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GERMICIDAL FABRIC

Robert I. Schattner, 3636 16th St. NW.,
Washington, D.C. 20010

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This invention relates to impregnated fabrics having anti-bacterial and germicidal properties and to methods and compositions for producing such fabrics.

This is continuation-in-part of pending application Ser. No. 191,447, filed May 1, 1962, by the same inventor, now abandoned.

It is generally desirable to provide fabrics, either in bolt form or after manufacture into garments, bandages, swabs, tampons, or the like, which have bactericidal and germicidal properties. This is especially true in the case of fabrics which are to come in contact with the body in the course of their use and which may be exposed to an environment which tends to promote the growth of bacterial and germs.

According to the present invention, applicant has found that fabrics may be treated in such a way that they resist the growth of and even destroy bacteria and germs upon contact. Furthermore, according to the invention, such properties may be imparted to the fabrics in a single treatment and are found to persist over long periods of time.

In both industrial and home washing processes, it is conventional practice to sour the wash in order to obtain a germicidal effect. Souring generally consists in adding to the wash water a weak acid or a salt which functions as a weak acid to lower the pH of the water to about 5. While this method is somewhat effective in killing germs present in the fabric which is being laundered, the treatment is found to have certain drawbacks.

First of all, souring is not entirely effective against certain hard-to-kill germs and bacteria, such as *Staphylococcus aureus*. Acidifying the wash water also has been found to be harmful to the life of the fabric and tends to accelerate fading of some dyes used in coloring fabrics. In addition, the germicidal effect of souring is not only incomplete but is of short duration.

Within the scope of the present invention are fabrics made from synethtic or natural fibers and blends thereof and including both woven and non-woven fabrics. The fabric may also comprise metallic and glass fibers now widely employed in the manufacture of various fabrics.

It is therefore an object of the invention to provide fabrics having bactericidal and germicidal properties.

A further object of the invention is to provide fabrics of the foregoing type wherein the bactericidal activity persists over a considerable period of time.

Another object of the invention is to provide a method for treating fabrics to render them germicidal and bactericidal and which is simple and efficient and does not deleteriously effect the fabric being treated.

An additional object of the present invention is to provide a method and composition for treating fabrics which results in effective and long lasting germicidal and bactericidal action and which is not harmful to the life or appearance of the fabric treated.

A further object of the invention is to provide fabrics and methods for producing such fabrics so that they are germ-free and are completely resistant to hard-to-kill organisms, such as Staphylococcus and Streptococcus.

Briefly, the proposed invention comprises impregnating the fabrics with an aqueous solution of sodium phenolate, sodium tetraborate, glycerine, and phenol.

Up to about 2% of various coloring agents may also be added so that the color of impregnant corresponds to the color of the fabric being treated. In the case of white fabrics, of course, a substantially colorless solution may be employed or various whitening or brightening agents may be added to the solution.

It has been found that aqueous solutions having the following general formulation are highly effective in rendering fabrics germicidal:

	Percent
Sodium phenolate	.8 to 15
Sodium tetraborate	.3 to 5.5
Glycerine	.8 to 15
Phenol	.2 to 16.5
Water	Balance

Amounts are stated in percent by weight throughout the present description and in the following claims, unless otherwise indicated.

EXAMPLE I

The familiar green hospital gowns are immersed in a solution of the following composition until the fabric is saturated:

	Percent
Sodium phenolate	.8
Sodium tetraborate	.3
Glycerine	.8
Phenol	2
Water	Balance

The gowns are then dried and are ready to use.

EXAMPLE II

Hospital gowns of the type described in Example I are immersed in a solution of the following composition until they are saturated:

	Percent
Sodium phenolate	1.2
Sodium tetraborate	.45
Glycerine	1.2
Phenol	3
Water	Balance

The gowns are then dried as in the preceding example and are ready for use.

EXAMPLE III

Hospital gowns of the type described in Example I are immersed in a solution of the following composition until they are saturated:

	Percent
Sodium phenolate	15
Sodium tetraborate	5.5
Glycerine	15
Phenol	16.5
Water	Balance

EXAMPLE IV

Hospital gowns of the type described in Example I are immersed in a solution of the following composition until they are saturated:

	Percent
Sodium phenolate	1.5
Sodium tetraborate	.5
Glycerine	1.3
Phenol	3.5
Chlorophyll	.75
Water	Balance

In the foregoing example, the chlorophyll is added so that the impregnating solution has a light green color roughly corresponding to the color of the gowns being treated.

EXAMPLE V

A vaginal tampon of rolled cotton gauze is immersed in a solution having the following composition until saturated:

	Percent
Sodium phenolate	1
Sodium tetraborate	.4
Glycerine	1
Phenol	2.5
Water	Balance

The tampon is then dried.

Vaginal smears taken after the use of such tampons show a marked reduction in the flora count as compared with smears taken after the use of conventional non-impregnated tampons.

EXAMPLE VI

A solution of the following composition is prepared:

	Percent
Sodium phenolate	1.27
Sodium tetraborate	2.51
Glycerine	2.40
Phenol	6.9
Water	86.92

The above formulation (Formula VI) is then applied to hospital gowns and gauze masks according to the following procedure suggested by the U.S.D.A. and the fabrics are tested to determine bactericidal activity against *Staphylococcus aureus*:

(a) *Preparation of the inoculum*

The test organism used is a 24-hour broth culture which is subcultured from a stock nutrient agar culture of *Staphylococcus aureus,* FDA 209, which is inoculated and grown for not more than one month. Only those cultures of organisms of which an aliquot shows survival in a 1:80 dilution of phenol for 5 minutes and in a 1:90 dilution of phenol for 10–15 minutes are considered satisfactory for testing purposes.

A 24-hour broth culture of the test organism is centrifuged for 10 minutes and the supernatant liquid is removed. A "button" of the test organism is then resuspended in 10 ml. of distilled water. Serial dilutions are then made using 10 ml. aliquots of distilled water and the third dilution is reserved for use as the inoculum or test organism. The number of organisms in 0.05 ml. of the third serial dilution is then counted using the direct microscopic method and employing a Petrof-Houser counting chamber. The 0.05 ml. sample contains approximately 50,000 organisms.

(b) *Preparation of the fabric*

The fabric to be treated is cut into sections about 12 inches square and the sections are weighed. A series of fabric sections are then impregnated with the above solution, varying the amount of solution as a percent of the weight of the particular section of cloth.

Some of the cloth sections are impregnated with the unaltered solution having a pH of about 8 and other sections with a solution to which sufficient sodium bifluoride sour is added to lower the pH to about 5, the usual pH level for home or industrial laundering.

The fabric sections are then air dried and are cut into smaller 1-inch squares.

(c) *Test procedure*

The sections prepared as described above are then placed in sterile petri dishes and are dried at room temperature for three hours. Next, the sections of cloth are placed on sterile agar plates and are carefully overlayed with 2 ml. of the inoculum and sterile agar using a circular motion during application from the outside toward the center of the cloth swatch to avoid flooding organisms. The section is then incubated for 48 hours after which the colonies on the section are counted and the percent inhibited is calculated.

A representative sampling of the results of the tests are set forth in the following table:

TABLE I.—INHIBITION OF STAPHYLOCOCCUS AUREUS BY IMPREGNATION OF FABRIC WITH FORMULA VI

Sample No.	Amount of Formula VI as a percent of the weight of the cloth sample	Percent pH 5.0	Inhibition pH 8.0 Percent
1	50	100	100
2	20	100	100
3	15	100	100
4	10	100	100
5	5	100	100
6	1	100	100
7	0.9–0.1	100	100
8	0.9–0.01	100	100

As will be seen from the above data, 100% inhibition is achieved with as low as 0.01% of the formula, calculated as a percent by weight of the cloth section. It is also apparent that 100% inhibition is attained at the ordinary pH of the solution which is about 8 and also with the pH reduced to about 5 by the addition of a sour. Thus, it is clear that souring does not adversely affect the ability of the composition to inhibit *Staphylococcus aureus.*

EXAMPLE VII

The same procedure is followed as in Example VI except that the test organism employed is *Streptococcus viridans.* The findings again show complete destruction and inhibition of the organism.

EXAMPLE VIII

The same procedure is followed as in Example VI except that the test organism employed is group A beta hemolytic Streptococcus. Again, complete destruction of the organism is observed.

EXAMPLE IX

The solution of Example VI is added to a large hospital washing machine. An amount of the solution equal to about 5% by weight of the weight of the clothes being laundered is employed. The washing machine is then operated through the normal wash and rinse cycles. The laundered clothes are found to be germ free and to have a residual inhibiting effect with respect to *Staphylococcus aureus.*

Where the composition of the present invention is added to wash water, as in the above example, it is necessary to employ a somewhat greater amount of the composition, than is used in the immersion method of impregnation, in order to obtain the desired germicidal and bacteriostatic effect. This, of course, is due to the higher dilution which occurs upon addition of wash water to the fabric. While good results can be obtained with quite small amounts of the composition, the best and most reliable results are obtained by using the composition in the amount of at least 5% by weight of the fabric in washing machine or similar dilution-type applications.

According to the present invention, it has now been made possible to treat fabrics, such as mops, wiping cloths, towels, garments, and the like so that they are rendered germ-free and so that this germ-free condition persists for long periods of time, as, for example, for the normal period between washings.

More specifically, the invention has shown the way to both industrial and home treatments for fabrics by impregnation and washing to kill germs present in the fabric and to inhibit the contamination of the fabric by such germs.

Furthermore, the invention has provided highly effective compositions and methods for producing fabrics which resist Staphylococcus and Streptococcus organisms which are very troublesome and difficult to eliminate disease producing organisms.

While immersion or washing in an aqueous solution of the stated type provides a ready means for effecting the impregnation, other methods may be selected for achiev-

ing the same end. For example, the solution might be sprayed onto the fabric or the fibers making up the fabric might be impregnated before weaving.

A wide variety of fabrics may be treated according to the present invention including loose weave gauze type materials employed in bandages and compresses and the close weave fabrics normally utilized in the manufacture of garments, bed sheets and the like. The desired results are obtained with cotton, rayon, nylon, wool, and various blends of these materials.

It will be apparent to those skilled in the art that various modifications may be made in the methods, compositions and products disclosed herein without departing essentially from the spirit and scope of the invention as expressed in the following claims.

What is claimed is:

1. A method for rendering fabric germ-free and germ-resistant comprising impregnating said fabric with an aqueous solution of the following composition:

from 0.8% to 15% by weight of sodium phenolate,
from 0.3% to 5.5% by weight of sodium tetraborate,
from 0.8% to 15% by weight of glycerine,
from 2.0% to 16.5% by weight of phenol, and
the balance water.

2. The method of claim 1 wherein the amount by weight of said aqueous solution used to impregnate said fabric is at least 0.01% by weight of the fabric.

3. A method for destroying *Staphylococcus aureus* organisms in fabric and making the fabric resistant to said organisms comprising washing said fabric in water containing at least 5% by weight, based upon the weight of the fabric, of an aqueous solution of the following composition:

from 0.8% to 15% by weight of sodium phenolate,
from 0.3% to 5.5% by weight of sodium tetraborate,
from 0.8% to 15% by weight of glycerine,
from 2.0% to 16.5% by weight of phenol, and
the balance water.

4. Fabric having germicidal and bactericidal activity comprising fabric impregnated with an aqueous solution containing from .8% to 15% sodium phenolate, from 13% to 5.5% sodium tetraborate, from .8% to 15% glycerine, from 2.0% to 16.5% phenol and the balance water.

5. Germ-free fabric which is resistant to contamination by *Staphylococcus aureus* organisms comprising a fabric

impregnated with at least 0.01% by weight, based upon the weight of the fabric, of an aqueous solution of the following composition:

1.27% by weight of sodium phenolate,
2.51% by weight of sodium tetraborate,
2.40% by weight of glycerine,
6.90% by weight of phenol, and
86.92% water.

6. Fabric having germicidal and bactericidal activity and comprising fabric impregnated with an aqueous solution containing from .8% to 15% sodium phenolate, from .3% to 5.5% sodium tetraborate, from .8% to 15% glycerine, from 2% to 16.5% phenol, up to about 2% of a coloring agent and the balance water.

7. A vaginal tampon having germicidal and bactericidal activity comprising porous fabric impregnated with an aqueous solution containing from .8% to 15% sodium phenolate, from .3% to 5.5% sodium tetraborate, from .8% to 15% glycerine, from 2% to 16.5% phenol and the balance water.

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ALBERT T. MEYERS, *Primary Examiner.*

FRANK CACCIAPAGLIA, SAM ROSEN, JULIAN S. LEVITT, *Examiners.*

GEORGE A. MENTIS, *Assistant Examiner.*