors were either painted wood or terrazzo, while nonporous were vinyl tile or linoleum. The porous material gave a lower count than the nonporous for the controls, but this material had no effect on the germicidal activity of the quaternary germicides. In the test, a portion was designated as blank between control II and a portion designated as 5 min. These designations were safety measures to prevent the germicides from reaching the control area. Each plate that exhibited no growth was streaked with a 24-hr. culture of the test organism and incubated at 37° for 48 hours. Growth occurred in each instance, showing no bacteriostatic action of the plates. In swabbing the floor coverings, the germicide could be transferred from the floor covering to the agar. If a substantial amount was transferred, the plate would exhibit bacteriostatic action.

Phenol 5% and cresol compound 2% were used as standards for comparison since they are excellent germicides under conditions of use. Therefore, all germicides used in these tests should have the same relative bactericidal efficacy.

SUMMARY

Phenol 5% and cresol compound 2% were used as standards in performance tests on various floor coverings. The quaternary ammonium germicides were compared with these standard disinfectants on waxed and unwaxed floor coverings. The quaternary ammonium compounds tested proved to be excellent germicides in the dilutions recommended by the manufacturer. Wax on the floor coverings did not interfere with germicidal action. In the case of stainless steel, wax did interfere with the disinfectant action, probably because the wax was not absorbed on the metal. Only in one case did an organic material interfere with the germicidal activity of the quaternary ammonium compound; the interfering substance in this case was unwaxed vinyl tile.

REFERENCES

(1) Reddish, G. F., *et al.*, "Antiseptics, Disinfectants, Fungicides, and Sterilization," 2nd ed., Lea and Febiger, Philadelphia, Pa., 1957, pp. 584, 586.
(2) Reddish, G. F., *Soap*, **11**, 95(1935).
(3) Domagk, G., *Deut. med. Wochschr.*, **61**, 829(1935); through *Chem. Abstr.*, 29, 7018(1935).
(4) Huyck, C. L., and Davy, E. D., *J. Am. Pharm. Assoc., Pract. Pharm. Ed.*, **8**, 27(1947).
(5) "Official Methods of Analysis of the Association of Official Agricultural Chemists," Association of Official Agricultural Chemists, 8th ed., Washington, D. C., 1955, pp 87–93.